

CHAPTER

51

STRUCTURES



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CHAPTER 51 STRUCTURES

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EFFECTIVE PAGES		51-00-04 GENERAL (cont)		51-10-01 GENERAL (cont)	
1 thru 15	Jan 20/2009	6	Jan 20/2005	25	Sep 20/2006
16	BLANK	7	Jan 20/2005	26	Sep 20/2006
51-CONTENTS		8	BLANK	51-10-02 GENERAL	
1	Jan 20/2005	51-00-05 GENERAL		1	Sep 20/2008
2	Sep 20/2005	1	Jan 20/2005	2	Jan 20/2005
3	Sep 20/2005	2	Jan 20/2005	R 3	Jan 20/2009
4	Sep 20/2005	51-00-06 GENERAL		O 4	Jan 20/2009
5	Sep 20/2006	1	Sep 20/2008	5	Jan 20/2005
6	Sep 20/2007	2	Sep 20/2008	6	Jan 20/2005
7	Sep 20/2006	3	Sep 20/2008	7	Jan 20/2005
8	BLANK	4	BLANK	8	Jan 20/2005
51-00-00 GENERAL		51-10-00 GENERAL		9	May 20/2006
1	Jan 20/2005	1	Jan 20/2005	10	May 20/2006
2	BLANK	2	BLANK	11	May 20/2006
51-00-01 GENERAL		51-10-01 GENERAL		12	May 20/2006
1	Jan 20/2005	1	Feb 20/2005	13	May 20/2006
2	Jan 20/2005	2	Sep 20/2006	14	May 20/2008
3	Jan 20/2005	3	Sep 20/2006	15	May 20/2006
4	Jan 20/2005	4	Jan 20/2005	16	May 20/2006
5	Jan 20/2005	5	Jan 20/2005	17	May 20/2006
6	Jan 20/2005	6	Jan 20/2005	18	May 20/2006
7	Jan 20/2005	7	Sep 20/2006	19	May 20/2006
8	Jan 20/2005	8	Sep 20/2006	20	May 20/2006
9	Jan 20/2005	9	Sep 20/2006	21	May 20/2006
10	BLANK	10	Sep 20/2006	22	Jan 20/2005
51-00-02 GENERAL		11	Sep 20/2006	23	Jan 20/2005
1	May 20/2006	12	Sep 20/2006	24	Jan 20/2005
2	Jan 20/2005	13	Sep 20/2006	25	Jan 20/2005
3	Jan 20/2005	14	Sep 20/2006	26	Jan 20/2005
4	BLANK	15	Sep 20/2006	27	Jan 20/2005
51-00-03 GENERAL		16	Sep 20/2006	28	Jan 20/2005
1	Jan 20/2005	17	Sep 20/2006	29	Jan 20/2005
2	BLANK	18	Sep 20/2006	30	Jan 20/2005
51-00-04 GENERAL		19	Sep 20/2006	31	Jan 20/2005
1	Jan 20/2005	20	Sep 20/2006	32	BLANK
2	Jan 20/2005	21	Sep 20/2006	51-10-03 GENERAL	
3	Jan 20/2005	22	Sep 20/2006	1	Sep 20/2007
4	Jan 20/2005	23	Sep 20/2006	2	Sep 20/2007
5	Jan 20/2005	24	Sep 20/2006	3	Jan 20/2005

A = Added, R = Revised, O = Overflow, D = Deleted

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51-10-03 GENERAL (cont)		51-10-04 ALLOWABLE DAMAGE GENERAL (cont)		51-20-01 GENERAL (cont)	
4	Jan 20/2005	135	Jan 20/2005	2	Sep 20/2007
5	Jan 20/2005	136	Jan 20/2005	3	May 20/2006
6	BLANK	137	Jan 20/2005	4	May 20/2006
51-10-04 ALLOWABLE DAMAGE GENERAL		138	Jan 20/2005	5	Jan 20/2005
101	May 20/2006	139	Jan 20/2005	6	Jan 20/2005
102	Jan 20/2005	140	Jan 20/2005	7	Jan 20/2005
103	Jan 20/2005	51-10-05 GENERAL		8	Jan 20/2005
104	May 20/2006	1	Jan 20/2005	9	Jan 20/2005
105	Jan 20/2005	2	Jan 20/2005	10	Jan 20/2005
106	Jan 20/2005	3	Jan 20/2005	11	Jan 20/2005
107	Jan 20/2005	4	Jan 20/2005	12	Jan 20/2005
108	Jan 20/2005	5	Jan 20/2005	13	Jan 20/2005
109	Jan 20/2005	6	Jan 20/2005	14	Jan 20/2005
110	Jan 20/2005	7	Jan 20/2005	15	Jan 20/2005
111	Jan 20/2005	8	Jan 20/2005	16	Jan 20/2005
112	Jan 20/2005	9	Jan 20/2005	17	Sep 20/2007
113	Jan 20/2005	10	BLANK	18	Jan 20/2005
114	Jan 20/2005	51-11-01 GENERAL		19	Jan 20/2005
115	Jan 20/2005	1	Jan 20/2005	20	Jan 20/2005
116	Jan 20/2005	2	Jan 20/2005	21	Jan 20/2005
117	Jan 20/2005	3	Jan 20/2005	22	Jan 20/2005
118	Jan 20/2005	4	Jan 20/2005	23	Jan 20/2005
119	Jan 20/2005	5	Jan 20/2005	24	Jan 20/2005
120	Jan 20/2005	6	Jan 20/2005	25	Jan 20/2005
121	Jan 20/2005	7	Jan 20/2005	26	May 20/2006
122	Jan 20/2005	8	Jan 20/2005	27	Jan 20/2005
123	Jan 20/2005	9	Jan 20/2005	28	Jan 20/2005
124	Jan 20/2005	10	Jan 20/2005	29	Jan 20/2005
125	Jan 20/2005	11	Jan 20/2005	30	Jan 20/2005
126	Jan 20/2005	12	Jan 20/2005	31	Jan 20/2005
127	Jan 20/2005	13	Jan 20/2005	32	Jan 20/2005
128	Jan 20/2005	14	Jan 20/2005	51-20-02 GENERAL	
129	Jan 20/2005	15	Jan 20/2005	1	Jan 20/2005
130	Jan 20/2005	16	Jan 20/2005	2	Jan 20/2005
131	Jan 20/2005	17	Jan 20/2005	3	Jan 20/2005
132	Jan 20/2005	18	Jan 20/2005	4	Jan 20/2005
133	Jan 20/2005	51-20-01 GENERAL		5	Jan 20/2005
134	Jan 20/2005	1	Sep 20/2007	6	Jan 20/2005
				7	Jan 20/2005

A = Added, R = Revised, O = Overflow, D = Deleted

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51-20-02 GENERAL (cont)		51-20-13 GENERAL		51-30-01 GENERAL (cont)	
8	Jan 20/2005	1	Jan 20/2005	15	Jan 20/2005
9	Jan 20/2005	2	Jan 20/2005	16	Jan 20/2005
10	Jan 20/2005	3	Jan 20/2005	17	Jan 20/2005
11	Jan 20/2005	4	Jan 20/2005	18	Jan 20/2005
12	Jan 20/2005	51-21-01 GENERAL		19	Jan 20/2005
13	Jan 20/2005	1	Jan 20/2005	20	Jan 20/2005
14	Jan 20/2005	2	Jan 20/2005	51-30-02 GENERAL	
15	Jan 20/2005	3	Jan 20/2005	1	Jan 20/2005
16	Jan 20/2005	4	Jan 20/2005	2	Jan 20/2005
51-20-03 GENERAL		5	Jan 20/2005	3	Jan 20/2005
1	Sep 20/2005	6	Jan 20/2005	4	Jan 20/2005
2	BLANK	7	Jan 20/2005	5	Jan 20/2005
51-20-04 GENERAL		8	Jan 20/2005	6	Jan 20/2005
1	Jan 20/2005	9	Jan 20/2005	7	Jan 20/2005
2	BLANK	10	Jan 20/2005	8	Jan 20/2005
51-20-05 GENERAL		11	Jan 20/2005	9	Jan 20/2005
1	Jan 20/2005	12	Jan 20/2005	10	Jan 20/2005
2	Jan 20/2005	13	Jan 20/2005	11	Jan 20/2005
3	Jan 20/2005	14	Jan 20/2005	12	Jan 20/2005
4	Jan 20/2005	15	Jan 20/2005	13	Jan 20/2005
51-20-06 GENERAL		16	BLANK	14	Jan 20/2005
1	Sep 20/2005	51-21-05 GENERAL		51-30-03 GENERAL	
2	Sep 20/2005	1	Jan 20/2005	1	Jan 20/2005
51-20-07 GENERAL		2	Jan 20/2005	2	Jan 20/2005
1	Jan 20/2005	51-30-01 GENERAL		3	Jan 20/2005
2	Jan 20/2005	1	Sep 20/2008	4	Jan 20/2005
3	Jan 20/2005	2	Jan 20/2005	5	Jan 20/2005
4	Jan 20/2005	3	Jan 20/2005	6	Jan 20/2005
5	Jan 20/2005	4	Jan 20/2005	7	Jan 20/2005
6	Jan 20/2005	5	Jan 20/2005	8	Jan 20/2005
7	Jan 20/2005	6	Jan 20/2005	9	Jan 20/2005
8	Jan 20/2005	7	Jan 20/2005	10	Jan 20/2005
9	Jan 20/2005	8	Jan 20/2005	11	Jan 20/2005
10	BLANK	9	Jan 20/2005	12	Jan 20/2005
51-20-09 GENERAL		10	Jan 20/2006	13	Jan 20/2005
1	Jan 20/2005	11	Jan 20/2005	14	Jan 20/2005
2	Jan 20/2005	12	Jan 20/2005	15	Jan 20/2005
3	Jan 20/2005	13	Jan 20/2005	16	Jan 20/2005
4	Jan 20/2005	14	Jan 20/2005	17	Jan 20/2005

A = Added, R = Revised, O = Overflow, D = Deleted

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51-30-03 GENERAL (cont)		51-31-03 GENERAL (cont)		51-40-02 GENERAL (cont)	
18	Jan 20/2005	2	Jan 20/2005	25	May 20/2006
19	Jan 20/2005	3	Jan 20/2005	26	May 20/2006
20	Jan 20/2005	4	Jan 20/2005	27	May 20/2006
21	Jan 20/2005	5	Jan 20/2005	28	May 20/2006
22	Jan 20/2005	6	Jan 20/2005	29	May 20/2006
23	Jan 20/2005	7	Jan 20/2005	30	May 20/2006
24	Jan 20/2005	8	Jan 20/2005	31	May 20/2006
25	Jan 20/2005	51-40-01 GENERAL		32	May 20/2006
26	Jan 20/2005	1	Jan 20/2005	33	May 20/2006
27	Jan 20/2005	2	Jan 20/2005	34	May 20/2006
28	Jan 20/2005	3	May 20/2008	35	May 20/2006
29	Jan 20/2005	4	Jan 20/2005	36	May 20/2006
30	Jan 20/2005	5	Jan 20/2005	37	May 20/2006
51-30-04 GENERAL		6	Jan 20/2005	38	May 20/2006
1	Jan 20/2005	51-40-02 GENERAL		39	May 20/2006
2	BLANK	1	May 20/2006	40	May 20/2006
51-30-05 GENERAL		2	Sep 20/2007	41	May 20/2006
1	Jan 20/2005	3	May 20/2006	42	May 20/2006
2	Jan 20/2005	4	May 20/2006	43	May 20/2006
3	Jan 20/2005	5	May 20/2006	44	May 20/2006
4	Jan 20/2005	6	May 20/2006	45	May 20/2006
5	Jan 20/2005	7	May 20/2006	46	May 20/2006
6	Jan 20/2005	8	May 20/2006	47	May 20/2006
7	Jan 20/2005	9	May 20/2006	48	May 20/2006
8	Jan 20/2005	10	May 20/2006	49	May 20/2006
9	Jan 20/2005	11	May 20/2006	50	May 20/2006
10	Jan 20/2005	12	May 20/2006	51	May 20/2006
11	Jan 20/2005	13	May 20/2006	52	May 20/2006
12	BLANK	14	May 20/2006	53	May 20/2006
51-30-06 GENERAL		15	May 20/2006	54	May 20/2006
1	Jan 20/2005	16	May 20/2006	55	May 20/2006
2	Jan 20/2005	17	May 20/2006	56	May 20/2006
3	Jan 20/2005	18	May 20/2006	57	May 20/2006
4	Jan 20/2005	19	May 20/2006	58	May 20/2006
51-31-01 GENERAL		20	May 20/2006	59	May 20/2006
1	Jan 20/2005	21	May 20/2006	60	May 20/2006
2	Jan 20/2005	22	May 20/2006	61	May 20/2006
51-31-03 GENERAL		23	May 20/2006	62	May 20/2006
1	Jan 20/2005	24	May 20/2006	63	May 20/2006

A = Added, R = Revised, O = Overflow, D = Deleted

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51-40-02 GENERAL (cont)		51-40-03 GENERAL (cont)		51-40-03 GENERAL (cont)	
64	May 20/2006	28	Jan 20/2005	67	Jan 20/2005
65	May 20/2006	29	Jan 20/2005	68	Jan 20/2005
66	May 20/2006	30	Jan 20/2005	69	Jan 20/2005
67	May 20/2006	31	Jan 20/2005	70	Jan 20/2005
68	May 20/2006	32	Jan 20/2005	71	Jan 20/2005
69	May 20/2006	33	Jan 20/2005	72	Jan 20/2005
70	May 20/2006	34	Jan 20/2005	73	Jan 20/2005
71	May 20/2006	35	Jan 20/2005	74	Jan 20/2005
72	May 20/2006	36	Jan 20/2005	75	Jan 20/2005
73	May 20/2006	37	Jan 20/2005	76	Jan 20/2005
74	May 20/2006	38	Jan 20/2005	77	Jan 20/2005
51-40-03 GENERAL		39	Jan 20/2005	78	Jan 20/2005
1	Jan 20/2005	40	Jan 20/2005	79	Jan 20/2005
2	Jan 20/2005	41	Jan 20/2005	80	Jan 20/2005
3	Jan 20/2005	42	Jan 20/2005	81	Jan 20/2005
4	Jan 20/2005	43	Jan 20/2005	82	Jan 20/2005
5	Jan 20/2005	44	Jan 20/2005	83	Jan 20/2005
6	Jan 20/2005	45	Jan 20/2005	84	Jan 20/2005
7	Sep 20/2006	46	Jan 20/2005	85	Jan 20/2005
8	Jan 20/2005	47	Jan 20/2005	86	Sep 20/2005
9	Jan 20/2005	48	Jan 20/2005	87	Jan 20/2005
10	Jan 20/2005	49	Jan 20/2005	88	Jan 20/2005
11	Jan 20/2005	50	Jan 20/2005	89	Jan 20/2005
12	Jan 20/2005	51	Jan 20/2005	90	Jan 20/2005
13	Jan 20/2005	52	Jan 20/2005	91	Jan 20/2005
14	Jan 20/2005	53	Jan 20/2005	92	Jan 20/2005
15	Jan 20/2005	54	Jan 20/2005	93	Jan 20/2005
16	Jan 20/2005	55	Jan 20/2005	94	Jan 20/2005
17	Jan 20/2005	56	Jan 20/2005	95	Jan 20/2005
18	Jan 20/2005	57	Jan 20/2005	96	Jan 20/2005
19	Sep 20/2005	58	Jan 20/2005	97	Jan 20/2005
20	Jan 20/2005	59	Jan 20/2005	98	Jan 20/2005
21	Jan 20/2005	60	Jan 20/2005	98.1	Jan 20/2005
22	Jan 20/2005	61	Jan 20/2005	98.2	Jan 20/2005
23	Jan 20/2005	62	Jan 20/2005	98.3	Jan 20/2005
24	Jan 20/2005	63	Jan 20/2005	98.4	Jan 20/2005
25	Jan 20/2005	64	Jan 20/2005	98.5	Jan 20/2005
26	Jan 20/2005	65	Jan 20/2005	98.6	Jan 20/2005
27	Jan 20/2005	66	Jan 20/2005	98.7	Jan 20/2005

A = Added, R = Revised, O = Overflow, D = Deleted

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51-40-03 GENERAL (cont)		51-40-05 GENERAL (cont)		51-40-07 GENERAL (cont)	
98.8	Jan 20/2005	25	Jan 20/2005	18	Jan 20/2005
51-40-04 GENERAL		26	Jan 20/2005	19	Jan 20/2005
1	Jan 20/2005	27	Jan 20/2005	20	Jan 20/2005
2	Jan 20/2005	28	Jan 20/2005	21	Jan 20/2005
3	Jan 20/2005	29	Jan 20/2005	22	Jan 20/2005
4	Jan 20/2005	30	Jan 20/2005	23	Jan 20/2005
5	Jan 20/2005	31	Jan 20/2005	24	Jan 20/2005
6	Jan 20/2005	32	Jan 20/2005	25	Jan 20/2005
7	Jan 20/2005	33	Jan 20/2005	26	Jan 20/2005
8	Jan 20/2005	34	Jan 20/2005	27	Jan 20/2005
9	Jan 20/2005	35	Jan 20/2005	28	Jan 20/2005
10	Jan 20/2005	36	Jan 20/2005	29	Jan 20/2005
11	Jan 20/2005	51-40-06 GENERAL		30	Jan 20/2005
12	BLANK	1	Jan 20/2005	31	Jan 20/2005
51-40-05 GENERAL		2	Jan 20/2005	32	Jan 20/2005
1	Jan 20/2005	3	Jan 20/2005	33	Jan 20/2005
2	Jan 20/2005	4	Jan 20/2005	34	Jan 20/2005
3	Jan 20/2005	5	Jan 20/2005	35	Jan 20/2005
4	Jan 20/2005	6	Jan 20/2005	36	Jan 20/2005
5	Jan 20/2005	7	Jan 20/2005	37	Jan 20/2005
6	Jan 20/2005	8	BLANK	38	Jan 20/2005
7	Jan 20/2005	51-40-07 GENERAL		39	Jan 20/2005
8	Jan 20/2005	1	Jan 20/2005	40	Jan 20/2005
9	Jan 20/2005	2	Jan 20/2005	41	Jan 20/2005
10	Jan 20/2005	3	Jan 20/2005	42	Jan 20/2005
11	Jan 20/2005	4	Jan 20/2005	43	Jan 20/2005
12	Jan 20/2005	5	Jan 20/2005	44	Jan 20/2005
13	Jan 20/2005	6	Jan 20/2005	45	Jan 20/2005
14	Jan 20/2005	7	Jan 20/2005	46	Jan 20/2005
15	Jan 20/2005	8	Jan 20/2005	47	Jan 20/2005
16	Jan 20/2005	9	Jan 20/2005	48	Jan 20/2005
17	Jan 20/2005	10	Jan 20/2005	49	Jan 20/2005
18	Jan 20/2005	11	Jan 20/2005	50	Jan 20/2005
19	Jan 20/2005	12	Jan 20/2005	51	Jan 20/2005
20	Jan 20/2005	13	Jan 20/2005	52	Jan 20/2005
21	Jan 20/2005	14	Jan 20/2005	53	Jan 20/2005
22	Jan 20/2005	15	Jan 20/2005	54	Jan 20/2005
23	Jan 20/2005	16	Jan 20/2005	55	Jan 20/2005
24	Jan 20/2005	17	Jan 20/2005	56	Jan 20/2005

A = Added, R = Revised, O = Overflow, D = Deleted

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Subject/Page	Date	Subject/Page	Date	Subject/Page	Date
51-40-07 GENERAL (cont)		51-40-09 GENERAL (cont)		51-41-02 GENERAL (cont)	
57	Jan 20/2005	12	Jan 20/2005	5	Sep 20/2007
58	Jan 20/2005	13	Jan 20/2005	6	Jan 20/2005
59	Jan 20/2005	14	Jan 20/2005	7	Jan 20/2005
60	Jan 20/2005	15	Jan 20/2005	8	Sep 20/2007
61	Jan 20/2005	16	Jan 20/2005	9	Jan 20/2005
62	BLANK	17	Jan 20/2005	10	Jan 20/2005
51-40-08 GENERAL		18	Jan 20/2005	11	Jan 20/2005
1	Jan 20/2005	19	Jan 20/2005	12	Sep 20/2007
2	Jan 20/2005	20	Jan 20/2005	13	Jan 20/2005
3	Jan 20/2005	21	Jan 20/2005	14	Jan 20/2005
4	Jan 20/2005	22	Jan 20/2005	15	Jan 20/2005
5	Jan 20/2005	23	Jan 20/2005	16	BLANK
6	Jan 20/2005	24	Jan 20/2005	51-41-03 GENERAL	
7	Jan 20/2005	25	Jan 20/2005	1	Jan 20/2005
8	Jan 20/2005	26	Jan 20/2005	2	Jan 20/2005
9	Jan 20/2005	27	Jan 20/2005	51-41-04 GENERAL	
10	Jan 20/2005	28	Jan 20/2005	1	Jan 20/2005
11	Jan 20/2005	29	Jan 20/2005	2	Jan 20/2005
12	Jan 20/2005	30	Jan 20/2005	3	Jan 20/2005
13	Jan 20/2005	31	Jan 20/2005	4	Jan 20/2005
14	Jan 20/2005	32	BLANK	5	Jan 20/2005
15	Jan 20/2005	51-41-01 GENERAL		6	BLANK
16	Jan 20/2005	1	Jan 20/2005	51-41-05 GENERAL	
17	Jan 20/2005	2	Jan 20/2005	1	Jan 20/2005
18	Jan 20/2005	3	Jan 20/2005	2	Jan 20/2005
19	Jan 20/2005	4	Jan 20/2005	3	Jan 20/2005
20	BLANK	5	Jan 20/2005	4	Jan 20/2005
51-40-09 GENERAL		6	Jan 20/2005	5	Jan 20/2005
1	Jan 20/2005	7	Jan 20/2005	6	Jan 20/2005
2	Jan 20/2005	8	Jan 20/2005	7	Jan 20/2005
3	Jan 20/2005	9	Jan 20/2005	8	Jan 20/2005
4	Jan 20/2005	10	Jan 20/2005	51-41-06 GENERAL	
5	Jan 20/2005	11	Jan 20/2005	1	Jan 20/2005
6	Jan 20/2005	12	Jan 20/2005	2	Jan 20/2005
7	Jan 20/2005	51-41-02 GENERAL		3	Jan 20/2005
8	Jan 20/2005	1	Sep 20/2007	4	BLANK
9	Jan 20/2005	2	Sep 20/2007	51-41-07 GENERAL	
10	Jan 20/2005	3	Sep 20/2007	1	Jan 20/2005
11	Jan 20/2005	4	Sep 20/2007	2	Jan 20/2005

A = Added, R = Revised, O = Overflow, D = Deleted

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51-41-07 GENERAL (cont)		51-50-01 GENERAL (cont)		51-50-02 GENERAL (cont)	
3	Jan 20/2005	3	Jan 20/2005	11	Jan 20/2005
4	Jan 20/2005	4	Jan 20/2005	12	Jan 20/2005
5	Jan 20/2005	5	Jan 20/2005	13	Jan 20/2005
6	Jan 20/2005	6	Jan 20/2005	14	Jan 20/2005
7	Jan 20/2005	7	Jan 20/2005	15	Jan 20/2005
8	Jan 20/2005	8	Jan 20/2005	16	Jan 20/2005
9	Jan 20/2005	9	Jan 20/2005	17	Jan 20/2005
10	Jan 20/2005	10	Jan 20/2005	18	Jan 20/2005
11	Jan 20/2005	11	Jan 20/2005	19	Jan 20/2005
12	Jan 20/2005	12	Jan 20/2005	20	Jan 20/2005
13	Jan 20/2005	13	Jan 20/2005	21	Jan 20/2005
14	Jan 20/2005	14	Jan 20/2005	22	Jan 20/2005
15	Jan 20/2005	15	Jan 20/2005	23	Jan 20/2005
16	Jan 20/2005	16	Jan 20/2005	24	Jan 20/2005
17	Jan 20/2005	17	Jan 20/2005	25	Jan 20/2005
18	Jan 20/2005	18	Jan 20/2005	26	Jan 20/2005
19	Jan 20/2005	19	Jan 20/2005	27	Jan 20/2005
20	Jan 20/2005	20	Jan 20/2005	28	BLANK
21	Jan 20/2005	21	Jan 20/2005	51-60-01 GENERAL	
22	Jan 20/2005	22	Jan 20/2005	1	Sep 20/2006
23	Jan 20/2005	23	Jan 20/2005	2	Jan 20/2005
24	Jan 20/2005	24	Jan 20/2005	3	May 20/2006
25	Jan 20/2005	25	Jan 20/2005	4	May 20/2006
26	BLANK	26	Jan 20/2005	5	May 20/2006
51-41-08 GENERAL		27	Jan 20/2005	6	May 20/2006
1	Jan 20/2005	28	Jan 20/2005	7	May 20/2008
2	Jan 20/2005	29	Jan 20/2005	8	Jan 20/2005
3	Jan 20/2005	30	Jan 20/2005	9	Jan 20/2005
4	Jan 20/2005	51-50-02 GENERAL		10	Jan 20/2005
5	Jan 20/2005	1	Jan 20/2005	11	Jan 20/2005
6	Jan 20/2005	2	Jan 20/2005	12	Jan 20/2005
7	Jan 20/2005	3	Jan 20/2005	13	Jan 20/2005
8	BLANK	4	Jan 20/2005	14	Jan 20/2005
51-41-09 GENERAL		5	Jan 20/2005	15	Jan 20/2005
1	Jan 20/2005	6	Jan 20/2005	16	Jan 20/2005
2	BLANK	7	Jan 20/2005	51-70-00 GENERAL	
51-50-01 GENERAL		8	Jan 20/2005	1	Jan 20/2005
1	Jan 20/2005	9	Jan 20/2005	2	BLANK
2	Jan 20/2005	10	Jan 20/2005		

A = Added, R = Revised, O = Overflow, D = Deleted

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51-70-01 REPAIR 1		51-70-03 GENERAL (cont)		51-70-04 GENERAL (cont)	
201	Feb 20/2005	22	Jan 20/2005	4	Sep 20/2006
202	Feb 20/2005	23	Jan 20/2005	5	Jan 20/2005
203	Feb 20/2005	24	Jan 20/2005	6	Jan 20/2005
204	Feb 20/2005	25	Jan 20/2005	7	Jan 20/2005
205	Feb 20/2005	26	Jan 20/2005	8	Jan 20/2005
206	Feb 20/2005	27	Jan 20/2005	9	Jan 20/2005
207	Feb 20/2005	28	Jan 20/2005	10	Jan 20/2005
208	BLANK	29	Jan 20/2005	11	Jan 20/2005
51-70-02 GENERAL		30	Jan 20/2005	12	Jan 20/2005
1	Jan 20/2005	31	Jan 20/2005	13	Jan 20/2005
2	Jan 20/2005	32	Jan 20/2005	14	Jan 20/2005
3	Jan 20/2005	33	Jan 20/2005	15	Jan 20/2005
4	Jan 20/2005	34	Jan 20/2005	16	Jan 20/2005
5	Jan 20/2005	35	Jan 20/2005	17	Jan 20/2005
6	Jan 20/2005	36	Jan 20/2005	18	Jan 20/2005
7	Jan 20/2005	37	Jan 20/2005	19	Jan 20/2005
8	BLANK	38	Jan 20/2005	20	Jan 20/2005
51-70-03 GENERAL		39	Jan 20/2005	21	Jan 20/2005
1	Jan 20/2005	40	Jan 20/2005	22	Jan 20/2005
2	Jan 20/2005	41	Jan 20/2005	23	Jan 20/2005
3	Jan 20/2005	42	Jan 20/2005	24	Jan 20/2005
4	Jan 20/2005	43	Jan 20/2005	25	Jan 20/2005
5	Jan 20/2005	44	Jan 20/2005	26	Jan 20/2005
6	Jan 20/2005	45	Jan 20/2005	27	Jan 20/2005
7	Jan 20/2005	46	Jan 20/2005	28	Jan 20/2005
8	Jan 20/2005	47	Jan 20/2005	29	Jan 20/2005
9	Jan 20/2005	48	Jan 20/2005	30	Jan 20/2005
10	Jan 20/2005	49	Jan 20/2005	31	Jan 20/2005
11	Jan 20/2005	50	Jan 20/2005	32	Jan 20/2005
12	Jan 20/2005	51	Jan 20/2005	33	Jan 20/2005
13	May 20/2008	52	Jan 20/2005	34	Jan 20/2005
14	Jan 20/2005	53	Jan 20/2005	35	Jan 20/2005
15	Jan 20/2005	54	Jan 20/2005	36	Jan 20/2005
16	Jan 20/2005	55	Jan 20/2005	37	Jan 20/2005
17	Jan 20/2005	56	BLANK	38	Jan 20/2005
18	Jan 20/2005	51-70-04 GENERAL		39	Jan 20/2005
19	Jan 20/2005	1	Jan 20/2005	40	Jan 20/2005
20	Jan 20/2005	2	Jan 20/2005	41	Jan 20/2005
21	Jan 20/2005	3	Jan 20/2005	42	Jan 20/2005

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43	Jan 20/2005	27	Jan 20/2005	11	Jan 20/2005
44	Jan 20/2005	28	Jan 20/2005	12	Jan 20/2005
45	Jan 20/2005	29	Jan 20/2005	13	Jan 20/2005
46	Jan 20/2005	30	Jan 20/2005	14	Jan 20/2005
47	Jan 20/2005	31	Jan 20/2005	15	Jan 20/2005
48	Jan 20/2005	32	Jan 20/2005	16	Jan 20/2005
49	Jan 20/2005	33	Jan 20/2005	17	Jan 20/2005
50	Jan 20/2005	34	Jan 20/2005	18	Jan 20/2005
51	Jan 20/2005	35	Jan 20/2005	19	Jan 20/2005
52	Jan 20/2005	36	Jan 20/2005	20	Jan 20/2005
53	Jan 20/2005	37	Jan 20/2005	21	Jan 20/2005
54	Jan 20/2005	38	Jan 20/2005	22	Jan 20/2005
51-70-05 GENERAL		39	Jan 20/2005	23	Jan 20/2005
1	Jan 20/2005	40	Jan 20/2005	24	Jan 20/2005
2	Jan 20/2005	41	Jan 20/2005	25	Jan 20/2005
3	Jan 20/2005	42	Jan 20/2005	26	Jan 20/2005
4	Sep 20/2006	43	Jan 20/2005	27	Jan 20/2005
5	Jan 20/2005	44	Jan 20/2005	28	Jan 20/2005
6	Jan 20/2005	45	Jan 20/2005	29	Jan 20/2005
7	Jan 20/2005	46	Jan 20/2005	30	Jan 20/2005
8	Jan 20/2005	47	Jan 20/2005	31	Jan 20/2005
9	Jan 20/2005	48	Jan 20/2005	32	Jan 20/2005
10	Jan 20/2005	49	Jan 20/2005	33	Jan 20/2005
11	Jan 20/2005	50	Jan 20/2005	34	Jan 20/2005
12	Jan 20/2005	51	Jan 20/2005	35	Jan 20/2005
13	Jan 20/2005	52	Jan 20/2005	36	Jan 20/2005
14	Jan 20/2005	53	Jan 20/2005	37	Jan 20/2005
15	Jan 20/2005	54	Jan 20/2005	38	Jan 20/2005
16	Jan 20/2005	51-70-06 GENERAL		39	Jan 20/2005
17	Jan 20/2005	1	Sep 20/2006	40	Jan 20/2005
18	Jan 20/2005	2	Jan 20/2005	41	Jan 20/2005
19	Jan 20/2005	3	Jan 20/2005	42	Jan 20/2005
20	Jan 20/2005	4	Jan 20/2005	43	Jan 20/2005
21	Jan 20/2005	5	Jan 20/2005	44	Jan 20/2005
22	Jan 20/2005	6	Jan 20/2005	45	Jan 20/2005
23	Jan 20/2005	7	Jan 20/2005	46	Jan 20/2005
24	Jan 20/2005	8	Jan 20/2005	47	Jan 20/2005
25	Jan 20/2005	9	Jan 20/2005	48	Jan 20/2005
26	Jan 20/2005	10	Jan 20/2005	49	Jan 20/2005

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50	Jan 20/2005	36	Jan 20/2005	24	Jan 20/2005
51	Jan 20/2005	37	Jan 20/2005	25	Jan 20/2005
52	BLANK	38	Jan 20/2005	26	Jan 20/2005
51-70-07 GENERAL		39	Jan 20/2005	27	Jan 20/2005
1	Jan 20/2005	40	Jan 20/2005	28	Jan 20/2005
2	Jan 20/2005	41	Jan 20/2005	29	Jan 20/2005
3	Sep 20/2006	42	Jan 20/2005	30	Jan 20/2005
4	Jan 20/2005	43	Jan 20/2005	31	Jan 20/2005
5	Jan 20/2005	44	Jan 20/2005	32	Jan 20/2005
6	Jan 20/2005	45	Jan 20/2005	33	Jan 20/2005
7	Jan 20/2005	46	Jan 20/2005	34	Jan 20/2005
8	Jan 20/2005	47	Jan 20/2005	35	Jan 20/2005
9	Jan 20/2005	48	Jan 20/2005	36	Jan 20/2005
10	Jan 20/2005	49	Jan 20/2005	37	Jan 20/2005
11	Jan 20/2005	50	BLANK	38	Jan 20/2005
12	Jan 20/2005	51-70-08 GENERAL		39	Jan 20/2005
13	Jan 20/2005	1	Jan 20/2005	40	Jan 20/2005
14	Jan 20/2005	2	Jan 20/2005	41	Jan 20/2005
15	Jan 20/2005	3	Sep 20/2006	42	Jan 20/2005
16	Jan 20/2005	4	Jan 20/2005	43	Jan 20/2005
17	Jan 20/2005	5	Jan 20/2005	44	Jan 20/2005
18	Jan 20/2005	6	Jan 20/2005	45	Jan 20/2005
19	Jan 20/2005	7	Jan 20/2005	46	Jan 20/2005
20	Jan 20/2005	8	Jan 20/2005	47	Jan 20/2005
21	Jan 20/2005	9	Jan 20/2005	48	Jan 20/2005
22	Jan 20/2005	10	Jan 20/2005	51-70-09 GENERAL	
23	Jan 20/2005	11	Jan 20/2005	1	Sep 20/2007
24	Jan 20/2005	12	Jan 20/2005	2	BLANK
25	Jan 20/2005	13	Jan 20/2005	51-70-10 GENERAL	
26	Jan 20/2005	14	Jan 20/2005	1	Sep 20/2007
27	Jan 20/2005	15	Jan 20/2005	2	May 20/2007
28	Jan 20/2005	16	Jan 20/2005	3	May 20/2007
29	Jan 20/2005	17	Jan 20/2005	4	May 20/2007
30	Jan 20/2005	18	Jan 20/2005	5	May 20/2007
31	Jan 20/2005	19	Jan 20/2005	6	BLANK
32	Jan 20/2005	20	Jan 20/2005	51-70-10 REPAIR GENERAL	
33	Jan 20/2005	21	Jan 20/2005	201	Sep 20/2007
34	Jan 20/2005	22	Jan 20/2005	202	Sep 20/2008
35	Jan 20/2005	23	Jan 20/2005	203	Sep 20/2007

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204	Sep 20/2007	243	Sep 20/2007	282	Sep 20/2007
205	Sep 20/2007	244	Sep 20/2007	283	Sep 20/2007
206	Sep 20/2007	245	Sep 20/2007	284	Sep 20/2007
207	Sep 20/2007	246	Sep 20/2007	285	Sep 20/2007
208	Sep 20/2007	247	Sep 20/2007	286	Sep 20/2007
209	Sep 20/2007	248	Sep 20/2007	287	Sep 20/2007
210	Sep 20/2007	249	Sep 20/2007	288	Sep 20/2007
211	Sep 20/2007	250	Sep 20/2007	289	Sep 20/2007
212	Sep 20/2007	251	Sep 20/2007	290	Sep 20/2007
213	Sep 20/2007	252	Sep 20/2007	291	Sep 20/2007
214	Sep 20/2007	253	Sep 20/2007	292	Sep 20/2007
215	Sep 20/2007	254	Sep 20/2007	293	Sep 20/2007
216	Sep 20/2007	255	Sep 20/2007	294	Sep 20/2007
217	Sep 20/2007	256	Sep 20/2007	295	Sep 20/2007
218	Sep 20/2007	257	Sep 20/2007	296	BLANK
219	Sep 20/2007	258	Sep 20/2007	51-70-10 REPAIR 1	
220	Sep 20/2007	259	Sep 20/2007	201	May 20/2005
221	Sep 20/2007	260	Sep 20/2007	202	May 20/2005
222	Sep 20/2007	261	Sep 20/2007	51-70-10 REPAIR 2	
223	Sep 20/2007	262	Sep 20/2007	201	Sep 20/2007
224	Sep 20/2007	263	Sep 20/2007	202	Sep 20/2007
225	Sep 20/2007	264	Sep 20/2007	203	Sep 20/2007
226	Sep 20/2007	265	Sep 20/2007	204	Sep 20/2007
227	Sep 20/2007	266	Sep 20/2007	205	May 20/2005
228	Sep 20/2007	267	Sep 20/2007	206	Sep 20/2007
229	Sep 20/2007	268	Sep 20/2007	51-70-10 REPAIR 3	
230	Sep 20/2007	269	Sep 20/2007	201	Sep 20/2007
231	Sep 20/2007	270	Sep 20/2007	202	Sep 20/2007
232	Sep 20/2007	271	Sep 20/2007	203	Sep 20/2007
233	Sep 20/2007	272	Sep 20/2007	204	Sep 20/2007
234	Sep 20/2007	273	Sep 20/2007	205	Sep 20/2007
235	Sep 20/2007	274	Sep 20/2007	206	Sep 20/2007
236	Sep 20/2007	275	Sep 20/2007	207	Sep 20/2007
237	Sep 20/2007	276	Sep 20/2007	208	Sep 20/2007
238	May 20/2008	277	Sep 20/2007	209	Sep 20/2007
239	May 20/2008	278	Sep 20/2007	210	Sep 20/2007
240	Sep 20/2007	279	Sep 20/2007	211	Sep 20/2007
241	Sep 20/2007	280	Sep 20/2007	212	Sep 20/2007
242	Sep 20/2007	281	Sep 20/2007		

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201	Sep 20/2007	8	Jan 20/2005	25	Jan 20/2005
202	May 20/2005	9	Jan 20/2005	26	Jan 20/2005
203	May 20/2005	10	Jan 20/2005	27	Jan 20/2005
204	May 20/2005	11	Jan 20/2005	28	Jan 20/2005
205	May 20/2005	12	Jan 20/2005	51-70-15 GENERAL	
206	Sep 20/2007	13	Jan 20/2005	1	Jan 20/2005
207	May 20/2005	14	Jan 20/2005	2	Jan 20/2005
208	May 20/2005	15	Jan 20/2005	3	Jan 20/2005
209	May 20/2005	16	Jan 20/2005	4	BLANK
210	Sep 20/2007	17	Jan 20/2005	51-70-16 GENERAL	
211	May 20/2005	18	BLANK	1	Jan 20/2005
212	May 20/2005	51-70-13 GENERAL		2	Jan 20/2005
213	May 20/2005	1	Jan 20/2005	3	Jan 20/2005
214	May 20/2005	2	Jan 20/2005	4	Jan 20/2005
215	Sep 20/2007	51-70-14 GENERAL		5	Jan 20/2005
216	May 20/2005	1	Jan 20/2005	6	Jan 20/2005
217	May 20/2005	2	Jan 20/2005	7	Jan 20/2005
218	May 20/2005	3	Jan 20/2005	8	Jan 20/2005
219	May 20/2005	4	Jan 20/2005	9	Jan 20/2005
220	Sep 20/2007	5	Jan 20/2005	10	Jan 20/2005
221	Sep 20/2007	6	Jan 20/2005	11	Jan 20/2005
222	BLANK	7	Jan 20/2005	12	Jan 20/2005
51-70-11 GENERAL		8	Jan 20/2005	13	Jan 20/2005
1	Jan 20/2005	9	Jan 20/2005	14	Jan 20/2005
2	Jan 20/2005	10	Sep 20/2007	15	Jan 20/2005
3	Jan 20/2005	11	Jan 20/2005	16	Jan 20/2005
4	Jan 20/2005	12	Jan 20/2005	17	Jan 20/2005
5	Jan 20/2005	13	Jan 20/2005	18	Jan 20/2005
6	Jan 20/2005	14	Jan 20/2005	19	Jan 20/2005
7	Jan 20/2005	15	Jan 20/2005	20	Jan 20/2005
8	BLANK	16	Jan 20/2005	21	Jan 20/2005
51-70-12 GENERAL		17	Jan 20/2005	22	Jan 20/2005
1	Jan 20/2005	18	Jan 20/2005	23	Jan 20/2005
2	Jan 20/2005	19	Jan 20/2005	24	Jan 20/2005
3	Jan 20/2005	20	Jan 20/2005	25	Jan 20/2005
4	Jan 20/2005	21	Jan 20/2005	26	Jan 20/2005
5	Jan 20/2005	22	Jan 20/2005	27	Jan 20/2005
6	Jan 20/2005	23	Jan 20/2005	28	Jan 20/2005
7	Jan 20/2005	24	Jan 20/2005	29	Jan 20/2005

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31	Jan 20/2005	33	Jan 20/2005	8	Jan 20/2005
32	Jan 20/2005	34	Jan 20/2005	9	Jan 20/2005
33	Jan 20/2005	35	Jan 20/2005	10	Jan 20/2005
34	Jan 20/2005	36	Jan 20/2005	11	Jan 20/2005
35	Jan 20/2005	37	Jan 20/2005	12	Jan 20/2005
36	BLANK	38	Jan 20/2005	13	Jan 20/2005
51-70-17 GENERAL		39	Jan 20/2005	14	Jan 20/2005
1	Jan 20/2005	40	Jan 20/2005	15	Jan 20/2005
2	Jan 20/2005	41	Jan 20/2005	16	Jan 20/2005
3	Jan 20/2005	42	Jan 20/2005	17	Jan 20/2005
4	Sep 20/2008	43	Jan 20/2005	18	Jan 20/2005
5	Jan 20/2005	44	Jan 20/2005	19	Jan 20/2005
6	Jan 20/2005	45	Jan 20/2005	20	Jan 20/2005
7	Jan 20/2005	46	Jan 20/2005	21	Jan 20/2005
8	Jan 20/2005	47	Jan 20/2005	22	Jan 20/2005
9	Jan 20/2005	48	Jan 20/2005	23	Jan 20/2005
10	Jan 20/2005	49	Jan 20/2005	24	Jan 20/2005
11	Jan 20/2005	50	Jan 20/2005	25	Jan 20/2005
12	Jan 20/2005	51	Jan 20/2005	26	Jan 20/2005
13	Jan 20/2005	52	Jan 20/2005	27	Jan 20/2005
14	Jan 20/2005	53	Jan 20/2005	28	Jan 20/2005
15	Jan 20/2005	54	Jan 20/2005	29	Jan 20/2005
16	Jan 20/2005	55	Jan 20/2005	30	Jan 20/2005
17	Jan 20/2005	56	BLANK	31	Jan 20/2005
18	Jan 20/2005	51-70-18 GENERAL		32	Jan 20/2005
19	Jan 20/2005	1	Jan 20/2005	33	Jan 20/2005
20	Jan 20/2005	2	Jan 20/2005	34	Jan 20/2005
21	Jan 20/2005	3	Jan 20/2005	35	Jan 20/2005
22	Jan 20/2005	4	Jan 20/2005	36	Jan 20/2005
23	Jan 20/2005	5	Jan 20/2005	37	Jan 20/2005
24	Jan 20/2005	6	Jan 20/2005	38	BLANK
25	Jan 20/2005	51-71-01 GENERAL		51-71-02 GENERAL	
26	Jan 20/2005	1	Jan 20/2005	1	Jan 20/2005
27	Jan 20/2005	2	Jan 20/2005	2	Jan 20/2005
28	Jan 20/2005	3	Sep 20/2008	3	Sep 20/2008
29	Jan 20/2005	4	May 20/2006	4	Jan 20/2005
30	Jan 20/2005	5	Jan 20/2005	5	Jan 20/2005
31	Jan 20/2005	6	Jan 20/2005	6	Jan 20/2005

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8	Jan 20/2005	51-71-03 GENERAL		39	Jan 20/2005
9	Jan 20/2005	1	Jan 20/2005	40	Jan 20/2005
10	Jan 20/2005	2	Jan 20/2005	41	Jan 20/2005
11	Jan 20/2005	3	Jan 20/2005	42	Jan 20/2005
12	Jan 20/2005	4	Jan 20/2005	43	Jan 20/2005
13	Jan 20/2005	5	Jan 20/2005	44	Jan 20/2005
14	Jan 20/2005	6	Jan 20/2005	45	Jan 20/2005
15	Jan 20/2005	7	Jan 20/2005	46	Jan 20/2005
16	Jan 20/2005	8	Jan 20/2005		
17	Jan 20/2005	9	Jan 20/2005		
18	Jan 20/2005	10	Jan 20/2005		
19	Jan 20/2005	11	Jan 20/2005		
20	Jan 20/2005	12	Jan 20/2005		
21	Jan 20/2005	13	Jan 20/2005		
22	Jan 20/2005	14	Jan 20/2005		
23	Jan 20/2005	15	Jan 20/2005		
24	Jan 20/2005	16	Jan 20/2005		
25	Jan 20/2005	17	Jan 20/2005		
26	Jan 20/2005	18	Jan 20/2005		
27	Jan 20/2005	19	Jan 20/2005		
28	Jan 20/2005	20	Jan 20/2005		
29	Jan 20/2005	21	Jan 20/2005		
30	Jan 20/2005	22	Jan 20/2005		
31	Jan 20/2005	23	Jan 20/2005		
32	Jan 20/2005	24	Jan 20/2005		
33	Jan 20/2005	25	Jan 20/2005		
34	Jan 20/2005	26	Jan 20/2005		
35	Jan 20/2005	27	Jan 20/2005		
36	Jan 20/2005	28	Jan 20/2005		
37	Jan 20/2005	29	Jan 20/2005		
38	Jan 20/2005	30	Jan 20/2005		
39	Jan 20/2005	31	Jan 20/2005		
40	Jan 20/2005	32	Jan 20/2005		
41	Jan 20/2005	33	Jan 20/2005		
42	Jan 20/2005	34	Jan 20/2005		
43	Jan 20/2005	35	Jan 20/2005		
44	Jan 20/2005	36	Jan 20/2005		
45	Jan 20/2005	37	Jan 20/2005		

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GENERAL - STRUCTURES

1. General

- A. This chapter describes general repair practices, materials and typical repairs which are applicable throughout the subsequent chapters of the manual. In addition, data regarding support of the airplane in the jugged position, symmetry check, aerodynamic smoothness, and control surface balancing is included.



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GENERAL - DEFINITIONS OF REFERENCE PLANES, REFERENCE LINES, AND GENERAL ABBREVIATIONS

1. General

- A. This general section gives the definitions of reference planes, reference lines and general abbreviations as they are used in the subsequent chapters of this manual.
- B. Refer to for Table 1/GENERAL for the general abbreviations that are applicable to airplane reference data for the fuselage, wing, vertical stabilizer, horizontal stabilizer and nacelle.

Table 1: General Abbreviations for the Fuselage, Wing, Vertical Stabilizer, Horizontal Stabilizer and Nacelle

FUSELAGE	
BBL or BL	Body (Fuselage) Buttock Line
RBL or RBBL	Right Buttock Line
LBL or LBBL	Left Buttock Line
STA or BS or B STA	Body (Fuselage) Station
BRP	Body (Fuselage) Reference Plane
BWL or WL	Body (Fuselage) Waterline
DOOR STA	Door Station
DOOR BL	Door Buttock Line
WING	
FSS	Front Spar Station
ISS	Inboard Slat Station
LES	Leading Edge Station
MAC	Mean Aerodynamic Chord
OSS	Outboard Slat Station
TE	Trailing Edge
WBL	Wing Buttock Line
WRP	Wing Reference Plane
W STA or WS	Wing Station
WTS	Wing Tip Station
VERTICAL STABILIZER	
FIN STA	Vertical Stabilizer (Fin) Station
RUD STA	Rudder Station
FSS	Front Spar Station
LFSS	Lower Front Spar Station
ASS or AS STA	Auxiliary Spar Station
LES	Leading Edge Station
HORIZONTAL STABILIZER	
ELEV STA	Elevator Station
HS BL	Horizontal Stabilizer Buttock Line
STAB STA	Horizontal Stabilizer Station
FS STA	Front Spar Station



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RS STA	Rear Spar Station
AUX SPAR STA or AUX S STA	Auxiliary Spar Station
NACELLE	
NAC BL	Nacelle Buttock Line
NAC STA	Nacelle Station
NAC WL	Nacelle Waterline
PP BL	Power Plane Buttock Line
PPS or PP STA	Power Plant Station
PP WL	Power Plant Waterline

C. Refer to Table 2/GENERAL for a list a list of general abbreviations used in this Structural Repair Manual (SRM).

Table 2: General Abbreviations Used in the Structural Repair Manual (SRM)

GENERAL	
AL or al	aluminum
APPROX or approx	approximate(ly)
ASSY or assy	assembly
AISI	American Iron and Steel Institute
BMS	Boeing Material Specification
BHD oe bhd	bulkhead
CAD	cadmium
CG	center of gravity
CHAM or cham	chamfer(ed)
CL	centerline
CRES or cres	corrosion-resistant steel
CSK or csk	countersink
D	diameter of fastener
DIA or dia	diameter
DWG or dwg	drawing(s)
F	Fahrenheit
FIG. or fig.	figure(s)
FS	front spar
FT or ft	feet (foot)
FTG or ftg	fitting
FWD or fwd	forward
HORIZ or horiz	horizontal
HT TR or ht tr	heat-treat
IN. or in.	inch

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INBD or inbd	inboard
INSTL or instl	install(ation)
KSI or ksi	kilopounds per square inch
LB or lb	pound(s)
LE	leading edge
LE STA	leading edge station
LWR or lwr	lower
MAX or max	maximum
MIN or min	minimum
No.	number(s)
OPTL or optl	optional
OUTBD or outbd	outboard
PAR. or par.	paragraph
PH	precipitation hardening
PSI or psi	pounds per square inch
QTY or qty	quantity
R or r	radius
REF or ref	reference
RS	rear spar
STA	station
SYM or sym	symmetrical
TYP or typ	typical
UPR or upr	upper

D. Refer to Table 3/GENERAL for the general fuselage definitions

Table 3: General Fuselage Definitions

B STA	Body (Fuselage) Station. A vertical plane perpendicular to the fuselage centerline, located by its distance from a point 159.00 inches forward of the nose.
BBL	Body (Fuselage) Buttock Line. A vertical plane parallel to the fuselage vertical centerline plane, BBL 0.00, located by its perpendicular distance from the fuselage centerline plane.
BWL	Body (Fuselage) Waterline. A horizontal plane located by its perpendicular distance from parallel, imaginary plane BWL 0.00, 133.00 inches below the lowest fuselage surface.
BRP	Body (Fuselage) Reference Plane. Horizontal plane, BWL 208.10, at the top surface of the main deck floor beams.

Table 4: Definitions of Reference Planes and Lines - Vertical / Horizontal Stabilizer, Wing, and Nacelle

Vertical Stabilizer (See Figure 1/GENERALDetail I)	
FIN STA	Fin Station. Plane perpendicular to the centerline of the vertical stabilizer rear spar. Distance is measured from Fin Station 0.00, intersection of rear spar centerline extension and body waterline 228.99.
FSS	Front Spar Station. Plane perpendicular to the vertical stabilizer front spar, measured from the fin front spar station 0.00, intersection of the front spar centerline extension and body waterline 228.99.



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(Continued)

LFFS	Lower Front Spar Station. Plane perpendicular to the vertical stabilizer lower front spar, measured from the Lower Front Spar Station 0.00, intersection of the lower front spar centerline extension and body waterline 228.99.
ASS	Auxiliary Spar Station. Plane perpendicular to the vertical stabilizer auxiliary spar, measured from the Auxiliary Spar Station 0.00, intersection of the auxiliary spar centerline extension and body waterline 228.99.
LES	Leading Edge Station. Plane perpendicular to the vertical stabilizer leading edge, measured from the Leading Edge Station 0.00, intersection of the leading edge line extension and body waterline 228.99.
RUD STA	Rudder Station. Plane perpendicular to the rudder hinge centerline, measured from Rudder Station 0.00, intersection of rudder hinge centerline and body waterline 228.99.
Horizontal Stabilizer (See Figure 1/GENERAL Detail II)	
AUX SPAR STA	Auxiliary Spar Station. Plane perpendicular to the horizontal stabilizer auxiliary spar, measured from Auxiliary Spar Station 0.00, intersection of auxiliary spar extension and stabilizer buttock line 0.00.
ELEV STA	Elevator Station. Plane perpendicular to the elevator hinge centerline measured from intersection of elevator hinge centerline and stabilizer buttock line 0.00.
FS STA	Front Spar Station. Plane perpendicular to the horizontal stabilizer front spar, measured from Front Spar Station 0.00, intersection of front spar and trace of body buttock line 0.00 at horizontal stabilizer reference plane.
HSBL	Stabilizer Buttock Line. Plane perpendicular to the horizontal stabilizer reference plane and parallel to the trace of the fuselage centerline. It is measured from stabilizer buttock line 0.00, intersection of horizontal stabilizer reference plane and body buttock line 0.00.
HSRP	Horizontal Stabilizer Reference Plane. Datum plane of the horizontal stabilizer which is inclined 7° degrees up at BBL 0 in the rear elevation.
LE STA	Leading Edge Station. Plane perpendicular to the horizontal stabilizer leading edge, measured from Stabilizer Leading Edge Station 0.00, intersection of leading edge line extension and stabilizer buttock line 0.00.
RS STA	Rear Spar Station. Plane perpendicular to the horizontal stabilizer rear spar, measured from Rear Spar Station 0.00, intersection of rear spar and trace of body buttock line 0.00 at horizontal stabilizer reference plane.
STAB STA	Stabilizer Station. Plane perpendicular to the stabilizer rear spar and horizontal stabilizer reference plane. Stabilizer station 0.00 is at the intersection of the leading edge extension, body buttock line 0.00 and the horizontal stabilizer reference plane.
Wing (See Figure 1/GENERAL Detail III)	
MAC	Mean Aerodynamic Chord. Chord of section of imaginary airfoil on the wing which would have vectors throughout the flight range identical to those of the actual wing.
WRP	Wing Reference Plane. Datum plane of the wing which is inclined up 5 degrees to plane normal to BBL 0 in rear elevation.
W STA	Wing Station. Plane perpendicular to the wing reference plane and the plane of the outboard rear spar, measured from intersection of extended leading edge and wing buttock line 0.00.
WBL	Wing Buttock Line. Plane perpendicular to the wing reference plane and parallel to the trace of the fuselage centerline. It is measured from intersection of wing reference plane and body buttock line 0.00.
FS or RS	Wing Front Spar or Rear Spar. Principal spanwise transverse members of the wing structure, perpendicular to the wing reference plane.
ISS	Inboard Slat Stations. Plane perpendicular to inboard leading edge slats, measured from intersection of the slat rotation axis and a plane perpendicular to the wing reference plane.
OSS	Outboard Slat Stations. Plane perpendicular to outboard leading edge slats, measured from intersection of the slat rotation axis and a plane perpendicular to the wing reference plane.
LES	Leading Edge Station. Plane perpendicular to the wing reference plane and the leading edge, measured from intersection of leading edge extension and wing buttock line 0.00.

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(Continued)

WTS	Wing Tip Station. Plane perpendicular to the wing reference plane and wing buttock line 0.00, measured from intersection of leading edge and wing buttock line 0.00.
Nacelle (See Figure 1/GENERAL Detail IV, V and V1)	
NAC BL	Nacelle Buttock Line. Nacelle Buttock Line 0.00 for the engine is 1.5 degrees inboard from Wing Buttock Line 255.00 at wing leading edge, and is a plane perpendicular to the Wing Reference Plane.

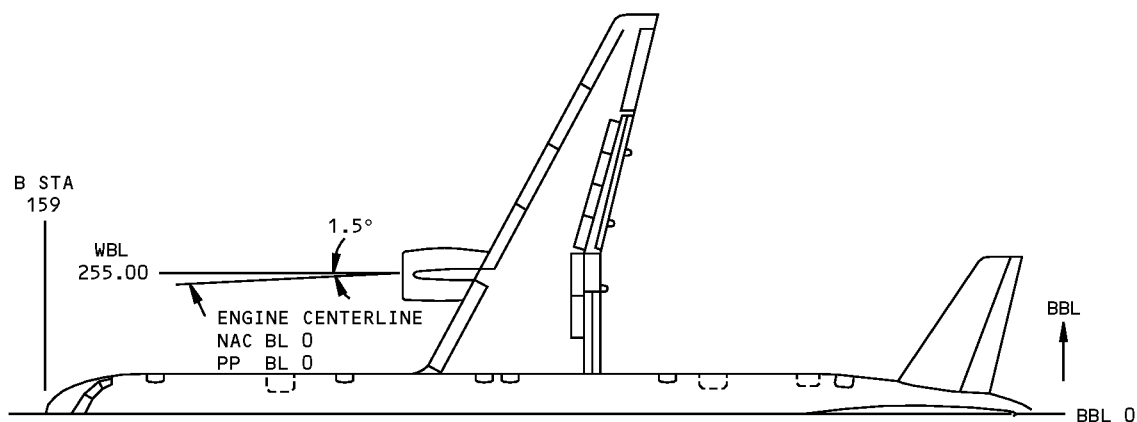
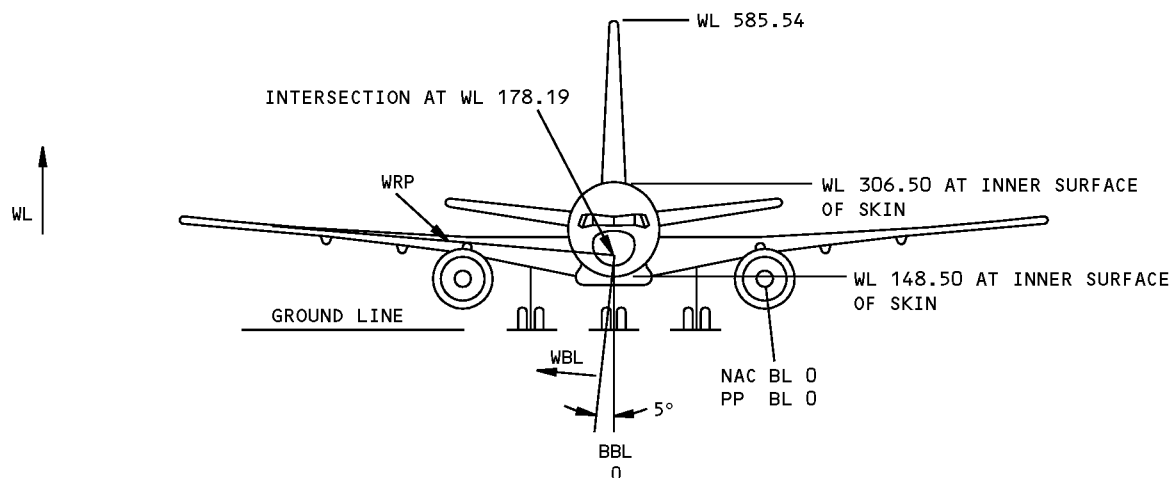
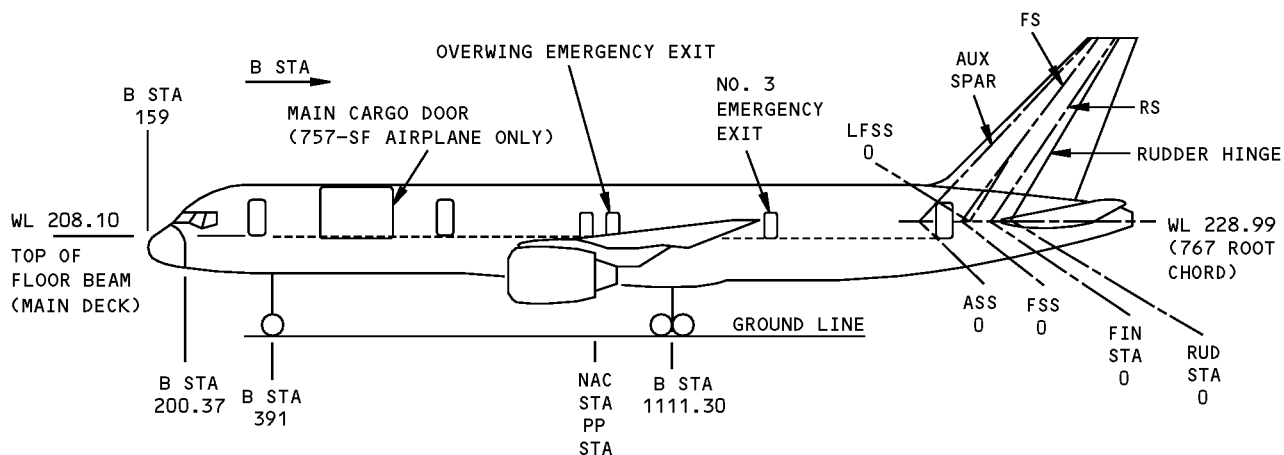
Table 5: Definition of Reference Planes and Lines - Wing

Wing (See Figure 1/GENERAL Detail III)	
MAC	Mean Aerodynamic Chord. Chord of section of imaginary airfoil on the wing which would have vectors throughout the flight range identical to those of the actual wing.
WRP	Wing Reference Plane. Datum plane of the wing which is inclined up 5 degrees to plane normal to BBL 0 in rear elevation.
W STA	Wing Station. Plane perpendicular to the wing reference plane and the plane of the outboard rear spar, measured from intersection of extended leading edge and wing buttock line 0.00.
WBL	Wing Buttock Line. Plane perpendicular to the wing reference plane and parallel to the trace of the fuselage centerline. It is measured from intersection of wing reference plane and body buttock line 0.00.
FS or RS	Wing Front Spar or Rear Spar. Principal spanwise transverse members of the wing structure, perpendicular to the wing reference plane.
ISS	Inboard Slat Stations. Plane perpendicular to inboard leading edge slats, measured from intersection of the slat rotation axis and a plane perpendicular to the wing reference plane.
OSS	Outboard Slat Stations. Plane perpendicular to outboard leading edge slats, measured from intersection of the slat rotation axis and a plane perpendicular to the wing reference plane.
LES	Leading Edge Station. Plane perpendicular to the wing reference plane and the leading edge, measured from intersection of leading edge extension and wing buttock line 0.00.
WTS	Wing Tip Station. Plane perpendicular to the wing reference plane and wing buttock line 0.00, measured from intersection of leading edge and wing buttock line 0.00.

Table 6: Definitions of Reference Planes and Lines - Nacelle

NAC STA	Nacelle Station. A vertical plane to the nacelle centerline. The zero position is located 100.00 inches forward of the forward face of the engine fan for the PW2037 engine. For the RB211-535 engines, these lines are called Power Plant Station (PPS) lines.
PP BL	Power Plant Buttock Line. Power Plant Buttock Line 0.00 for the RB211-535 engines is 1.5 degrees inboard from Wing Buttock Line 255.00 at wing leading edge, and is a plane perpendicular to the Wing Reference Plane.
PP WL	Power Plant Waterline. A plane inclined 2.4072 degrees upward from the wing reference plane. The PP WL 100.00 (centerline of RB211-535 engines) is measured 161.70 inches down from the wing leading edge at WBL 255.00.
PPS or PP STA	Power Plant Station. Used on the RB211-535 engines, it is similar to the Nacelle Station lines used on the PW2037 engine. The zero position is located 100.00 inches forward of the forward face of the engine fan for the RB211-535 engines.

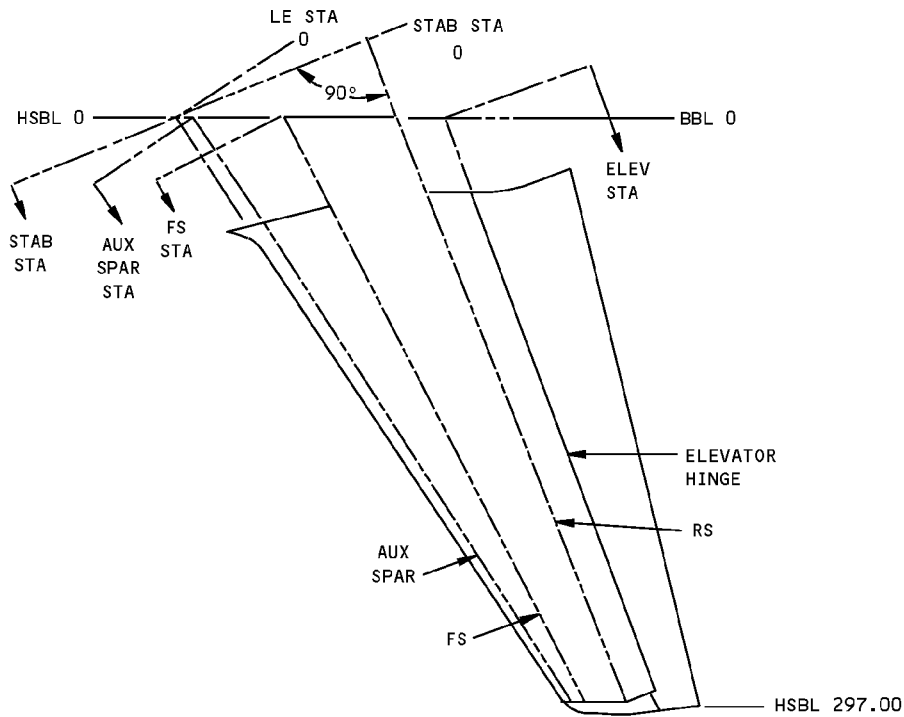
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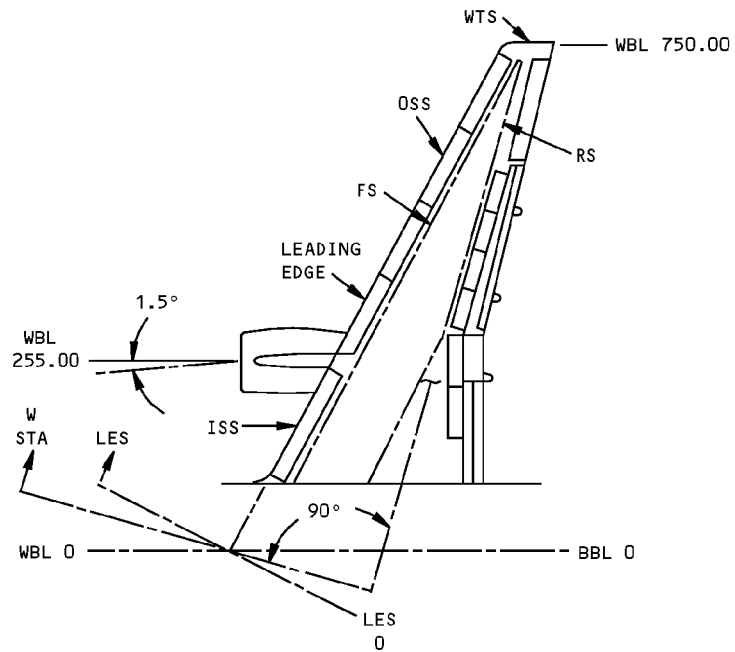
DETAIL I

Definition of Reference Planes and Lines
Figure 1 (Sheet 1 of 4)

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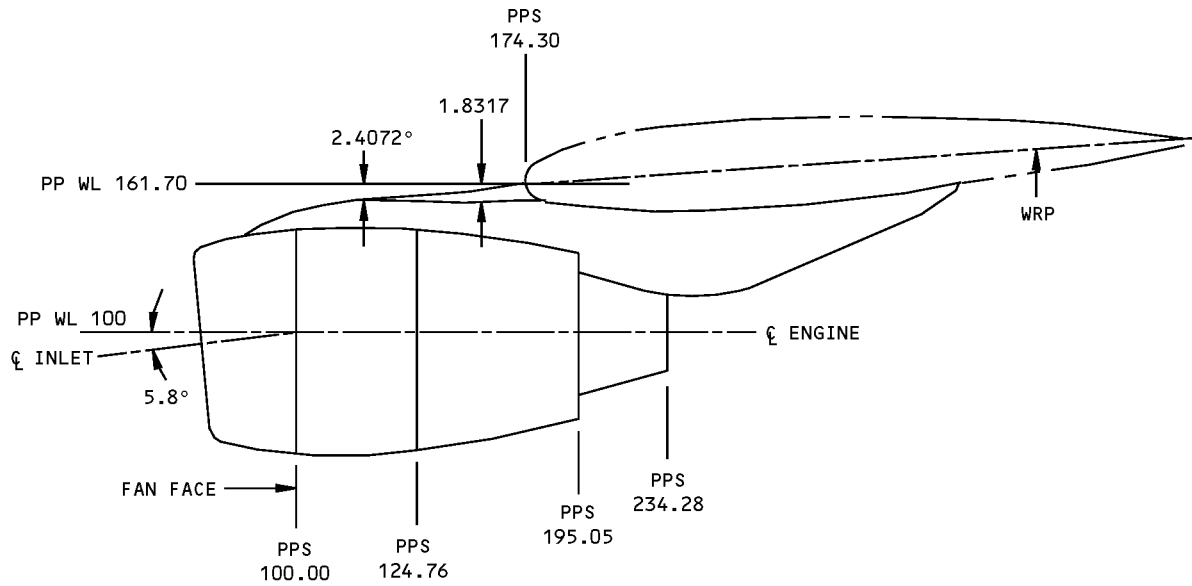
PLAN VIEW OF HORIZONTAL STABILIZER
DETAIL II



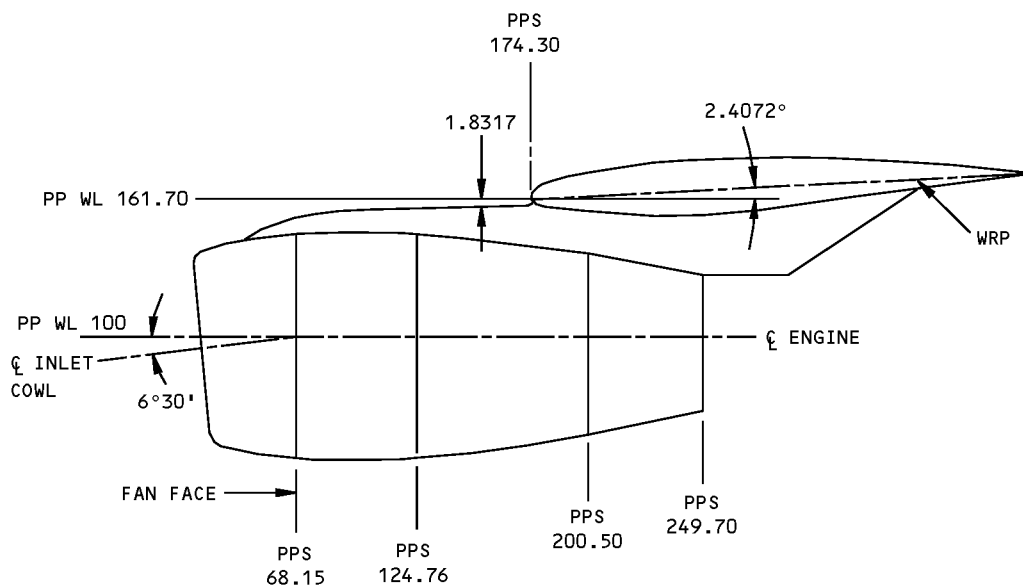
PLAN VIEW OF WING
DETAIL III

Definition of Reference Planes and Lines
Figure 1 (Sheet 2 of 4)

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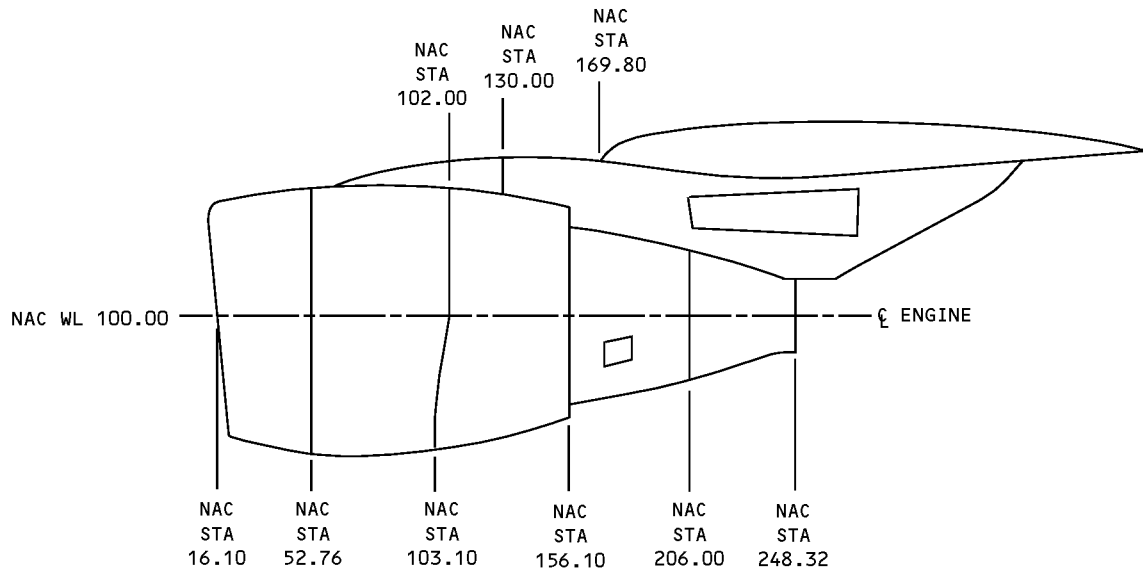
LEFT SIDE VIEW OF NACELLE FOR RB211-535C ENGINE
DETAIL IV



LEFT SIDE VIEW OF NACELLE FOR RB211-535E4 ENGINE
DETAIL V

Definition of Reference Planes and Lines Figure 1 (Sheet 3 of 4)

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LEFT SIDE VIEW OF NACELLE FOR PW2037 ENGINE
DETAIL VI

Definition of Reference Planes and Lines
Figure 1 (Sheet 4 of 4)



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GENERAL - MAJOR ASSEMBLY AND INSTALLATION BREAKDOWN

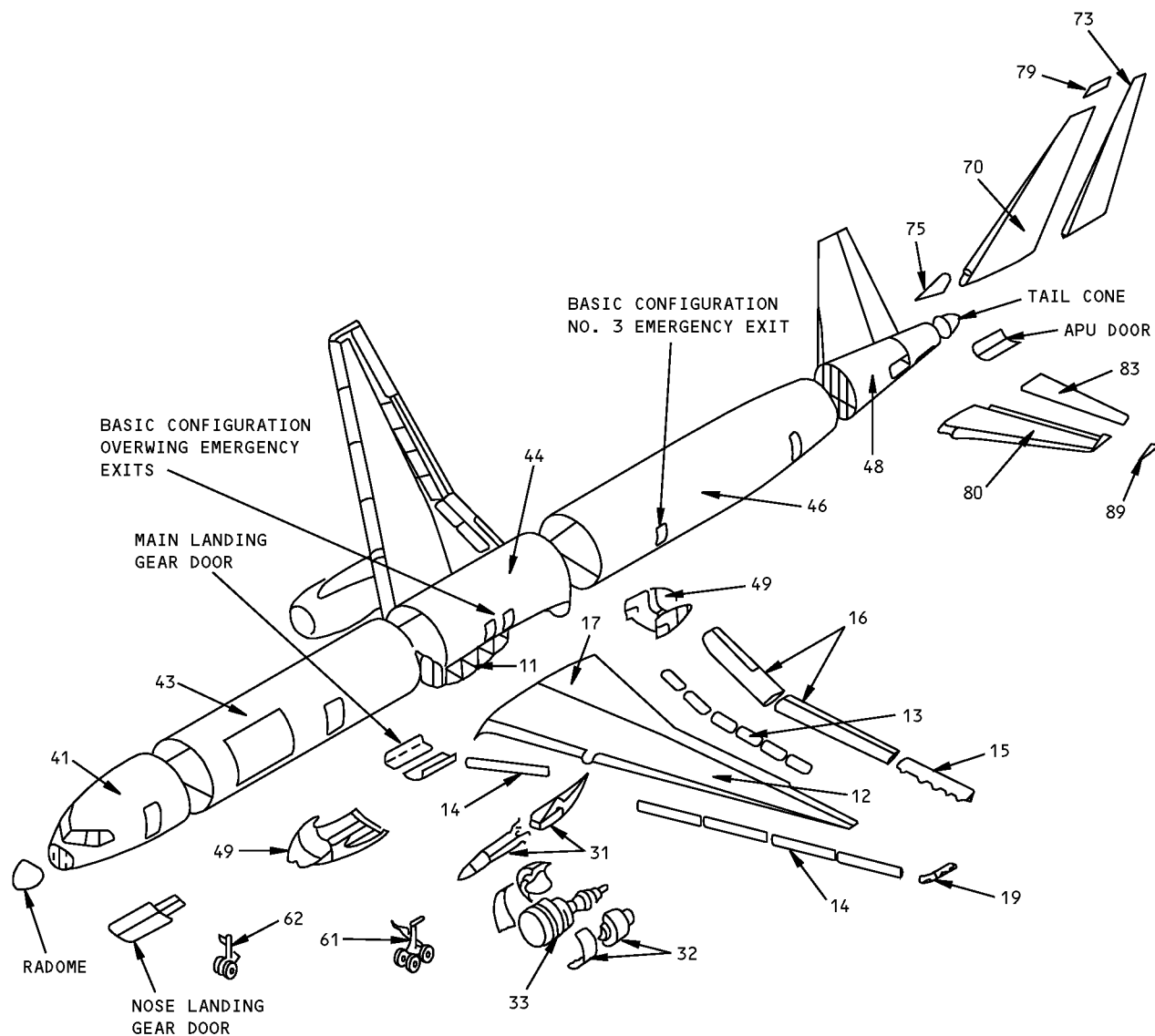
1. General

- A. Major assemblies and installation breakdowns as they are located on the 757 airplane are shown in Figure 1/GENERAL. Accompanying the figure is a list identifying each major assembly along with its reference drawing number.

The reference drawing numbers will aid in the location and identification of various subassemblies of each major assembly.

- B. Identification numbers in Figure 1/GENERAL do not correspond to ATA assigned numbers. To aid in locating specific structures of interest, refer to the Introduction for manual arrangement and numbering system used.

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NOTES

- A** FOR ROLLS ROYCE RB211-535C ENGINE
- B** FOR PRATT & WHITNEY PW 2037 ENGINE
- C** FOR 757-SF AIRPLANES ONLY



**Major Assembly and Installation Breakdown
Figure 1 (Sheet 1 of 2)**



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IDENTIFICATION	DRAWING TITLE	DRAWING NUMBER
11	WING CENTER SECTION ASSY	111N0001
12	OUTBOARD WING ASSY	112N0001
13	INBOARD SPOILER INSTL	113N4000
	OUTBOARD SPOILER INSTL	113N5000
14	INBOARD LEADING EDGE SLAT INSTL	114N3000
	OUTBOARD LEADING EDGE SLAT INSTL	114N4000
15	AILERON INSTL	113N7000
16	INBOARD TRAILING EDGE FLAP INSTL	113N2000
	OUTBOARD TRAILING EDGE FLAP INSTL	113N3000
17	FIXED TAILING EDGE INSTL	113N1000
19	WING TIP INSTAL	119N0001
31	STRUT ASSY A	311N5002
	STRUT ASSY B	
32	COWL INSTL A	
	COWL INSTL B	
33	POWER PLANT INSTL A	
	POWER PLANT INSTL B	
41	BODY INSTL - SECTION 41	141N0001
43	BODY INSTL - SECTION 43	143N0001
	MAIN CARGO DOOR INSTL C	65-25326
44	BODY INSTL - SECTION 44	144N0001
46	BODY INSTL - SECTION 46	146N0001
48	BODY INSTL - SECTION 48	148N0001
49	WING-TO-BODY FAIRING INSTL	149N0001
61	MAIN LANDING GEAR INSTL	161N0000
62	NOSE LANDING GEAR INSTL	162N0000
70	VERTICAL STABILIZER INSTL	170N0001
73	RUDDER INSTL	173N2001
75	DORSAL FIN ASSY	146N0800
79	VERTICAL STABILIZER TIP INSTL	179N0001
80	HORIZONTAL STABILIZER INSTL	180N0001
83	ELEVATOR INSTL	183N2001
89	HORIZONTAL STABILIZER TIP INSTL	189N0001
	RADOME ASSY	284N1418
	NOSE LANDING GEAR DOOR INSTL	141N6900
	MAIN LANDING GEAR DOOR INSTL	149N6001
	APU DOOR INSTL	148N6660
	TAIL CONE INSTL	148N8301

LIST OF MATERIALS

Major Assembly and Installation Breakdown
Figure 1 (Sheet 2 of 2)

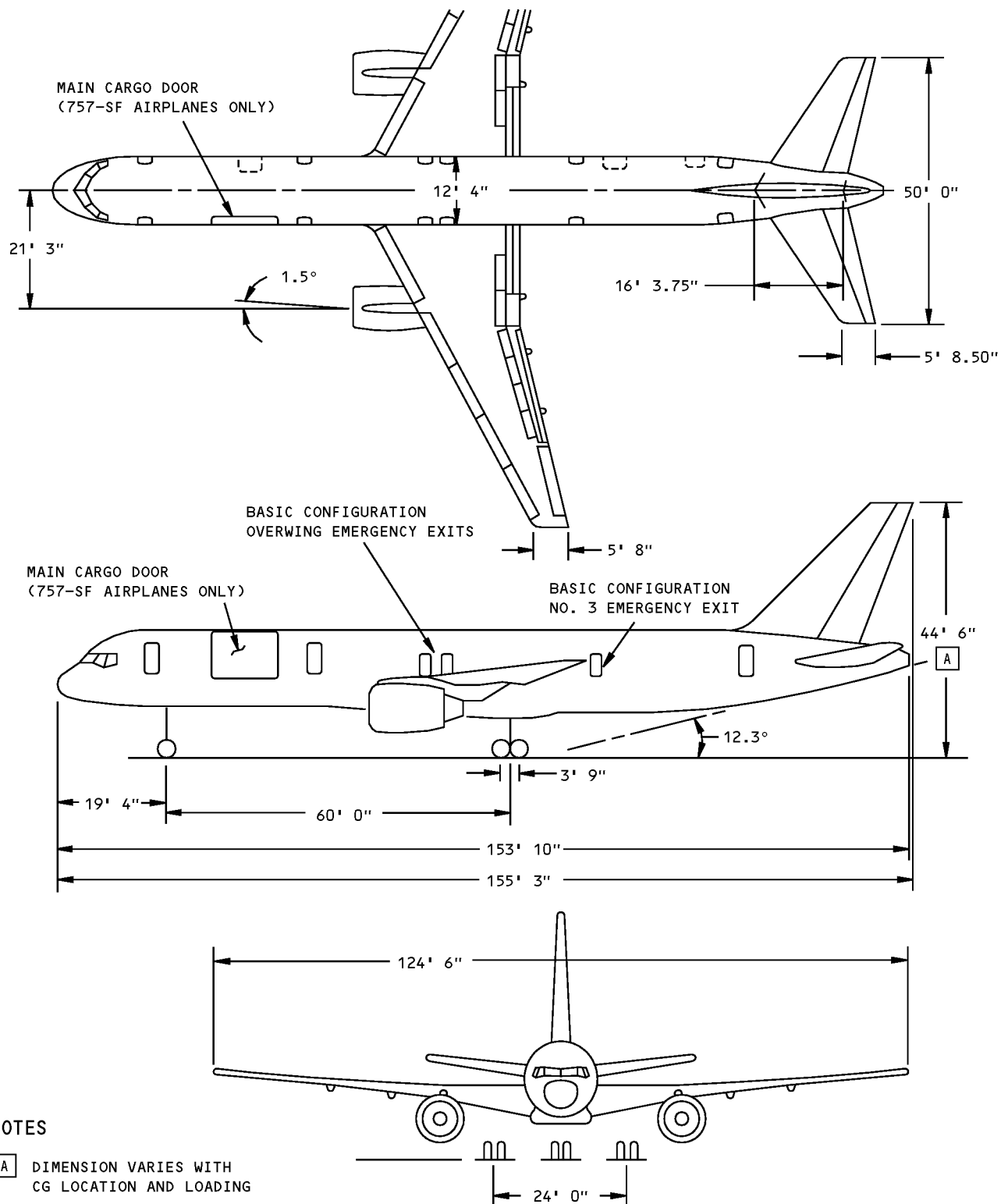
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GENERAL
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Jan 20/2005

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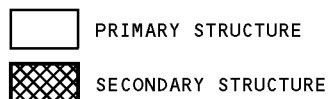
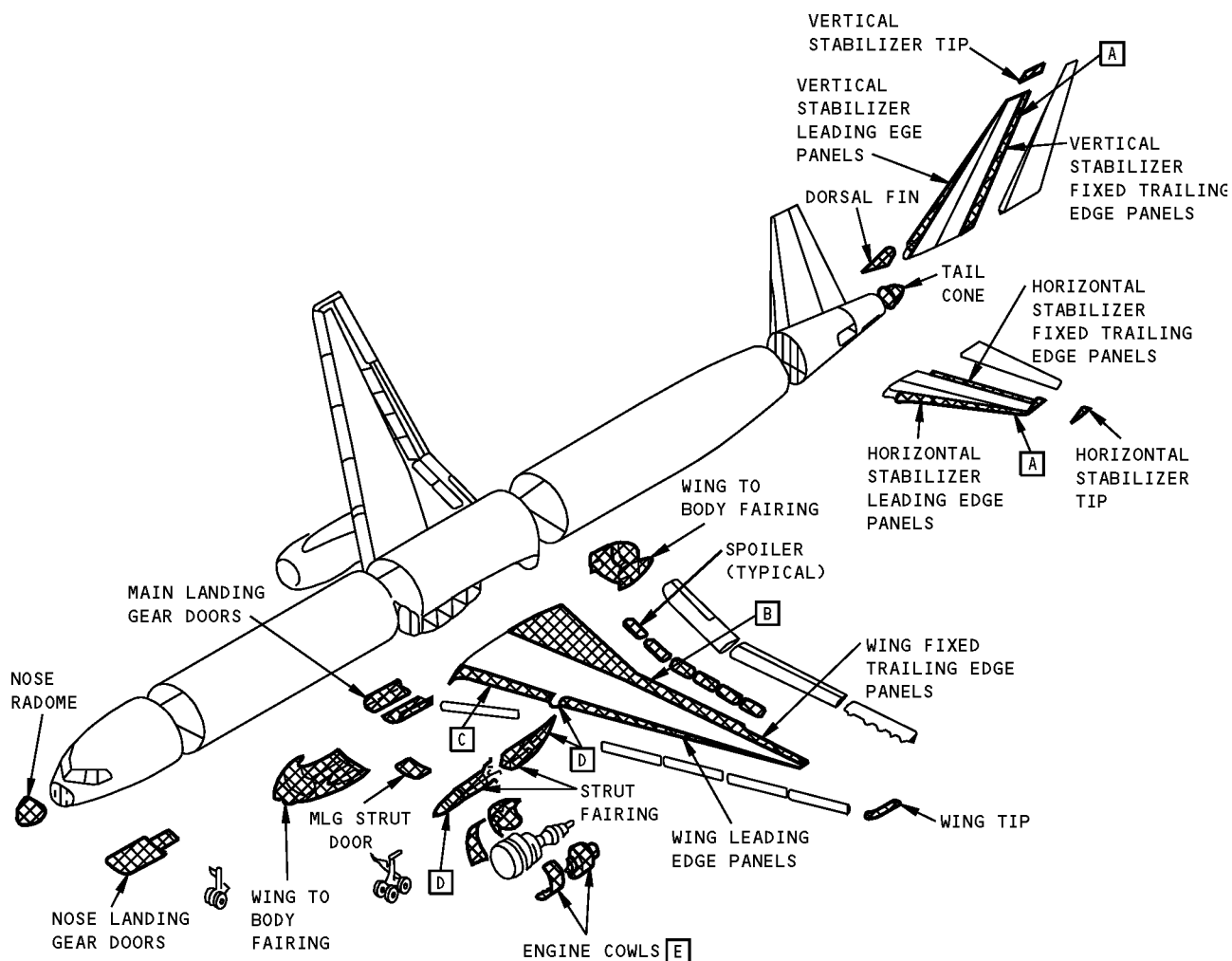
GENERAL - PRINCIPAL DIMENSIONS



**Principal Dimensions
Figure 1**

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GENERAL - STRUCTURAL CLASSIFICATION



Structural Classification Diagram
Figure 1 (Sheet 1 of 2)



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NOTES

- AREAS AS INDICATED ARE CLASSED AS SECONDARY STRUCTURE. (SEE ALSO NOTES [A] THRU [E].) THESE COMPONENTS, THOUGH NOT PRIMARY LOAD CARRYING UNITS, ARE SUBJECTED TO AERODYNAMIC LOADS. DAMAGE, WHICH MAY AFFECT PRIMARY STRUCTURE AND ENGINES OR ADVERSELY AFFECT AERODYNAMIC CHARACTERISTICS AND/OR SURFACE STIFFNESS, MUST BE EVALUATED
- WITHIN PRIMARY STRUCTURE ARE PRINCIPAL STRUCTURAL ELEMENTS (SEE FIGURE 2, TABLE I). PRINCIPAL STRUCTURAL ELEMENTS (PSE'S) ARE THOSE WHICH CONTRIBUTE SIGNIFICANTLY TO CARRYING FLIGHT, GROUND AND PRESSURIZATION LOADS

[A] HORIZONTAL AND VERTICAL STABILIZER FIXED TRAILING EDGE PANELS
PRIMARY STRUCTURE IN THIS AREA IS LIMITED TO THE ELEVATOR AND RUDDER SUPPORT STRUCTURE

[B] WING TRAILING EDGE
PRIMARY STRUCTURE IN THIS AREA IS DEFINED AS THAT STRUCTURE WHICH GIVES SUPPORT TO THE FLAPS, AILERONS, LANDING GEAR SUPPORT BEAM, AND LANDING GEAR TRUNNION

[C] WING LEADING EDGE
PRIMARY STRUCTURE IN THIS AREA IS LIMITED TO THE LEADING EDGE SLAT SUPPORT STRUCTURE

[D] ENGINE STRUT
SECONDARY STRUCTURE IN THIS AREA IS LIMITED TO THE STRUT FAIRING ONLY

[E] ENGINE INLET AND EXTERIOR PANELS, AND PRIMARY EXHAUST:
- INLET COWL LEADING EDGES, ACOUSTIC PANELS, AND INTERIOR SKIN PANELS ARE CLASSED AS SECONDARY STRUCTURE. HOWEVER THEIR FAILURE MAY CAUSE CRITICAL ENGINE DAMAGE
- OUTER SKIN AND ACCESS PANELS AFT OF THE INLET COWL LEADING EDGE ARE CLASSED AS SECONDARY STRUCTURE.

Structural Classification Diagram
Figure 1 (Sheet 2 of 2)



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STRUCTURAL AREA	STRUCTURAL ELEMENT
FUSELAGE	CREW WINDOW AND CABIN STRUCTURE CABIN WINDOWS WINDOW FORGINGS SKIN AT CORNERS OF WINDOW FORGINGS NO. 1L CREW AND PASSENGER ENTRY DOOR NO. 1L CREW AND PASSENGER ENTRY DOOR CUTOUT STRUCTURE NO. 1R GALLEY AND SERVICE DOOR NO. 1R GALLEY AND SERVICE DOOR CUTOUT STRUCTURE NO. 2L & R PASSENGER DOORS NO. 2L & R PASSENGER DOORS CUTOUT STRUCTURE NO. 3L & R EMERGENCY EXITS NO. 3L & R EMERGENCY EXITS CUTOUT STRUCTURE NO. 4L & R PASSENGER DOORS NO. 4L & R PASSENGER DOORS CUTOUT STRUCTURE NO. 1 CARGO DOOR NO. 1 CARGO DOOR CUTOUT STRUCTURE NO. 2 CARGO DOOR NO. 2 CARGO DOOR CUTOUT STRUCTURE NO. 3 CARGO DOOR (OPTIONAL INSTALLATION) NO. 3 CARGO DOOR (OPTIONAL INSTALLATION) CUTOUT STRUCTURE FORWARD ACCESS DOOR FORWARD ACCESS DOOR CUTOUT STRUCTURE ELECTRONICS BAY ACCESS DOOR ELECTRONICS BAY ACCESS DOOR CUTOUT STRUCTURE FUSELAGE BS 199.09 BULKHEAD (FORWARD PRESSURE) FUSELAGE BS 263.0 BULKHEAD (NOSE WHEEL WELL) FUSELAGE BS 324.0 BULKHEAD (NOSE WHEEL WELL) FUSELAGE BS 395.0 BULKHEAD (NOSE WHEEL WELL) FUSELAGE BS 900.0 BULKHEAD (FRONT SPAR) FUSELAGE BS 1040.0 BULKHEAD (REAR SPAR) FUSELAGE BS 1180.0 BULKHEAD (AFT WHEEL WELL) FUSELAGE BS 1720.0 BULKHEAD (AFT PRESSURE) UPPER LOBE TYPICAL FRAMES BS 420-900 AND BS 1180-1720 LOWER LOBE TYPICAL FRAMES BS 420-900 AND BS 1180-1720 OVERWING STUB FRAMES BS 920-1020 LANDING GEAR BEAM ATTACHMENT FRAME BS 1140 LANDING GEAR SIDE STRUT ATTACHMENT FRAME BS 1080 FRAMES BS 1060,1100,1120,1160 SECTIONS 41 THRU 47 FUSELAGE UPPER LOBE SKIN AND STRINGERS SECTIONS 41 THRU 47 FUSELAGE LOWER LOBE SKIN AND STRINGERS CIRCUMFERENTIAL SKIN AND STRINGER SPLICES BS 439,661,781,900,1180,1459,1621,1720 LONGITUDINAL SKIN LAP SPLICES NOSE AND MAIN LANDING GEAR SUPPORT STRUCTURES WHEEL WELL PRESSURE DECK BS 1040-1180 FLOOR BEAM STRUCTURE, FORWARD OF BS 900 AND BS 1200 - 1701 FLOOR STRUCTURE OVER NOSE & MAIN LANDING GEAR WHEEL WELL KEEL BEAM KEEL BEAM STIFFENER AND WEB ATTACHMENT TO WING STRINGER 18A AFT SHEAR DECK BS 1681.8-1720 CREASE BEAM (S-17) ALL SECTIONS LOWER LOBE, CARGO BULKHEADS SUPPORT STRUCTURE CABIN WINDOWS OVERWING EMERGENCY EXITS (OVERWING EXITS A/P ONLY)

TABLE I

Principal Structural Elements
Figure 2 (Sheet 1 of 5)



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STRUCTURAL AREA	STRUCTURAL ELEMENT
FUSELAGE (CONT)	MAIN DECK CARGO DOOR CUTOUT STRUCTURE (757-SF A/P ONLY) MAIN DECK CARGO DOOR (757-SF A/P ONLY) CARGO HANDLING SYSTEM AND FLOOR TRACKS (757-SF A/P ONLY) SECTION 48 PLATFORM FITTINGS STRINGER 2, BS 1720 TO BS 1806 SECTION 48 SKIN AND STRINGERS - BS 1720 TO BS 1896.20 PRESSURE BULKHEAD - BS 1720 FIN FRONT SPAR SUPPORT INTERCOSTAL AND TRANSVERSE FITTINGS BULKHEAD BS 1743.85 BULKHEAD BS 1768.30 BULKHEAD BS 1797.45 BULKHEAD BS 1862.45 UPPER LONGERON BS 1720 - BS 1885, STR 9L AND 9R STABILIZER PIVOT SUPPORT STRUCTURE APU FIREWALL BULKHEAD AND PLENUM ATTACHMENT JACK SCREW SUPPORT FITTING LOWER LONGERON BS 1720 - BS 1992.80 STRINGER 19 SERVICE AND PRESSURE RELIEF DOOR SERVICE AND PRESSURE RELIEF DOOR CUTOUT STRUCTURE APU INLET CUTOUT STRUCTURE

TABLE I

Principal Structural Elements
Figure 2 (Sheet 2 of 5)



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STRUCTURAL AREA	STRUCTURAL ELEMENT
EMPENNAGE	<p>FIN</p> <p>FRONT SPAR CHORDS, STIFFENERS, AND WEB</p> <p>REAR SPAR CHORDS, STIFFENERS, AND WEB</p> <p>FIN-TO-BODY ATTACH FITTINGS</p> <p>AFT TORQUE BOX HINGE RIBS AND SHEAR TIES</p> <p>AFT TORQUE BOX TYPICAL RIBS AND SHEAR TIES</p> <p>AFT TORQUE BOX SKINS AND STRINGERS</p> <p>RUDDER ACTUATOR SUPPORT FITTINGS</p> <p>RUDDER HINGE RIBS</p> <p>RUDDER HINGE PLATE FITTINGS</p> <p>RUDDER</p> <p>FRONT SPAR CHORDS, STIFFENERS, AND WEB</p> <p>REAR SPAR CHORDS, STIFFENERS, AND WEB</p> <p>SKIN</p> <p>ACTUATOR RIBS</p> <p>ACTUATOR FITTING</p> <p>HINGE RIBS</p> <p>HINGE ATTACHMENT FITTINGS</p> <p>STABILIZER</p> <p>FRONT SPAR CHORDS, STIFFENERS, AND WEB</p> <p>REAR SPAR CHORDS, FAILSAFE CHORD, STIFFENERS, AND WEB</p> <p>AFT TORQUE BOX SKIN AND STRINGERS</p> <p>CENTERLINE RIB NO. 1</p> <p>JACKSCREW FITTING</p> <p>PIVOT RIB</p> <p>PIVOT FITTING</p> <p>AFT TORQUE BOX RIBS AND SHEAR TIES</p> <p>ELEVATOR ACTUATOR SUPPORT FITTINGS</p> <p>ELEVATOR HINGE SUPPORT RIBS</p> <p>ELEVATOR TYPICAL HINGE FITTINGS</p> <p>ELEVATOR THRUST HINGE FITTINGS</p> <p>ELEVATOR</p> <p>FRONT SPAR CHORDS, STIFFENERS, AND WEB</p> <p>SKIN</p> <p>TYPICAL RIBS</p> <p>HINGE FITTINGS</p> <p>ACTUATOR FITTINGS</p> <p>ATTACHMENT POINTS</p> <p>FIN-TO-BODY BOLTS</p> <p>HORIZONTAL STABILIZER-TO-BODY HINGE PINS</p> <p>HORIZONTAL STABILIZER HINGE HOUSING BEARING</p> <p>JACKSCREW SUPPORT FITTING-TO-JACKSCREW GIMBLE</p>
WING	<p>CENTER SECTION FRONT SPAR CHORDS, WEB, AND STIFFENERS</p> <p>CENTER SECTION REAR SPAR CHORDS, WEB, AND STIFFENERS</p> <p>CENTER SECTION LOWER PANEL SKIN AND STRINGERS</p> <p>CENTER SECTION UPPER PANEL SKIN AND STRINGERS</p> <p>CENTER SECTION UPPER AND LOWER SKIN SPLICE STRINGERS</p> <p>CENTER SECTION SPANWISE BEAMS</p> <p>INTERNAL BEAM AT BL 38.9</p> <p>KEEL BEAM CHORDS AND FITTINGS</p> <p>REAR SPAR BREATHER BEAM AT BL 0.0</p> <p>OVER WING FLOOR BEAMS</p> <p>SIDE OF BODY RIB</p>

TABLE I (CONT)

Principal Structural Elements
Figure 2 (Sheet 3 of 5)

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STRUCTURAL AREA	STRUCTURAL ELEMENT
WING (CONT)	LOWER SURFACE SIDE OF BODY SPLICE UPPER SURFACE SIDE OF BODY SPLICE & WING-TO-BODY JOINT PLUS CHORD REAR SPAR AT SIDE OF BODY SPLICE AND TERMINAL FITTING FRONT SPAR AT SIDE OF BODY SPLICE AND TERMINAL FITTING REAR SPAR CHORDS, WEB, AND STIFFENERS FRONT SPAR CHORDS, WEB, AND STIFFENERS LOWER PANEL SKIN AND STRINGERS UPPER PANEL SKIN AND STRINGERS LOWER PANEL CUTOUTS SHEAR TIED RIBS TYPICAL RIBS UPPER AND LOWER SPANWISE SKIN SPLICE STRINGERS MAIN LANDING GEAR SUPPORT STRUCTURE ENGINE SUPPORT STRUCTURE TRAILING EDGE FLAPS - MAIN BOX TRAILING EDGE FLAP TRACKS AND SUPPORT STRUCTURE TRAILING EDGE FLAP MAIN CARRIAGES
POWER PLANT	FORWARD ENGINE MOUNT FITTINGS AND SUPPORT STRUCTURE AFT ENGINE MOUNT FITTINGS, LINKS, AND SUPPORT STRUCTURE THRUST LINKS AND SUPPORT STRUCTURE UPPER LINK AND UPPER SPAR FITTING MIDSPAR FITTINGS SIDEBRACE FITTINGS AND SIDE LINKS DIAGONAL BRACE AND LOWER SPAR FITTING MIDSPAR CHORDS
MAIN LANDING GEAR	OUTER CYLINDER INNER CYLINDER GLAND NUT METERING PIN ORIFICE PLATE NUT, ORIFICE PLATE FILLER CAP RETENTION RING DRAG BRACE PINS, DRAG BRACE TRUNNION LINK TRUNNION PIN FORWARD TRUNNION FUSE BOLT TORSION LINKS PINS, TORSION LINK TRUCK BEAM PIN, TRUCK PIVOT UPPER AND LOWER SIDE STRUT REACTION LINK PINS, REACTION LINK SUPPORT LINK UPPER AND LOWER SWIVEL ASSY STABILIZER LINK PIN, STABILIZER LINK UPPER AND LOWER DOWNLOCK LINK PINS, DOWNLOCK LINK SPINDLE PIN, RETRACT ACTUATOR

TABLE I (CONT)

**Principal Structural Elements
Figure 2 (Sheet 4 of 5)**



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STRUCTURAL AREA	STRUCTURAL ELEMENT
NOSE LANDING GEAR	OUTER CYLINDER INNER CYLINDER TORSION LINKS PINS, TORSION LINK STEERING COLLAR STEERING SUPPORT PLATES NUT, STEERING COLLAR STEERING SUPPORT PLATES NUT, STEERING COLLAR PIN, STEERING ACTUATOR GLAND NUT BULKHEAD RETAINER SEAL TRUNNION PINS METERING PIN ORIFICE PLATE NUT, ORIFICE PLATE UPPER AND LOWER DRAG BRACE PINS, DRAG BRACE FORWARD AND AFT LOCK LINK PINS, LOCK LINK PINS, RETRACT ACTUATOR

TABLE I (CONT)

Principal Structural Elements
Figure 2 (Sheet 5 of 5)



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GENERAL - CROSS REFERENCES FOR BOEING SOURCE DOCUMENTS

1. References

Reference	Title
51-10-02, GENERAL	Inspection and Removal of Damage
51-20-02, GENERAL	Heat Treat Verification - Hardness and Conductivity Testing
51-20-05, GENERAL	Repair Sealing
51-20-06, GENERAL	Shot Peening
51-20-07, GENERAL	Freeze Plug Installation
51-30-01, GENERAL	Sheet Metal Materials
51-40-02, GENERAL	Fastener Installation and Removal
51-40-05, GENERAL	Fastener Hole Sizes
51-40-08, GENERAL	Countersinking
51-40-09, GENERAL	Coldworking of Holes for Fatigue Improvement
51-70-09, GENERAL	Metal-to-Metal Structural Repair Adhesive Bond Procedures
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
DOCUMENT D-18888-1	Boeing Process Specifications

2. General

- A. Some Chapter 51 data has been derived from the Boeing Process Specifications document, DOCUMENT D-18888-1, and other Boeing source documents. Refer to Table 1/GENERAL for a list of these source documents and the SRM ATA Number where the data is incorporated. If the source document is only referred to in an SRM ATA, the source document will not be listed.

Table 1: Cross References for Boeing Source Documents

ATA NUMBER	SOURCE DOCUMENT	SUBJECT
51-10-02, GENERAL	D6-9002	Appearance Control of Clad Aluminum Exterior Skins
51-20-02, GENERAL	BAC 5946	Temper Inspection of Aluminum
51-20-05, GENERAL	BAC 5000 BACD2027	Fay and Fillet Seals Countersink Symbols and Dimensions
51-20-06, GENERAL	BAC 5730	Shot Peening
51-20-07, GENERAL	BAC 5063	Fastener Installation in Composite Structure
51-30-01, GENERAL	BAC 5300	Forming, straightening, and Fitting of Metal Parts
51-40-02, GENERAL	BAC 5004-1 BAC 5004-2 BAC 5004-3 BAC 5009 BAC 5047 BAC 5060 BAC 5063	Installation of Solid Rivets Installation of Permanent Straight Shank Fasteners Installation of Blind Fasteners Bolt and Nut Installation Installation of Fluid-Tight Fasteners Installation of Interference Fit, Radius Lead-in Fasteners Fastener Installation in Composite Structure
51-40-05, GENERAL	BAC 5004-2 BAC 5009 BAC 5060 BAC 5063	Installation of Permanent Straight Shank Fasteners Bolt and Nut Installation Installation of Interference Fit, Radius Lead-in Fasteners Fastener Installation in Composite Structure



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Table 1: Cross References for Boeing Source Documents (Continued)

ATA NUMBER	SOURCE DOCUMENT	SUBJECT
51-40-05, GENERAL	BAC 5004-1 BAC 5004-2 BAC 5004-3 BAC 5009 BAC 5047 BAC 5060 BAC 5063	Installation of Solid Rivets Installation of Permanent Straight Shank Fasteners Installation of Blind Fasteners Bolt and Nut Installation Installation of Fluid-Tight Fasteners Installation of Interference Fit, Radius Lead-in Fasteners Fastener Installation in Composite Structure
51-40-08, GENERAL	BACD2027 BAC 5004-1 BAC 5004-2 BAC 5004-3 BAC 5009 BAC 5047 BAC 5060 BAC 5063	Countersink Symbols and Dimensions Installation of Solid Rivets Installation of Permanent Straight Shank Fasteners Installation of Blind Fasteners Bolt and Nut Installation Installation of Fluid-Tight Fasteners Installation of Interference Fit, Radius Lead-in Fasteners Fastener Installation in Composite Structure
51-40-09, GENERAL	BAC 5768 BAC 5973	Mandrel Cold Working of Holes in Aluminum Sleeve Cold Working of Holes in Aluminum
51-70-09, GENERAL	D6-48758 BAC 5514 BAC 5514-589 BAC 5555	Structural Repair Bonding Common Bonding Requirements for Structural Adhesives Application of Corrosion Inhibiting Adhesive Primer Phosphoric Acid Anodizing of Aluminum for Structural Repair Bonding
51-70-14, GENERAL	BAC 5056 BAC 5598	Fabrication of Flame-Sprayed Aluminum Coatings Bonding Aluminum Foil to Composite Parts



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GENERAL - STRUCTURAL REPAIR DEFINITIONS

1. Applicability

- A. This subject gives the definitions related to repair classification and inspection for damage-tolerant and non-damage tolerant primary or secondary structures as applicable.

2. References

Reference	Title
51-10-02, GENERAL	Inspection and Removal of Damage
SOPM 20-20-01	Magnetic Particle Inspection
SOPM 20-20-02	Penetrant Methods of Inspection

3. General

- A. The SRM is being updated incrementally to account for damage tolerance analysis improvements, testing, experience, Non-Destructive Inspection (NDI) technology improvements etc. As part of the update, new terminology will be introduced as defined below. When the update is complete, all repairs to Principal Structural Elements (PSE) will be classified as defined in Paragraph 3.B./GENERAL. During the transition, both types of terminology will exist.
- B. The following definitions will be incrementally introduced for repairs to Principal Structural Elements (PSE) which require a damage tolerance analysis:
- (1) Category A Repair: A permanent repair for which the inspections given in the Maintenance Planning Data (MPD) document, are sufficient and no other actions are necessary.
 - (2) Category B Repair: A permanent repair for which supplemental inspections are necessary at the specified threshold and repeat intervals.
 - (3) Category C Repair: A time-limited repair which must be replaced or reworked within a specified time limit. Also supplemental inspections can be necessary at a specified threshold and repeat interval.
- C. The following definitions will be used for repairs which are not critical for damage tolerance or have not yet been updated during the transition period discussed above:
- (1) Permanent Repair: A repair where no action is necessary except the operator's normal maintenance.
 - (2) Interim Repair: A repair that has the necessary structural strength and could stay on the airplane indefinitely. The repair must be inspected at specified intervals and replaced if deterioration is detected or damage is found
 - (3) Time-Limited Repair: A repair that has the necessary structural strength but does not have sufficient durability. This repair must be replaced after a specified time, usually given as a number of flight cycles, flight hours or a calendar time
- D. The definitions of the terms as they apply to the repairs are as follows:
- (1) Damage Tolerance: The ability of structure to sustain anticipated loads in the presence of damage, such as fatigue cracks until it is detected through inspection or malfunction and repaired.
 - (2) Damage Tolerant Repair: A repair that meets the necessary damage tolerance conditions.
 - (3) Repeat Intervals: The period in flight cycles, flight hours or calendar time that occurs between the necessary inspections.

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- (4) Supplemental Inspections: Special inspections of the repaired structure which are done in addition to an operator's normal maintenance inspections.
- (5) Threshold: The period in flight cycles, flight hours or calendar time from the time an airplane is delivered or a repair is made until the first supplemental inspection is necessary. For Category B repairs, the threshold starts from the time the repair was installed if the repair fasteners in the critical rows have been installed in new fastener holes or existing fastener holes that have been zero-timed. If the repair fasteners are installed in existing fastener holes that have not been zero-timed, the inspection threshold will start from the time the airplane was delivered.
- (6) Time Limit: The maximum period in flight cycles, flight hours or calendar time that is permitted until it is necessary to replace or rework a time-limited repair.
- (7) Zero-Timing: The process used to improve the repair durability in order to make the inspection threshold start from the time the repair is installed. This involves the removal of small cracks and fatigue damaged material by oversizing the existing fastener holes before the repair is installed as given in 51-10-02, GENERAL. Zero-timing must only be used where specifically permitted in an SRM chapter-section-repair. Also zero-timing must not cause short edge-margins, or short fastener spacing, or knife-edging of the fastened material at the location of the repair fasteners.
- (8) Critical Fastener Row: Fastener row to be inspected to meet damage tolerance requirements.
- (9) Zonal Inspection: General visual or surveillance inspection of each airplane zone, defined by access and area as given in the Maintenance Planning Data (MPD) document, to check system and powerplant installation and structure for security and general condition.
- (10) Types of Inspections:
 - (a) General Visual Inspection: A visual check of the exposed areas of the wing surface, fuselage, doors and door cutouts, and wheel wells that are visible without the use of ladders, workstands, etc.
 - (b) Surveillance Inspection: A visual check that will detect obvious unsatisfactory conditions, discrepancies in externally visible or internal structure or system and powerplant items. This type of inspection may require removal of fillets, fairings, access panels, doors, etc. Adequate lighting and normal inspection aids are to be used as required, such as a flashlight and/or inspection mirror.
 - (c) Detailed Inspection: An intensive visual examination of a specific structural area, system, installation or assembly to detect damage, failure or irregularity. Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate by the inspector. Inspection aids such as mirrors, magnifying lenses, etc. may be used. Surface cleaning and elaborate access procedures may be required.
 - (d) Special Detailed (Non-Destructive Testing) Inspection: An intensive examination of a specific item(s), installation, or an assembly to detect damage, failure or irregularity. The examination is likely to make extensive use of specialized inspection techniques and/or equipment. Intricate cleaning and substantial access or disassembly procedure may be required. Non-Destructive Testing (NDT) inspections are used to examine all subsurface damage and most small cracks. NDT is also used in areas where a visual inspection is not sufficient to find the dimensions of damage. NDT procedures recommended for use in the SRM are as follows:
 - 1) Eddy Current: An NDT procedure which uses eddy currents find damage in metals that have good conductivity properties. The eddy current inspection is the preferred NDT procedure used to find most damage on metal parts. The three types of eddy current inspections used in the SRM are as follows:



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- a) High Frequency Eddy Current (HFEC) Inspection: Used to find surface cracks, porosity, and corrosion.
- b) Medium Frequency Eddy Current (MFEC) Inspection: Used to find subsurface cracks in the first layer that start and grow along the faying surface. It also will detect surface cracks.
- c) Low Frequency Eddy Current (LFEC) Inspection: Used to find surface cracks, and corrosion. Refer to Part 6 of the NDT Manual for the Eddy Current inspection procedures.
- 2) Ultrasonic: An NDT procedure which uses sound waves to find surface and subsurface damage (cracks, porosity, delamination, or disbonds, for example) on metal and composite materials that have good permeability properties. Refer to Part 4 of the NDT Manual for the Ultrasonic inspection procedures.
- 3) Resonance Frequency: A tap test NDT procedure that can be used to find delaminations and interply disbonds in composite, honeycomb or bonded structures that have thin skins. Refer to Part 1 of the NDT Manual for the Resonance Frequency inspection procedures.
- 4) X-Ray: An NDT procedure that uses radiography to find cracks and damage (disbonds, for example) in metallic and composite structures which cannot be accessed for visual inspection. X-Rays can identify if fluids are inside honeycomb parts and can be used to identify the dimensions of the damage. Refer to Part 2 of the NDT Manual for the X-Ray inspection procedures.
- 5) Magnetic Particle: An NDT procedure that applies a magnetic field to a ferro-magnetic part which has fine magnetic particles on the surface. The magnetic field causes the magnetic particles to group together in areas that have cracks on or near the surface. Refer to SOPM 20-20-01 for the magnetic particle inspection procedures.
- 6) Penetrant: Penetrant examination uses the property of a liquid to go into a defect that is open at the surface of the part. The liquid is applied to the surface and permitted to soak in. A developer is applied to pull the liquid out of the defect so it can be seen. Visible penetrants are examined under white light. Fluorescent penetrants are examined under ultraviolet light. Refer to SOPM 20-20-02 for the penetrant inspection procedures.



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NOTE: The data for the Inspection and Removal of Damage has moved to 51-10-02, GENERAL.



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GENERAL - AERODYNAMIC SMOOTHNESS REQUIREMENTS

1. General

- A. The 757 airplane requires an aerodynamically clean shape and smooth exterior for high performance. Unrepaired damage, unfilled dents (51-70-01, REPAIR 1) or repairs which change the shape or roughen the surface will be reflected in reduced performance. Every effort should be made to maintain original contour and exterior surface smoothness.
- B. Exterior surface aerodynamic smoothness is classified in two categories: critical and noncritical (Figure 1/GENERAL).
- (1) Critical aerodynamic surfaces are those surfaces which require a high degree of aerodynamic smoothness. Figure 1/GENERAL illustrates the critical surfaces as follows:
- (a) Fuselage nose to fuselage station 1180.
 - (b) Wing upper surface from leading edge to rear spar centerline and wing lower surface from leading edge to front spar centerline.
 - (c) Nacelle and pylon areas as shown in Figure 6/GENERAL. Refer to 51-11-01, GENERAL for RB211-535C nacelle critical aerodynamic surfaces.
 - (d) Vertical stabilizer, right and left surfaces, from leading edge to centerline of rear spar.
 - (e) Horizontal stabilizer, upper and lower surfaces, from leading edge to centerline of rear spar.
- (2) Protect the finish from scuffing, scratches and other damage on the critical upper surfaces by wearing soft soled shoes and by covering the areas adjacent to the work area. Refer to 51-20-0 of the 757 Maintenance Manual for finish requirements. Repair all scuffed or damaged finish as soon as possible.
- (3) Skin repairs in the regions of critical aerodynamic smoothness should be of the flush type to maintain optimum performance; but external repairs may be used providing the limitations in the regions of the static pressure ports and angle of attack sensors are observed (Figure 7/GENERAL). Accumulation of external repairs can result in significant performance penalty.
- C. All other exterior surfaces of the airplane are considered as noncritical. The smoothness criteria that apply to flush and external repairs in the various areas of the airplane are illustrated in Figure 1/GENERAL.
- D. Refer to 51-10-03, GENERAL if the airplane is approved for Reduced Vertical Separation Minimum (RVSM) operation and has damage near the primary static ports.

2. References

Reference	Title
51-10-03, GENERAL	Skin Waviness Inspection for Reduced Vertical Separation Minimum (RVSM) Operation
51-11-01, GENERAL	Aerodynamic Smoothness - RB211-535 Engine Nacelle
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-70-01, REPAIR 1	Procedures to Rework Allowable Dents on the External Aerodynamic Surfaces of Metallic Parts

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3. Joints and Fasteners - Critical Areas

- A. Except for the longitudinal lap splices of fuselage skins, all joints are flush within the regions of critical aerodynamic smoothness. Close control must be exercised to maintain head protrusion within the limits of Figure 3/GENERAL, Figure 4/GENERAL, Figure 5/GENERAL and Figure 6/GENERAL. All skin gaps and protruding permanently installed bolts and screws should be filled and faired with aerodynamic smoother (BMS 5-95) as detailed in AMM 51-20-05. Use aerodynamic smoother (BMS 5-79) in areas which may come in contact with jet fuel.

4. Joints and Fasteners - Noncritical Areas

- A. At all joints, except around some frequently used access panels, apply aerodynamic smoother. Chordwise lap joints are allowed aft of the wing rear spar and on control surfaces. Fastener flushness tolerances are sometimes greater in noncritical areas. No filler is required on screw and boltheads.

5. Fastener Flushness Tolerances

NOTE: In all areas, height measurements for all fasteners are made from the structural aerodynamic surface to the highest point on the fastener head. There is no differentiation between hand-installed and machine-installed rivets.

A. Fastener flushness tolerances for Flush - Shear Head Rivets

- (1) In CRITICAL Areas of the Wing, Empennage, and Nacelle / Strut, the Tolerances will be:

- 90% = +.001 to +.004
- 10% = +.0005 to +.006
- All others will be shaved flush +.001 to +.003

- (2) In NON-CRITICAL Areas of the Wing, Empennage, and Nacelle / Strut, the Tolerances will be:

- 90% = +.001 to +.005
- 10% = +.001 to +.007
- All others will be driven flush within -.002 to +.007 and may be shaved flush +.001 to +.003

NOTE: Micro Shaving is not permitted for reduced shear head rivets such as BACR15CE, BACR15GF or BACR15FV (as given in BAC5004-1).

B. Fastener Tolerances for Hex-Drive Bolts and Lockbolts

- (1) Fastener flushness for BACB30WQ bolts = +.0055 ± .003.

- (2) In EXTRA-CRITICAL Areas of the Wing, Empennage, and Nacelle / Strut, the Tolerances will be:

- 90% flat-head Hex-Drive Bolts and Lockbolts flush within = ± .003
- 10% flat-head Hex-Drive Bolts and Lockbolts = -.005 to +.003
- Dome-head Hex-Drive Bolts and Lockbolts flush within +.0025 - .002 +.003.003.

- (3) In CRITICAL Areas of the Wing, Empennage, and Nacelle / Strut, the Tolerances will be:

- 90% flat-head Hex-Drive Bolts and Lockbolts flush within = ± .003
- 10% flat-head Hex-Drive Bolts and Lockbolts = -.005 to +.003
- Dome-head 5/32 (-5) and 3/16 (-6) Hex-Drive Bolts and Lockbolts flush within +.0045 ± .003.
- Dome-head 1/4 (-8) , 5/16 (-10) Hex Drive Bolts and Lockbolts flush within +.0055 ± .003

- (4) In NON-CRITICAL Areas of the Wing, Empennage, and Nacelle / Strut, the Tolerances will be:

- All flat-head Hex-Drive and Lockbolts flush within +.0045 ± .003
- Dome-head 5/32 (-5) and 3/16 (-6) Hex-Drive Bolts and Lockbolts flush within +.0045 ± .003
- Dome-head 1/4 (-8) , 5/16 (-10) Hex Drive Bolts and Lockbolts flush within the +.0055 ± .003



757-200 STRUCTURAL REPAIR MANUAL

- C. Fastener flushness tolerances for CRITICAL and NON-CRITICAL areas of the fuselage for CE, GF and FV type rivets are as follows:

- A minimum of 90% flush within $+.001$ to $+.006$
- A maximum of 10% may be flush within $+.0061$ to $+.008$.

NOTE: There is no differentiation between hand-installed and machine-installed rivets.

6. Aerodynamic Smoothness Requirements

A. Fuselage

- (1) See Figure 3/GENERAL for details of smoothness requirements of fuselage and see Figure 7/GENERAL for smoothness requirements and for limitation on repairs in region of static pressure ports and angle of attack sensors.
- (2) Refer to 51-10-03, GENERAL if the airplane is approved for Reduced Vertical Separation Minimum (RVSM) operation and has damage near the primary static ports.

B. Horizontal and Vertical Stabilizer

- (1) See Figure 4/GENERAL for details of smoothness requirements of stabilizers.

C. Wing

- (1) See Figure 5/GENERAL for details of smoothness requirements of wing.

D. Nacelle and Pylon

- (1) See Figure 6/GENERAL for smoothness requirements of nacelle and pylon for PW2000 series engines. Refer to Figure 6/GENERAL for smoothness requirements of pylon for RB211-535 engine. Refer to 51-11-01, GENERAL for smoothness requirements of nacelle for RB211-535 engine.

7. Microshaving of Aluminum Alloy Rivets

- A. A rivet microshaver shown in Figure 2/GENERAL is used to shave aluminum alloy rivets to meet surface flushness requirements. The microshaver is a pistol-grip air motor with an adjustable microstop. A cutter shaves the rivet head to within 0.002 inch of the sheet surface. Spring-loaded rubber feet, mounted in a free-turning stabilizer, prevent slipping of the cutter.

- B. When shaving rivets, the following practices must be observed in order to maintain rivet strength:

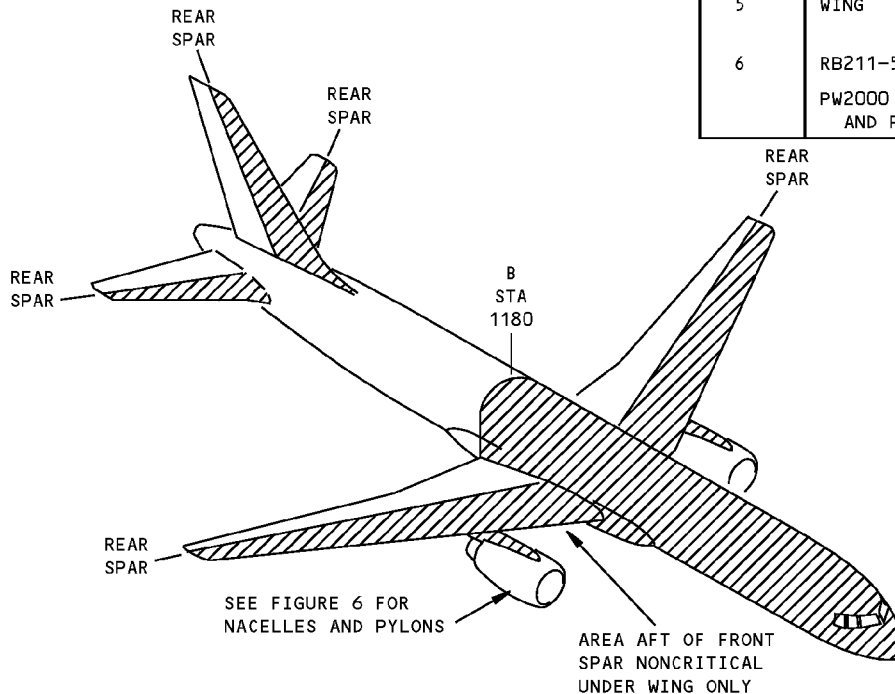
- (1) Head protrusion shall not exceed H in Figure 2/GENERAL, Table II after driving and prior to shaving.
- (2) Head diameter shall not be less than D in Figure 2/GENERAL, Table II, after shaving.
- (3) Select a cutter larger in diameter than the rivet head. See Figure 2/GENERAL, Table I for recommended cutter diameters.

WARNING: DISCONNECT THE MICROSHAVER FROM THE AIR SOURCE BEFORE YOU ADJUST OR TOUCH THE CUTTER. IF YOU DO NOT, INJURY TO PERSONS CAN BE THE RESULT.

- (4) Adjust the stop of shaver to extend 0.001 to 0.002 inch beyond the cutter and test this setting on scrap stock prior to use, to avoid damaging sheet surface.
- (5) Use steady pressure on the tool to obtain a constant speed.
- (6) Rock the shaver lightly on contoured surface to trim all edges of the rivet.
- (7) Refinish the shaved rivet heads as given in 51-20-01, GENERAL.

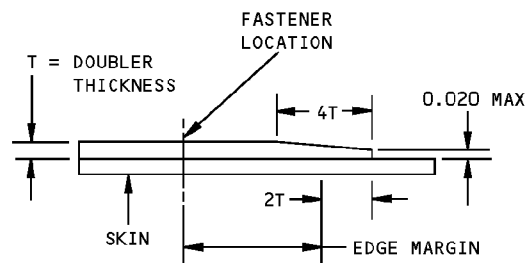
757-200 STRUCTURAL REPAIR MANUAL

FIGURE	DESCRIPTION	REFERENCE DRAWING
3,7	FUSELAGE	140N1580
4	EMPENNAGE	170N1530
5	WING	110N3201 69-16254
6	RB211-535 PYLON PW2000 SERIES AND PYLON	311N5003 300N3000



CRITICAL AREA
HIGH DEGREE OF AERODYNAMIC
SMOOTHNESS REQUIRED

CAUTION: SOFT SOLED SHOES OR RUBBER
OVERSHOES MUST BE WORN WHEN
WORKING OR WALKING IN CRITICAL
AREAS TO PREVENT SCUFFING OR
DAMAGE TO SKIN.



CHAMFERED EXTERNAL PATCH (TYPICAL) [A]

NOTES

- SURFACE FINISH IN CRITICAL AREAS SHALL BE 130 MICROINCHES (0.03 CUTOFF) OR BETTER EXCEPT AS NOTED.
- SURFACE FINISH IN NONCRITICAL AREAS SHALL BE 180 MICROINCHES (0.03 CUTOFF) OR BETTER EXCEPT AS NOTED.

- SEE FIG. 7 FOR SMOOTHNESS REQUIREMENTS AND FOR LIMITATIONS ON REPAIRS IN REGION OF STATIC PRESSURE PORTS AND ANGLE OF AIRFLOW SENSORS.

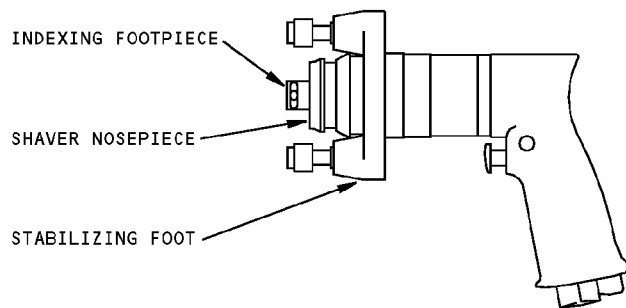
[A] FOR OPTIMUM PERFORMANCE REPLACE AN EXTERNAL REPAIR WITH A FLUSH REPAIR IN A REGION OF AERODYNAMIC SMOOTHNESS.

Aerodynamic Smoothness - Critical Areas
Figure 1

757-200 STRUCTURAL REPAIR MANUAL

MICROSHAVER CUTTER DIMENSIONS	
RIVET DIA	CUTTER DIA
1/8	0.375
5/32	0.500
3/16	0.500
1/4	0.625
5/16	0.750
3/8	1.00

TABLE I

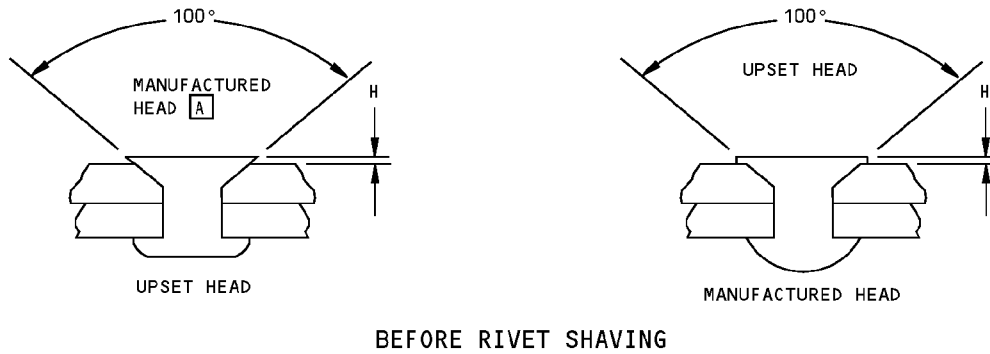


MICROSHAVER

MICROSHAVER MODEL	MANUFACTURER
ZT306 ZT405 ZT208 (ELECTRIC)	ZEPHYR MANUFACTURING CO. INC. 201 HINDRY AVE. P.O. BOX 759 INGLEWOOD, CALIFORNIA 90307
TD-300-OAD TD-300A-OAID TD-300-OAID	INGERSOLL-RAND CO. PAINTED POST PLANT HAMILTON ST. PAINTED POST, NEW YORK 14870

Microshaving of Aluminum Alloy Rivets
Figure 2 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- [A] DO NOT MICROSHAVE BACR15CE, BACR15DS, AND NAS1097 100° SHEAR HEAD RIVETS. DO NOT MICROSHAVE BACR15FV AND MS14218 120° MODIFIED HEAD RIVETS IF INSTALLED FOR THE FIRST TIME. OVERSIZE BACR15FV AND MS14218 RIVETS MAY BE MICROSHAVED IF THE SKIN IS THIN. REFER TO 51-40-02, PARA. 2.

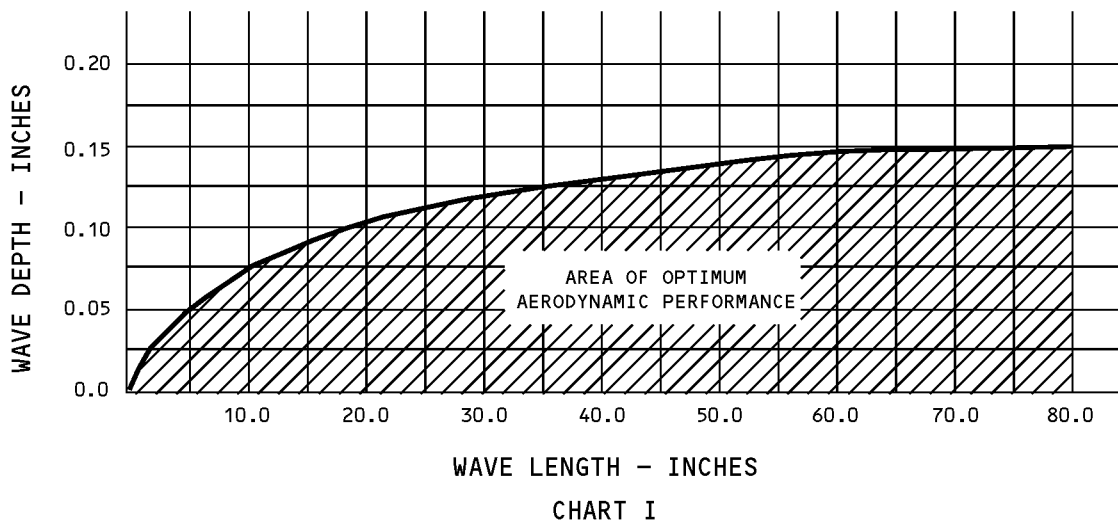
RIVET HEAD SHAVING DIMENSIONS		
RIVET DIA	BEFORE SHAVING	AFTER SHAVING
	H MAX	MINIMUM DIAMETER D
		STD CSK
	100°	100°
1/8	0.007	0.204
5/32	0.009	0.262
3/16	0.010	0.326
1/4	0.012	0.443
5/16	0.014	0.526
3/8	0.016	0.650

TABLE II

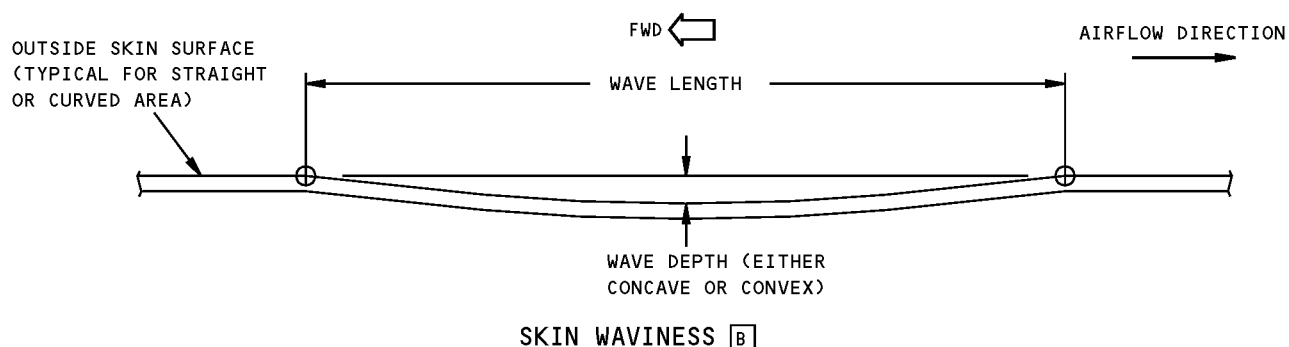


Microshaving of Aluminum Alloy Rivets
Figure 2 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL



FOR BOTH STRAIGHT AND CURVED AREAS SKIN SMOOTHNESS OVER CONTINUOUS SKIN IN THE CRITICAL AND NONCRITICAL REGIONS SHALL BE WITHIN INDICATED LIMITS ON CHART I, ABOVE. IF THE DEPTH-TO-WAVE LENGTH ACTUAL VALUES ARE ABOVE THE GIVEN PLOT LINE, REFER TO **A**.



Aerodynamic Smoothness - Fuselage
Figure 3 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL

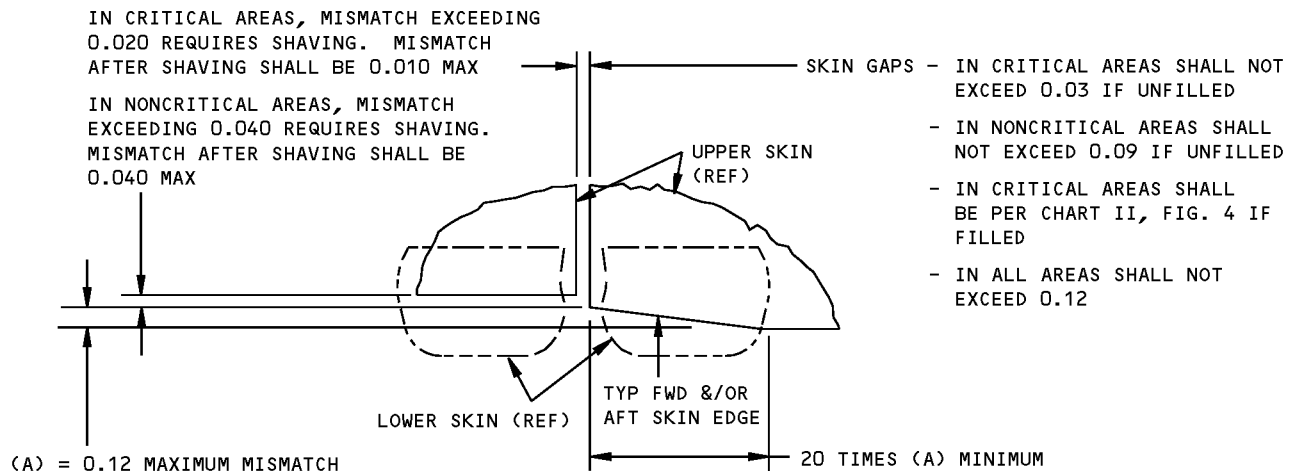
NOTES

- DO NOT SHAVE STEEL OR TITANIUM FASTENERS, BACR15CE RIVETS, OR BACR15FV (BRILES) RIVETS. BRILES RIVET HEADS MAY BE SHAVED ONLY IF OVERSIZED RIVETS ARE INSTALLED IN REWORKED HOLES. REFER TO SRM 51-40-02 FOR REWORK OF EXISTING BRILES RIVET INSTALLATIONS.
- FOR DETAILS OF CRITICAL AND NONCRITICAL AREAS, SEE FIGURE 1.
- SEE DETAILS I AND II FOR DETERMINING FLUSHNESS OF BACR15CE AND BACR15FV (BRILES) RIVETS.

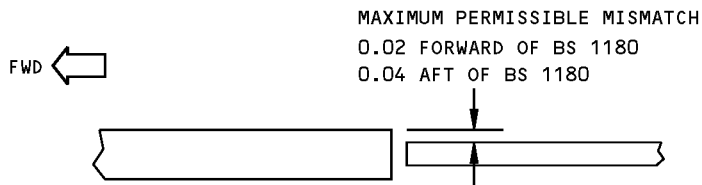
- SURFACE FINISH IN CRITICAL AREAS SHALL BE 130 MICROINCHES (0.30 CUTOFF) OR BETTER.
- SURFACE FINISH IN NON-CRITICAL AREAS SHALL BE 180 MICROINCHES (0.30 CUTOFF) OR BETTER.

[A] IF THE SKIN SMOOTHNESS IS WITHIN THE LIMITS OF SRM 53-00-01, FIG. 101, DETAIL III BUT MORE THAN THE SKIN WAVINESS LIMIT SHOWN IN CHART I, THE AIRPLANE CAN STILL FLY, BUT A LOSS OF AERODYNAMIC PERFORMANCE WILL OCCUR.

[B] THE SKIN WAVINESS LIMITS THAT ARE SHOWN ARE FOR OPTIMUM PERFORMANCE. FUEL CONSUMPTION WILL BE MORE WHEN THE SKIN WAVINESS IS MORE THAN THE LIMITS.



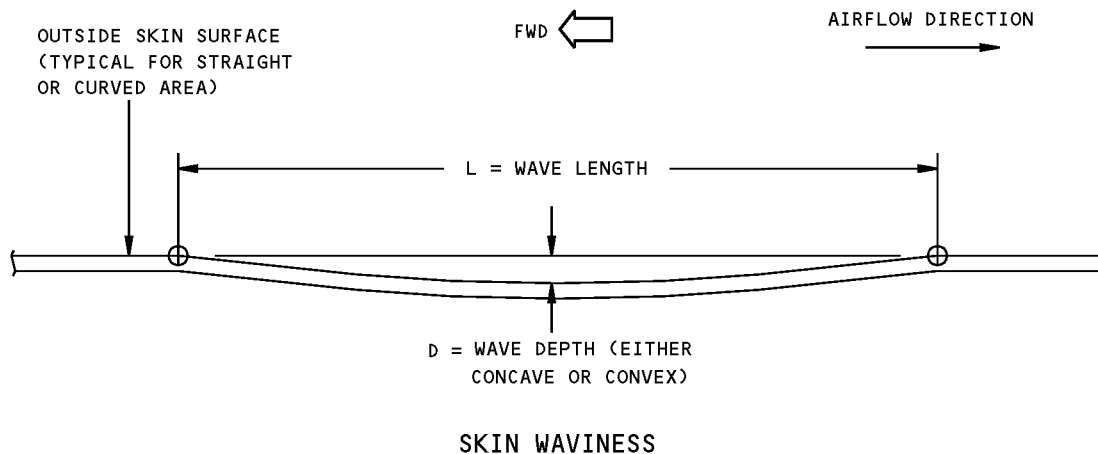
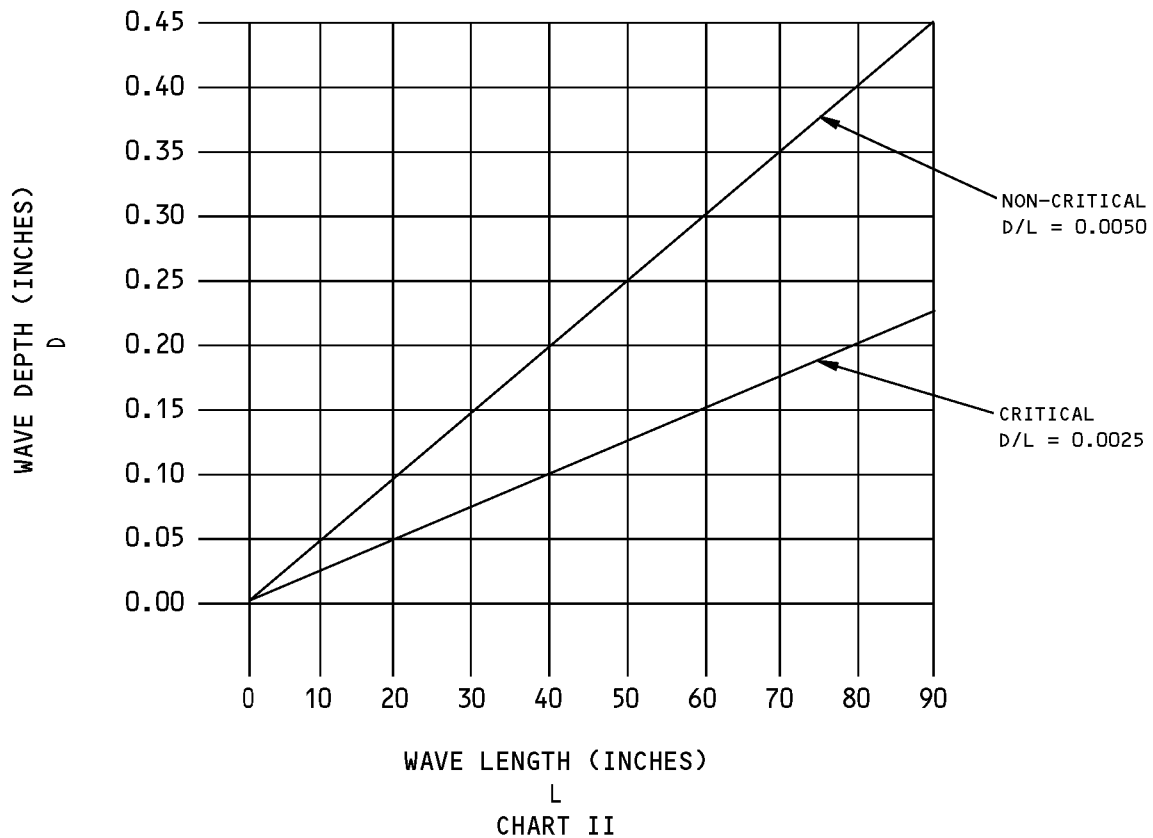
PERMISSIBLE MISMATCH AND GAP OF SKIN EDGES



PERMISSIBLE MISMATCH AT SKIN BUTT JOINTS

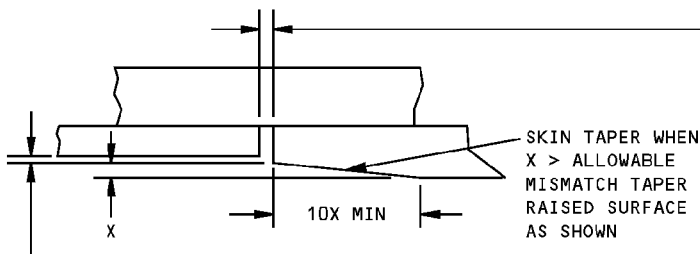
Aerodynamic Smoothness - Fuselage
Figure 3 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL



Aerodynamic Smoothness - Horizontal and Vertical Stabilizer
Figure 4 (Sheet 1 of 3)

757-200 STRUCTURAL REPAIR MANUAL



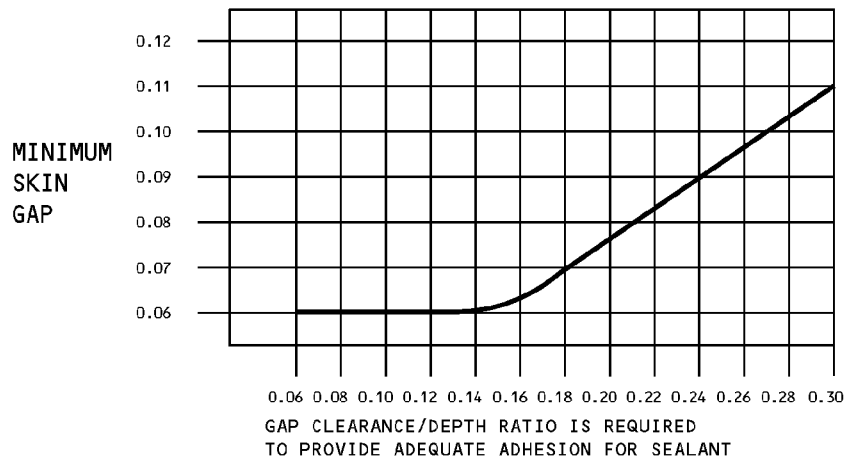
SKIN GAPS -

- IN NONCRITICAL AREAS SHALL NOT EXCEED 0.09 IN WIDTH IF UNFILLED
- IN CRITICAL AREAS SHALL NOT EXCEED 0.03 IN WIDTH IF UNFILLED
- IN CRITICAL AREAS FILLED GAPS SHALL BE PER CHART II

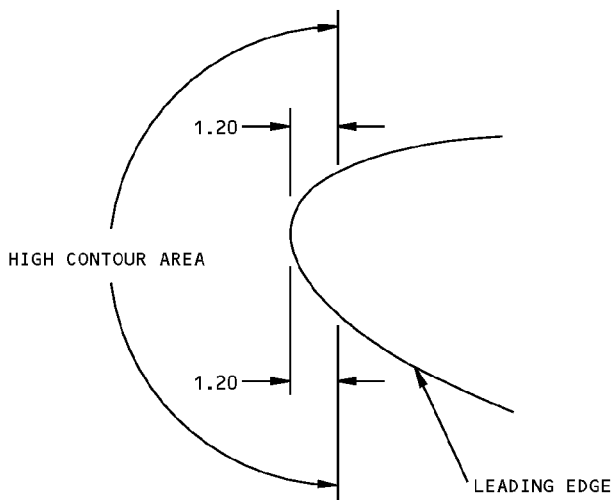
ALLOWABLE MISMATCH -

- IN CRITICAL AREAS SHALL NOT EXCEED 0.007 AT FRONT SPAR JOINTS, 0.010 AT JOINTS AHEAD OF FRONT SPAR AND FORWARD 50% OF ELEVATOR AND RUDDER CHORDS, AND 0.015 FOR JOINTS BETWEEN SPARS
- SHALL NOT EXCEED 0.030 FOR NONCRITICAL AREA JOINTS
- SPANWISE MISMATCH ALONG LEADING EDGE OF HORIZONTAL STABILIZER AND VERTICAL FIN SHALL BE ± 0.03 AT SKIN SPLICES
- DORSAL FIN TO VERTICAL FIN MISMATCH SHALL BE ± 0.030

EXTERIOR GAPS



GAP DEPTH CHART II



LEADING EDGE HIGH CONTOUR AREA [A]

**Aerodynamic Smoothness - Horizontal and Vertical Stabilizer
Figure 4 (Sheet 2 of 3)**

757-200 STRUCTURAL REPAIR MANUAL

FASTENER TYPE	CRITICAL AREAS	NONCRITICAL AREAS
SOLID ALUMINUM RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.007 HIGH
BACR15CE RIVETS SEE DETAIL I, FIG. 3	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.004 HIGH, EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.002 LOW TO 0.007 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.005 HIGH, EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.002 LOW TO 0.007 HIGH
BACR15FV BRILES RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.001 HIGH TO 0.005 HIGH, EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.0005 HIGH TO 0.007 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.001 HIGH TO 0.006 HIGH, EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.0005 HIGH TO 0.008 HIGH
LOCKBOLTS AND HI-LOKS	SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.003 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.005 LOW TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.010 LOW TO 0.005 HIGH
SCREWS AND BOLTS	SHALL BE FLUSH WITHIN TOLERANCE 0.005 LOW TO 0.003 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.008 LOW TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.010 LOW TO 0.005 HIGH

FASTENER FLUSHNESS
TABLE IV

NOTES

- DO NOT SHAVE STEEL OR TITANIUM FASTENERS, BACR15CE OR BACR15FV (BRILES) RIVETS. BRILES RIVET HEADS MAY BE SHAVED ONLY IF OVERSIZED RIVETS ARE INSTALLED IN REWORKED HOLES. REFER TO 51-40-02 FOR REWORK OF EXISTING BRILES RIVET HOLES
- FOR DETAILS OF CRITICAL AND NONCRITICAL AREAS, SEE FIGURE 1
- SEE FIGURE 3, DETAILS I AND II FOR DETERMINING FLUSHNESS OF BACR15CE AND BACR15FV (BRILES) RIVETS
- SURFACE FINISH IN CRITICAL AREAS SHALL BE 130 MICROINCHES (0.30 CUTOFF) OR BETTER
- SURFACE FINISH IN NON-CRITICAL AREAS SHALL BE 180 MICROINCHES (0.30 CUTOFF) OR BETTER

A IN HIGH CONTOUR AREA OF LEADING EDGE THE FLUSHNESS TOLERANCE ON FASTENERS IS 0.007 LOW TO 0.003 HIGH WITH RESPECT TO SKIN SURFACE. 20% SHALL BE WITHIN TOLERANCE 0.012 LOW TO 0.003 HIGH

Aerodynamic Smoothness - Horizontal and Vertical Stabilizer Figure 4 (Sheet 3 of 3)

757-200 STRUCTURAL REPAIR MANUAL

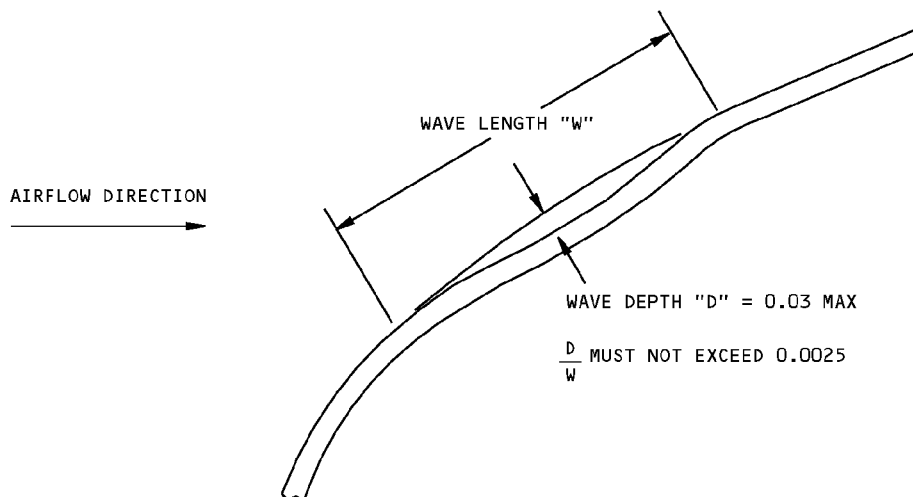
FASTENER TYPE	CRITICAL AREAS	NONCRITICAL AREAS
FLUID-TIGHT RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.001 HIGH TO 0.003 HIGH	
BACR15CE ALUMINUM AND BLIND RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.003 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.0005 LOW TO 0.006 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.005 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.0005 LOW TO 0.007 HIGH
ALL OTHER ALUMINUM RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.001 TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.002 LOW TO 0.007 HIGH
STEEL LOCKBOLTS HI-LOCKS AND BACB30PT BOLTS	SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.003 HIGH EXCEPT FOR 10% WHICH MAY BE FLUSH WITHIN 0.005 LOW TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.005 HIGH
STUMP TYPE LOCKBOLTS	SQUEEZED FLUSH WITHIN 0.00 TO 0.003 HIGH	
NONREMOVABLE SCREWS AND BOLTS	SHALL BE COUNTERSUNK WITHIN TOLERANCE 0.015 LOW TO 0.005 LOW, TO ALLOW FOR FILLER	FLUSH WITHIN TOLERANCE 0.010 LOW TO 0.005 HIGH
REMOVABLE SCREWS AND BOLTS A	SHALL BE FLUSH WITHIN TOLERANCE 0.010 LOW TO 0.002 HIGH	

**FASTENER FLUSHNESS
TABLE V**

NOTES

- FOR DETAILS OF CRITICAL AND NONCRITICAL AREAS SEE FIG. 1
- DO NOT SHAVE STEEL OR TITANIUM FASTENERS OR BACR15CE ALUMINUM RIVETS
- SEE FIG. 3, DETAIL I FOR DETERMINING FLUSHNESS FOR BACR15CE RIVETS
- REFER TO APPLICABLE ALLOWABLE DAMAGE AND REPAIR DATA FOR TAPERING LIMITS OF COMPOSITE PANEL EDGE BANDS
- SURFACE FINISH OF INTERSPAR SKIN SHALL BE 130 MICROINCHES (0.03 CUTOFF) OR BETTER
- DO NOT SHAVE FIBERGLASS PANELS

A WHEN INSTALLED WITH BACW10Z COUNTERSUNK WASHERS SHALL BE FLUSH WITHIN TOLERANCE 0.010 LOW TO 0.000



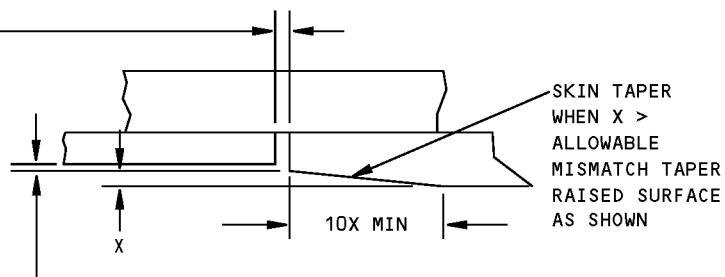
PERMISSIBLE LEADING EDGE SKIN WAVINESS STREAMWISE

**Aerodynamic Smoothness - Wing
Figure 5 (Sheet 1 of 2)**

757-200 STRUCTURAL REPAIR MANUAL

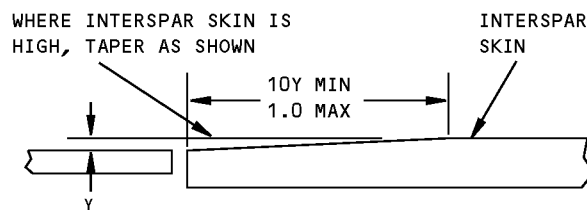
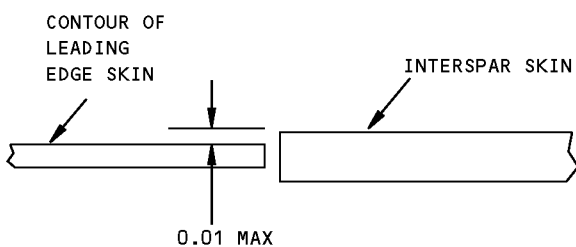
SKIN GAPS -

- IN NONCRITICAL AREAS SHALL NOT EXCEED 0.09 IN WIDTH IF UNFILLED
- IN CRITICAL AREAS SHALL NOT EXCEED 0.03 IN WIDTH IF UNFILLED
- IN CRITICAL AREAS FILLED GAPS SHALL BE PER CHART II, FIGURE 4



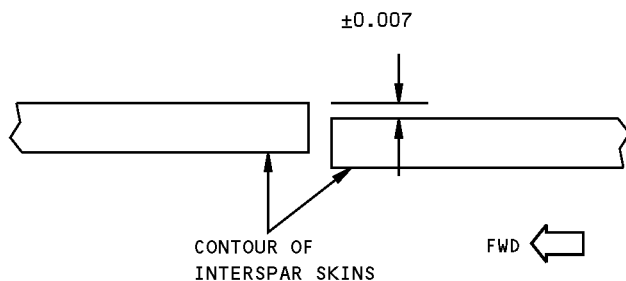
ALLOWABLE MISMATCH -

- IN CRITICAL AREAS SHALL NOT EXCEED 0.007 AT THE FRONT SPAR JOINTS, 0.010 AT JOINTS AHEAD OF FRONT SPAR AND 0.007 FOR BETWEEN SPAR JOINTS
- IN NONCRITICAL AREAS SHALL NOT EXCEED 0.030

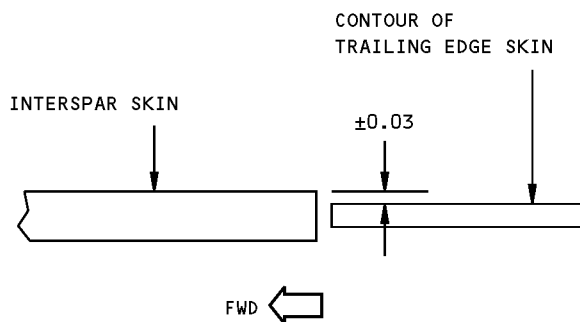


FWD ←

PERMISSIBLE MISMATCH AT TOP AND BOTTOM SKIN SPLICES FWD OF FRONT SPAR



PERMISSIBLE MISMATCH AT TOP AND BOTTOM INTERSPAR SKIN SPLICES

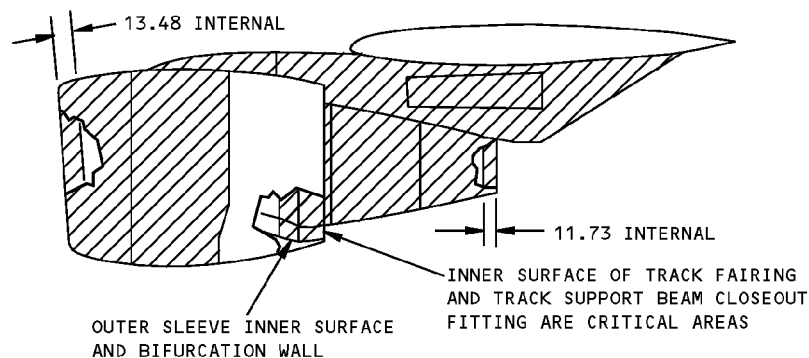


PERMISSIBLE MISMATCH AT TOP AND BOTTOM SKIN SPLICES AT AND AFT OF THE REAR SPAR

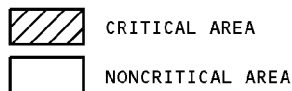
Aerodynamic Smoothness - Wing
Figure 5 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

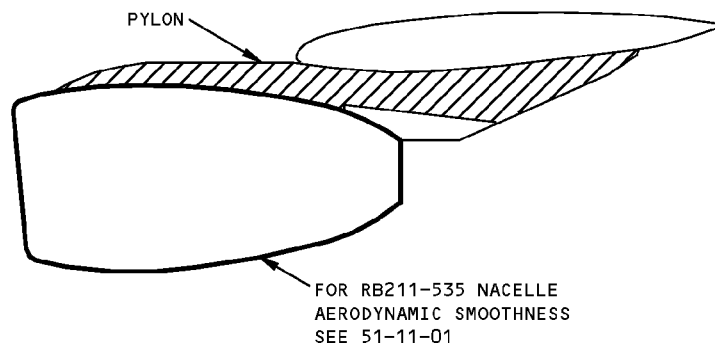
REF DWG
300N3000



PW2000 SERIES ENGINES



REF DWG
311N5003



RB211-535 ENGINE

LOCATION OF CRITICAL AREAS DETAIL I

NOTES

- FOR INFORMATION ON MISMATCH AND GAPS AT JOINTS, SEE TABLES V AND VI
- FOR DETAILS OF CRITICAL AND NONCRITICAL AREAS, SEE FIGURE 1
- DO NOT SHAVE STEEL OR TITANIUM REMOVABLE FASTENERS, AND BACR15CE RIVETS. SEE DETAIL I, FIGURE 3 FOR MEASUREMENT OF BACR15CE FLUSHNESS
- SEE 51-11-01 FOR RB211-535C NACELLE AERODYNAMIC SMOOTHNESS REQUIREMENTS
- FOR PW2000 COWL AND FAIRING INTERFACE, SEE TABLE VII. FOR OTHER AREAS, SEE TABLE VI
- SURFACE FINISH IN CRITICAL AREAS SHALL BE 130 MICROINCHES (0.30 CUTOFF) OR BETTER
- SURFACE FINISH IN NON-CRITICAL AREAS SHALL BE 180 MICROINCHES (0.30 CUTOFF) OR BETTER
- [A] TO BE DETERMINED BY USE OF A 6.0 SPLINE AND FEELER GAGE
- [B] FOR EXCEPTIONS TO THESE REQUIREMENTS, SEE DETAIL IV
- [C] IF TAPER OF COMPOSITE PANELS EXCEEDS 35% OF EDGE BAND THICKNESS OR 0.5 INCH FROM EDGE, REPAIR PER 51-70-03, FIG. 23 OR 51-70-06, FIG. 22

Aerodynamic Smoothness - Nacelle and Pylon Figure 6 (Sheet 1 of 6)

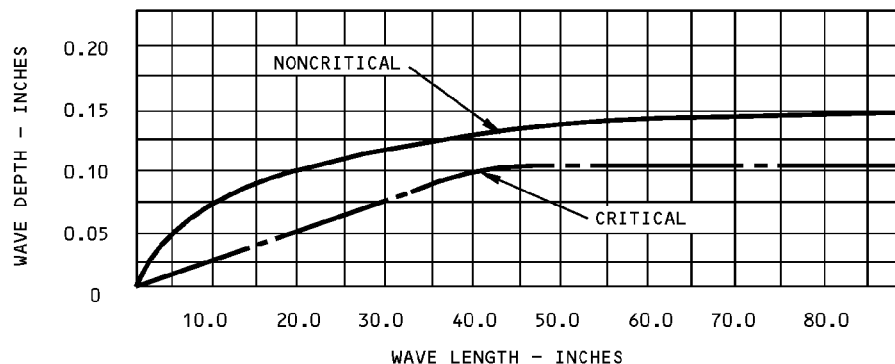
757-200 STRUCTURAL REPAIR MANUAL

FASTENER TYPE	CRITICAL AREAS	NONCRITICAL AREAS
FLUSH ALUMINUM ALLOY RIVETS		SHALL BE FLUSH WITHIN TOLERANCE 0.001 LOW TO 0.007 HIGH
SHEAR HEAD (BACR15CE) RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.004 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.001 LOW TO 0.007 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.005 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.0005 LOW TO 0.007 HIGH
SCREWS AND BOLTS	ALL REMOVABLE SCREWS AND BOLTS SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.003 HIGH	ALL COUNTERSUNK SCREWS AND BOLTS SHALL BE FLUSH WITHIN TOLERANCE 0.010 LOW TO 0.005 HIGH
HI-LOK FASTENERS AND LOCKBOLTS	SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.003 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.005 LOW TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.005 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.005 LOW TO 0.007 HIGH

FASTENER FLUSHNESS FOR RB211-535 PYLONS
TABLE I

FASTENER TYPE	CRITICAL AREAS	NONCRITICAL AREAS
FLUSH ALUMINUM ALLOY RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.007 HIGH
SHEAR HEAD (BACR15CE) RIVETS	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.003 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.005 LOW TO 0.006 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.000 TO 0.005 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.002 LOW TO 0.007 HIGH
SCREWS AND BOLTS	ALL REMOVABLE SCREWS AND BOLTS SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.003 HIGH	ALL COUNTERSUNK SCREWS AND BOLTS SHALL BE FLUSH WITHIN TOLERANCE 0.010 LOW TO 0.005 HIGH
HI-LOK FASTENERS AND LOCKBOLTS	SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.003 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.005 LOW TO 0.003 HIGH	SHALL BE FLUSH WITHIN TOLERANCE 0.003 LOW TO 0.005 HIGH EXCEPT FOR 10% WHICH MAY BE WITHIN TOLERANCE 0.003 LOW TO 0.005 HIGH

FASTENER FLUSHNESS FOR PW2000 SERIES NACELLE AND PYLON
TABLE II



RB211-535 PYLON AND PW2000 SERIES NACELLE AND PYLON
CHART I

Aerodynamic Smoothness - Nacelle and Pylon
Figure 6 (Sheet 2 of 6)



757-200
STRUCTURAL REPAIR MANUAL

AERODYNAMIC SMOOTHNESS REQUIREMENTS FOR RB211-535 PYLONS				
CONDITION		LOCATION	CRITICAL	NONCRITICAL
1	WAVE DEPTH TO LENGTH RATIO	ALL SKINS	0.0025	SEE GRAPH
2	1.0 MAX DIA DISH AT FASTENERS (MAY BE ADDITIVE TO ABOVE)	AT FASTENERS	0.0050 A	0.0100 A

TABLE III

AERODYNAMIC SMOOTHNESS REQUIREMENTS FOR PW2000 SERIES NACELLES AND PYLONS				
CONDITION		LOCATION	CRITICAL	NONCRITICAL
1	WAVE DEPTH TO LENGTH RATIO	ALL SKINS	SEE CHART I	SEE CHART I
2	1.0 MAX DIA DISH AT FASTENERS (MAY BE ADDITIVE TO ABOVE)	AT FASTENERS	0.0050 A	0.0100 A

TABLE IV

Aerodynamic Smoothness - Nacelle and Pylon
Figure 6 (Sheet 3 of 6)



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STRUCTURAL REPAIR MANUAL

GAPS	LOCATION	CRITICAL AREAS	NONCRITICAL AREAS
LONGITUDINAL (STREAMWISE) BUTT JOINTS-MAX. GAPS	REMOVABLE PANELS	0.060	0.060
	HINGED PANELS	0.080	0.080
	FIXED SKINS	0.040	0.040
TRANSVERSE (NORMAL TO AIRSTREAM) BUTT JOINT GAPS	FIXED SKINS	0.030	0.00 TO +0.06
	REMOVABLE & HINGED PANELS	+0.01 TO +0.07	+0.01 TO +0.07
FLUSHNESS			
LONGITUDINAL JOINT FLUSHNESS	FIXED SKINS	0.00 TO +0.02	0.00 TO +0.03
	REMOVABLE & HINGED PANELS	0.00 TO +0.03	0.00 TO +0.03
TRANSVERSE JOINT FLUSHNESS	FIXED SKINS	-0.02 TO 0.00	-0.03 TO +0.02
	REMOVABLE & HINGED PANELS	-0.030 TO +0.025	-0.04 TO +0.02

REQUIRED AERODYNAMIC SMOOTHNESS TOLERANCES FOR PYLON – RB211-535 ENGINES

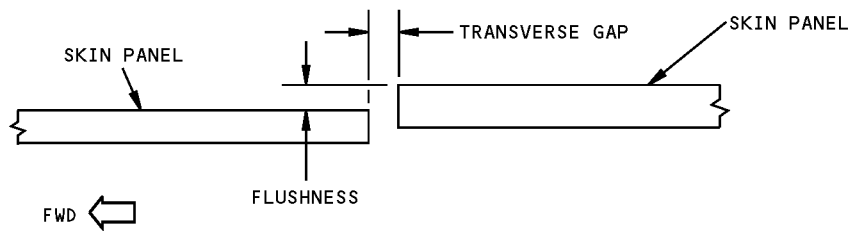
TABLE V

GAPS B	LOCATION	CRITICAL AREAS	NONCRITICAL AREAS
LONGITUDINAL (STREAMWISE) BUTT JOINTS-MAX. GAPS	REMOVABLE PANELS	0.060	0.060
	HINGED PANELS	0.080	0.080
	FIXED SKINS	0.040	0.040
TRANSVERSE (NORMAL TO AIRSTREAM) BUTT JOINT GAPS	FIXED SKINS	0.030	0.00 TO +0.06
	REMOVABLE & HINGED PANELS	+0.01 TO +0.07	+0.01 TO +0.07
FLUSHNESS			
LONGITUDINAL JOINT FLUSHNESS	FIXED SKINS	-0.020 TO +0.020	-0.030 TO +0.03
	REMOVABLE & HINGED PANELS	-0.025 TO +0.025	-0.040 TO +0.040
TRANSVERSE JOINT FLUSHNESS	FIXED SKINS	-0.020 TO +0.020	-0.030 TO +0.030
	REMOVABLE & HINGED PANELS	-0.025 TO +0.025	-0.040 TO +0.040

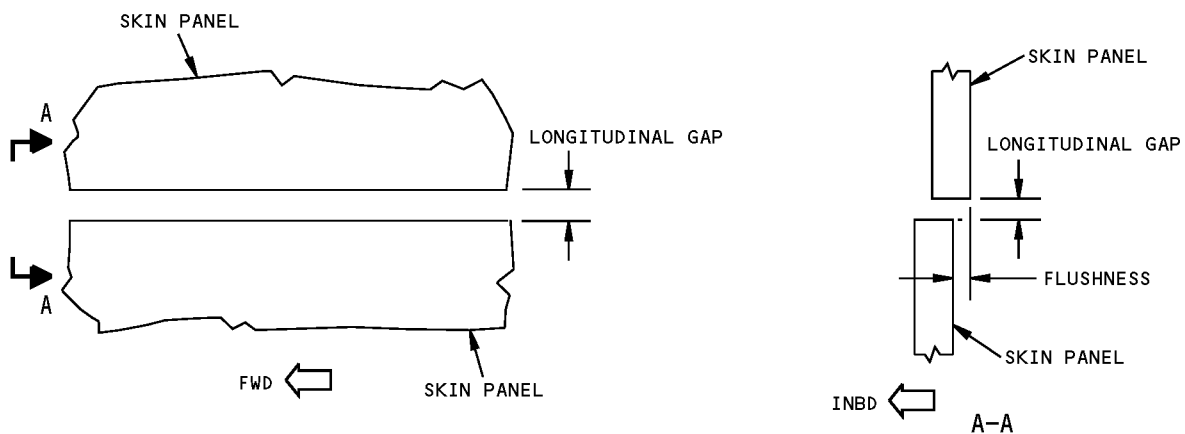
**REQUIRED AERODYNAMIC SMOOTHNESS TOLERANCES
FOR PYLON AND NACELLE – PW2000 SERIES ENGINES**
TABLE VI

Aerodynamic Smoothness - Nacelle and Pylon
Figure 6 (Sheet 4 of 6)

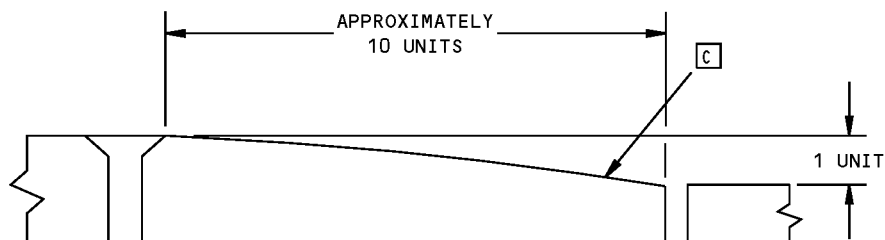
757-200 STRUCTURAL REPAIR MANUAL



MEASUREMENT OF FLUSHNESS AND GAP
AT A TRANSVERSE BUTT JOINT
DETAIL III



MEASUREMENT OF FLUSHNESS AND GAP
AT A LONGITUDINAL BUTT JOINT
DETAIL IV



SHAPE OF SHAVE FAIR

IF MISMATCH OF TRANSVERSE SKIN BUTT JOINTS IS GREATER THAN SPECIFIED VALUES
SHAVING WILL BE REQUIRED. MISMATCH AFTER SHAVING SHALL BE WITHIN VALUES
AND SHAPE OF THE FAIR SHALL BE AS SHOWN ABOVE

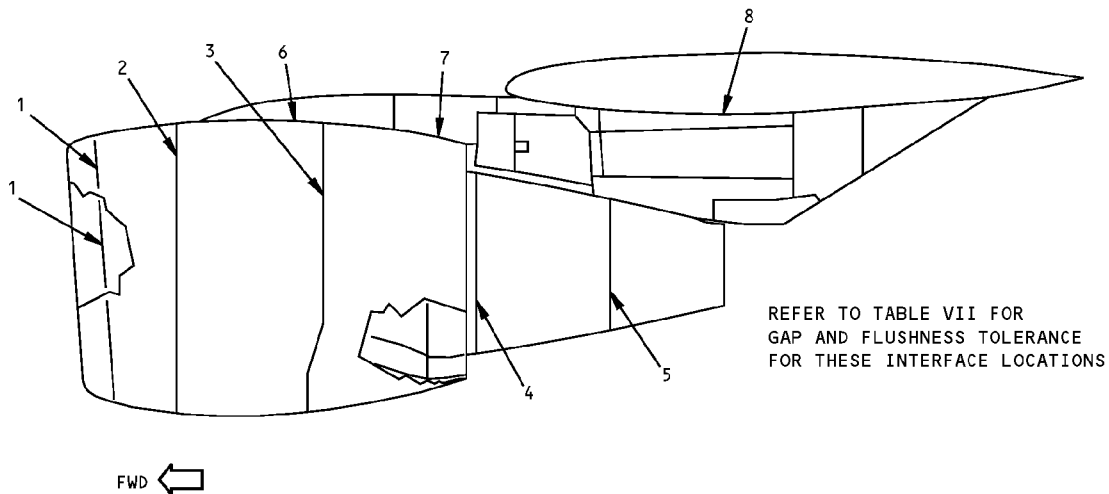
SHAVING OF MISMATCHED SKIN JOINTS THAT
EXCEED THE REQUIREMENTS OF TABLE V AND VI
DETAIL V

Aerodynamic Smoothness - Nacelle and Pylon Figure 6 (Sheet 5 of 6)

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EXCEPTIONS TO TABLE VI - GAPS AND FLUSHNESS - PW2037					
LOCATION OF INTERFACE (SEE DETAIL VI)		GAPS		FLUSHNESS	
ITEM	DESCRIPTION OF INTERFACE	LONGITUDINAL	TRANSVERSE	LONGITUDINAL	TRANSVERSE
1	INLET COWL -- LIP SKIN-TO-ACOUSTIC		0.10 ±0.03		-0.03 TO +0.01
2	INLET COWL-TO-FAN COWL (EXTERNAL)		0.10 ±0.06		-0.04 TO +0.04
3	FAN COWL-TO-FAN DUCT COWL		0.09 TO 0.28		-0.05 TO +0.05
4	FAN DUCT INNER WALL-TO-CORE COWL		0.48 ±0.10		-0.04 TO +0.025
5	CORE COWL-TO-PRIMARY EXHAUST				0.26 ±0.06
6	FWD STRUT FAIRING-TO-FAN COWL	0.15 0.21 MAX 0.12 MIN			
7	FWD STRUT FAIRING-TO-FAN DUCT COWL	0.15 0.175 MAX 0.065 MIN			
8	AFT FAIRING PANELS-TO-WING	0.45 ±0.15			

TABLE VII

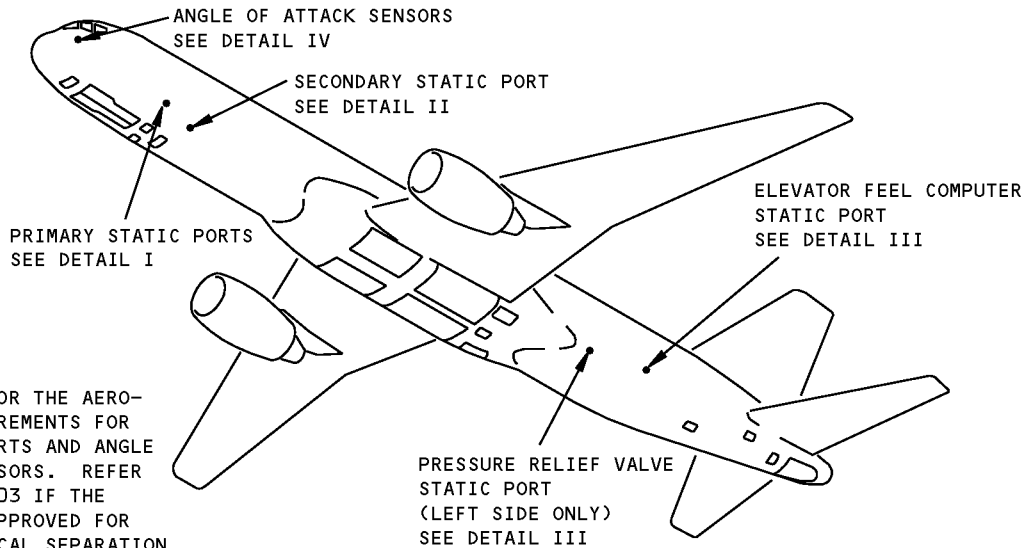


LOCATION OF AND FAIRING INTERFACE - PW2000 SERIES ENGINES
DETAIL VI

Aerodynamic Smoothness - Nacelle and Pylon
Figure 6 (Sheet 6 of 6)

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NOTE: SEE TABLE I FOR THE AERO-DYNAMIC REQUIREMENTS FOR THE STATIC PORTS AND ANGLE OF ATTACK SENSORS. REFER TO SRM 51-10-03 IF THE AIRPLANE IS APPROVED FOR REDUCED VERTICAL SEPARATION MINIMUM (RVSM) OPERATION AND HAS DAMAGE NEAR THE PRIMARY STATIC PORTS.

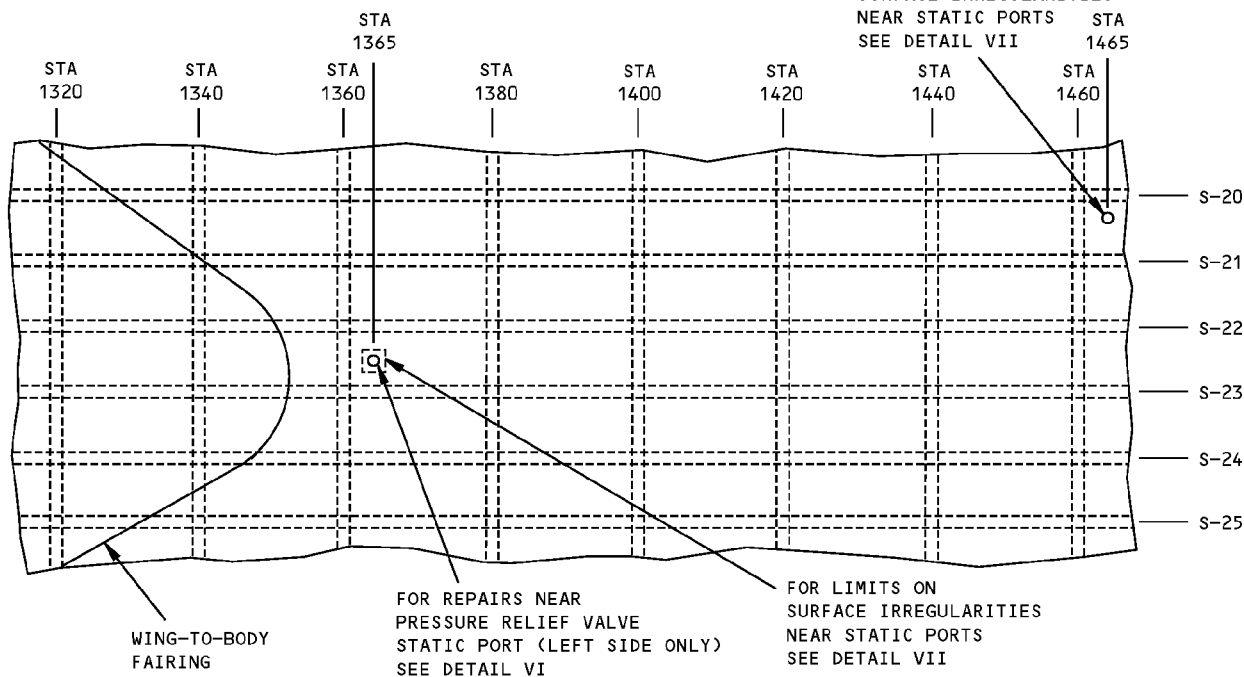
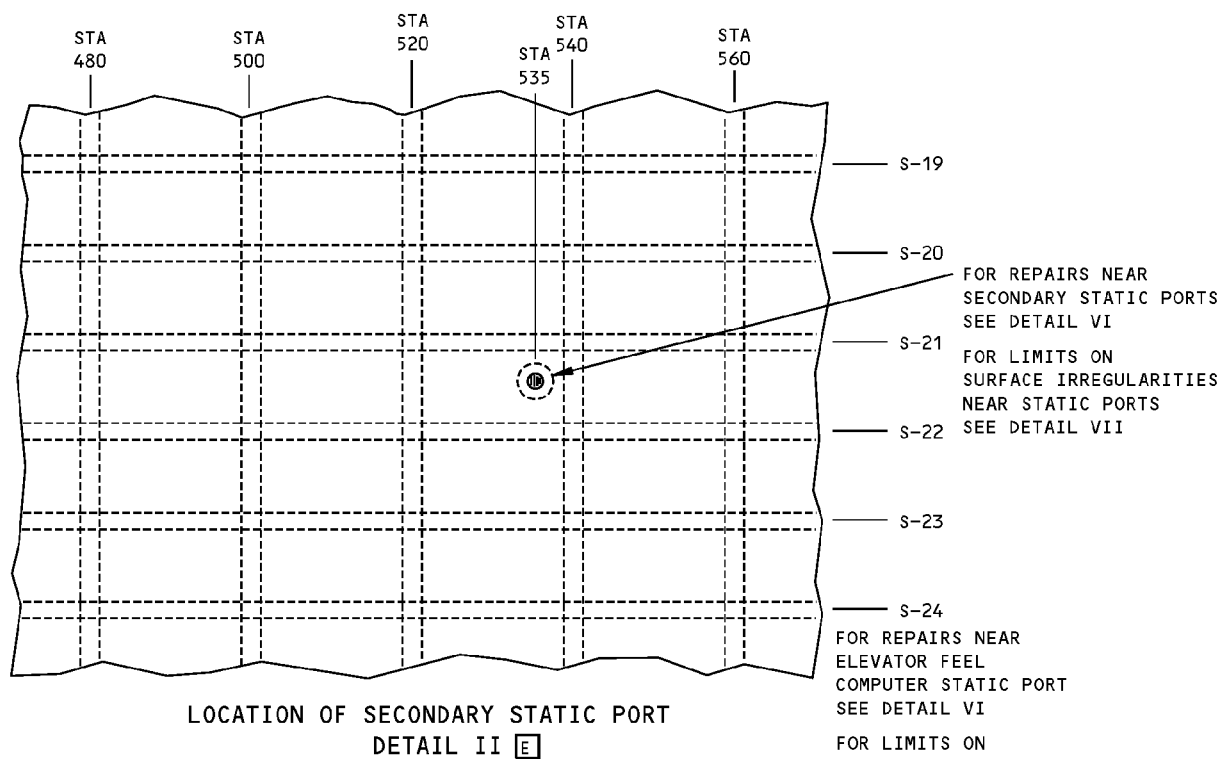
LEFT SIDE IS SHOWN, RIGHT SIDE IS OPPOSITE (EXCEPT AS NOTED)

AIR DATA SENSOR	LOCATION	AERODYNAMIC REQUIREMENTS	COMMENTS
PITOT PROBES	STA 210 WL 208 & 220 RH AND LH	USE GENERAL REPAIR AND SMOOTHNESS CRITERIA APPLICABLE TO FORWARD FUSELAGE	
ALPHA VANES (ANGLE OF ATTACK SENSORS)	STA 227 WL 198 RH AND LH	EDGES OF REPAIR MUST BE AT LEAST 100H AWAY FROM THE VANE IN ALL DIRECTIONS AS SHOWN IN DETAIL V	SRM 53-00-01 REPAIRS ARE PERMITTED PROVIDED THAT DETAIL V CRITERIA ARE MET.
TAT PROBE	STA 433 WL 203 RH	USE GENERAL REPAIR AND SMOOTHNESS CRITERIA APPLICABLE TO FORWARD FUSELAGE	
STATIC PRESURE PORTS - ALTERNATE AIRDATA SYSTEM	STA 535 WL 173 RH AND LH	SEE DETAIL VI SEE DETAIL VII	SEE DETAIL VI
STATIC PRESSURE PORTS - PRESSURE RELIEF VALVE	STA 1365 WL 166 LH	SEE DETAIL VI SEE DETAIL VII	SEE DETAIL VI
STATIC PRESSURE PORTS - ELEVATOR FEEL COMPUTER	STA 1465 WL 180 RH & LH	SEE DETAIL VI SEE DETAIL VII	SEE DETAIL VI
STATIC PRESSURE PORTS - PRIMARY AIRDATA SYSTEM	STA 490 WL 178 & 180 RH AND LH	SEE DETAIL VII	REFER TO SRM 53-00-01, REPAIR 8 (FOR PASSENGER AIRPLANES) OR REPAIR 17 (FOR 757-SF AIRPLANES) FOR THE REPAIR DATA. REFER TO SRM 51-10-03 FOR RVSM DATA.

AERODYNAMIC REQUIREMENTS FOR REPAIRS NEAR AIR DATA SENSORS ON 757
TABLE I

Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors
Figure 7 (Sheet 1 of 7)

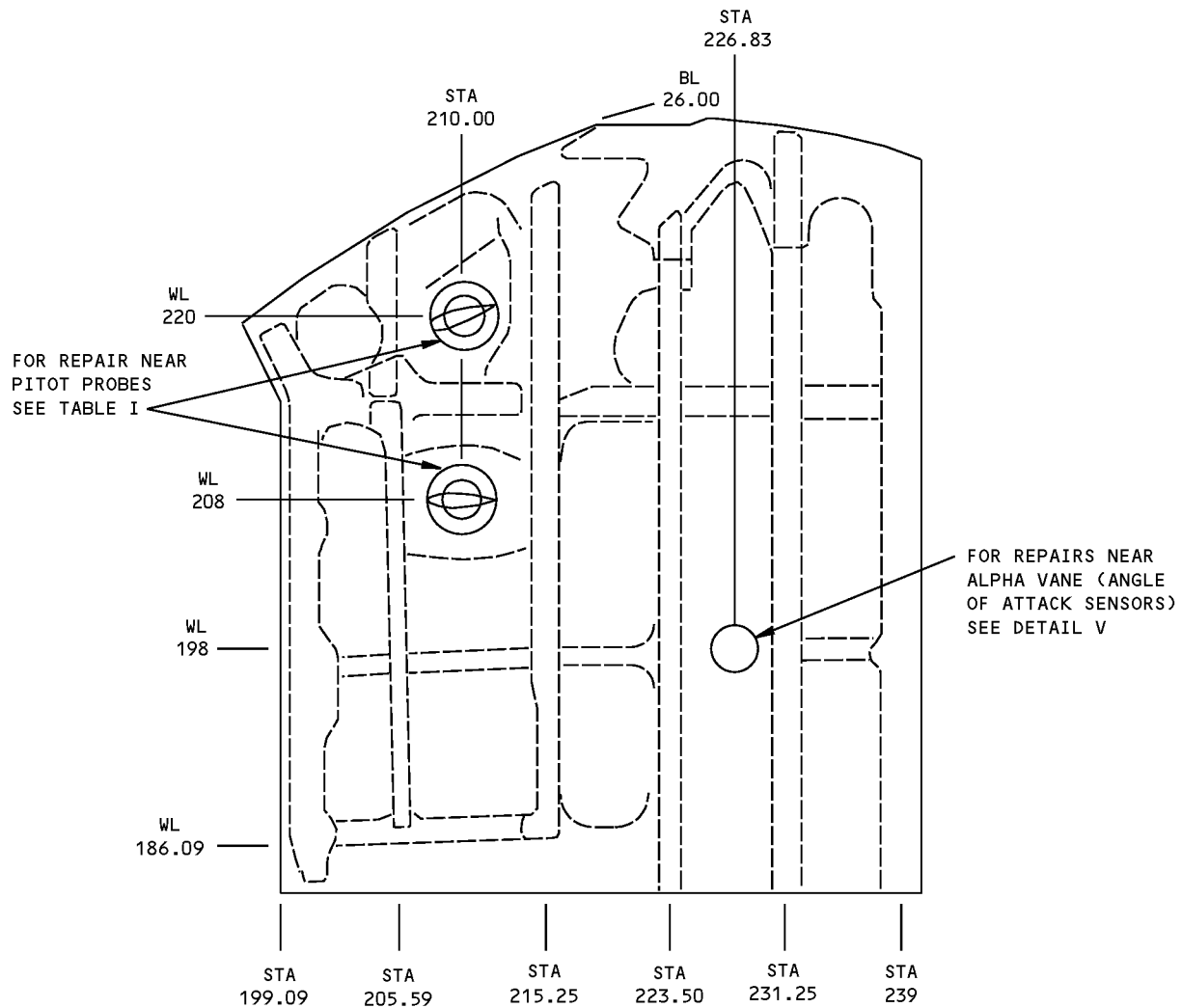
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LOCATION OF PRESSURE RELIEF VALVE STATIC PORT AND ELEVATOR FEEL COMPUTER STATIC PORT
DETAIL III

Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors Figure 7 (Sheet 2 of 7)

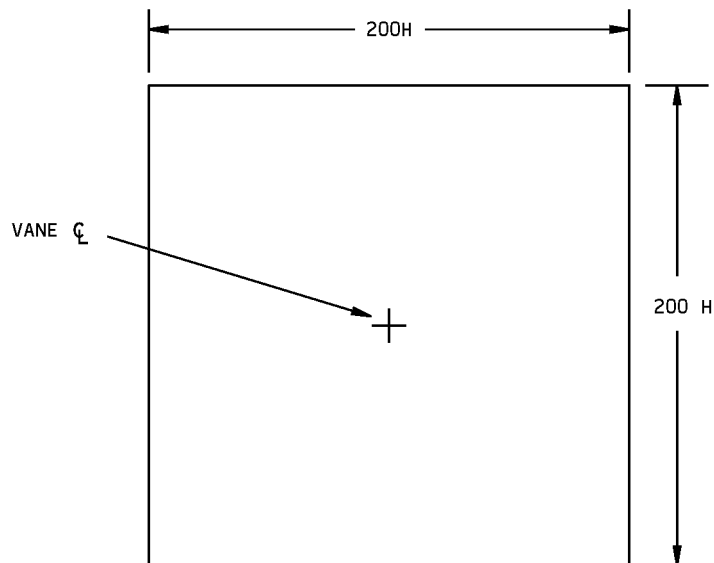
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LOCATION OF ANGLE OF ATTACK SENSORS AND PITOT PROBE
DETAIL IV

Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors
Figure 7 (Sheet 3 of 7)

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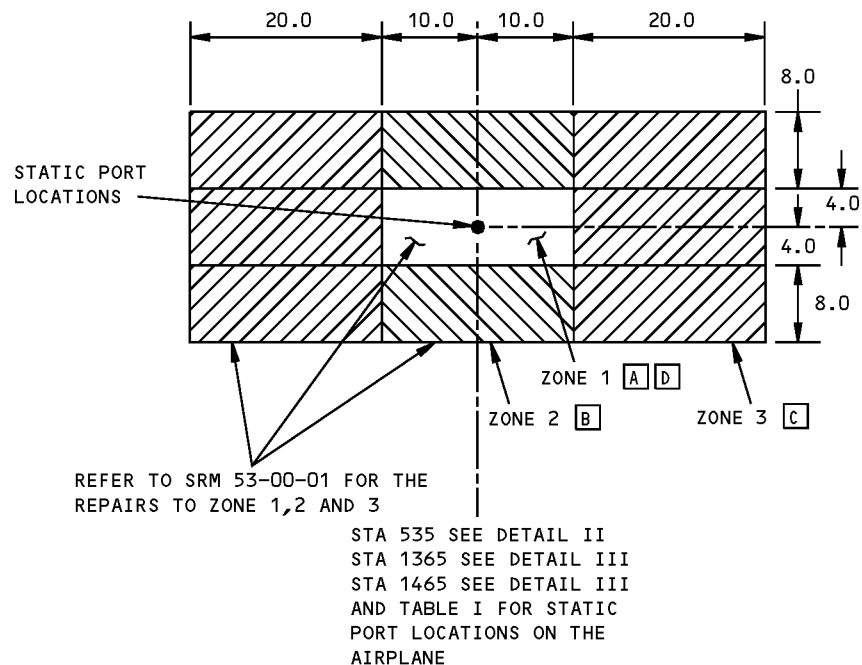
• NOTES FOR DETAIL V:




- ZONE IS CENTERED AT THE ALPHA VANE.
- H = THICKNESS OF EXTERNAL REPAIR PLATE FOR EXTERNAL REPAIRS
- H = THICKNESS OF TAPERED SHIM, IF ANY, WHICH IS PLACED BETWEEN THE ORIGINAL SKIN AND THE BACKUP STRUCTURE FOR A "FLUSH" REPAIR
- REPAIR EDGES ARE NOT PERMITTED WITHIN THE ZONE (I.E. IF A REPAIR ENTERS THE ZONE IT MUST COVER THE ZONE COMPLETELY)
- NO TAPERED SHIMS MAY ENTER THE ZONE
- CHAMFER EXTERNAL REPAIR EDGES TO A 4:1 TAPER RATIO, WITH A MAXIMUM EDGE THICKNESS OF 0.02 INCH
- MAINTAIN VANE ALIGNMENT WITHIN DRAWING TOLERANCE.

ZONE FOR CONTROLLING REPAIRS NEAR THE ALPHA VANE
(ANGLE OF ATTACK SENSOR)
DETAIL V

Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors
Figure 7 (Sheet 4 of 7)

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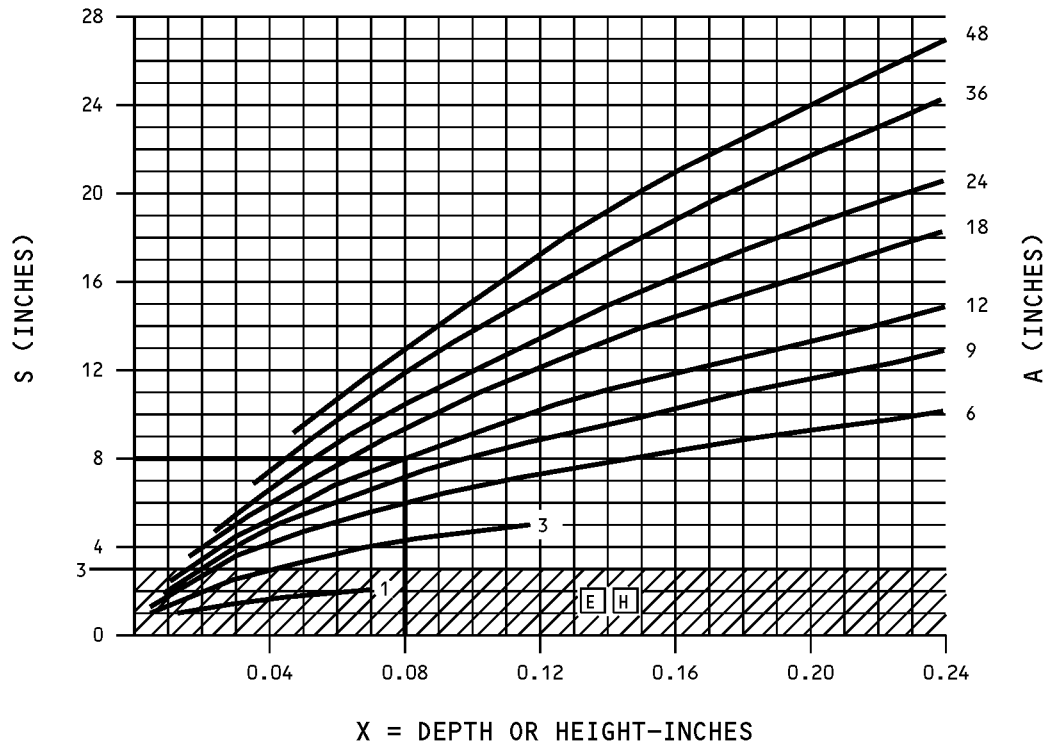
-  REPAIR ZONE 1 [A] [D]
-  REPAIR ZONE 2 [B]
-  REPAIR ZONE 3 [C]

NOTE: ZONE BOUNDARIES ARE MEASURED RELATIVE TO STATIC PORT LOCATIONS AND MAY NOT LINE-UP WITH FRAMES, STRINGERS OR OTHER STRUCTURAL MEMBERS.

REPAIR ZONES NEAR STATIC PORTS
DETAIL VI

Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors
Figure 7 (Sheet 5 of 7)

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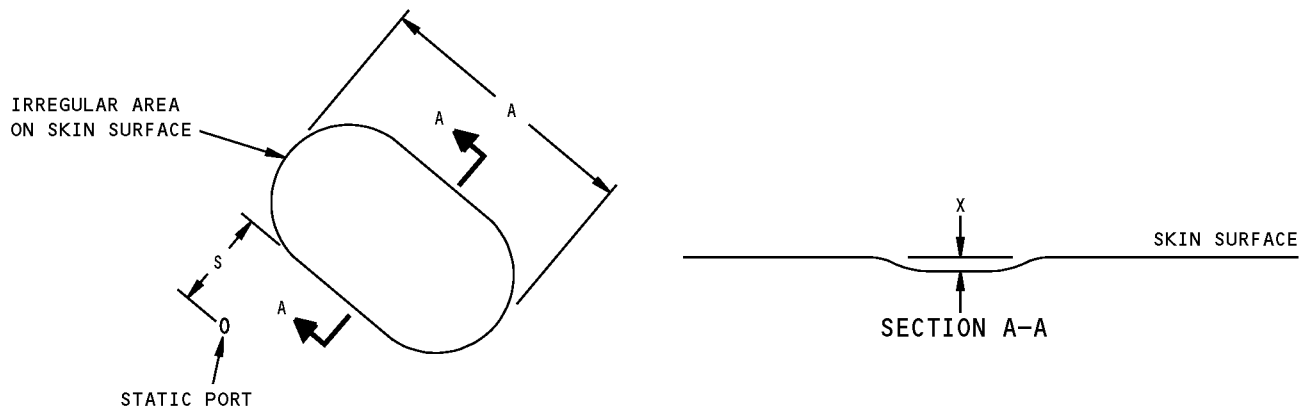


LIMITS ON SURFACE IRREGULARITIES NEAR STATIC PORTS
DETAIL VII G I J

A = LARGEST DIMENSION OF IRREGULARITY (DIAMETER, MAJOR AXIS OR DIAGONAL DEPENDING ON SHAPE)
(DAMAGE ABOVE THE CURVE IS PERMITTED. DAMAGE BELOW THE CURVE IS NOT PERMITTED.)

X = MAXIMUM DEPTH OR HEIGHT OF THE IRREGULARITY K

S = DISTANCE FROM THE STATIC PRESSURE PORT TO THE NEAREST EDGE OF THE IRREGULARITY (I.E., TO THE POINT WHERE DEVIATION FROM NORMAL CONTOUR BEGINS). F



Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors
Figure 7 (Sheet 6 of 7)

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STRUCTURAL REPAIR MANUAL

NOTES

[A] THE FOLLOWING RESTRICTIONS APPLY:

1. EXTERNAL REPAIRS ONLY. THE EDGES MUST BE CHAMFERED TO A 4:1 TAPER RATIO WITH A MAXIMUM EDGE THICKNESS OF 0.02 INCH
2. NO REPAIR EDGES WITHIN THIS ZONE (I.E. ANY REPAIR WHICH ENTERS THE ZONE MUST COVER AT LEAST THE ENTIRE ZONE)
3. REPAIRS COVERING THIS ZONE MUST HAVE $L \geq 2.2W$
4. NO TAPERED SHIMS MAY ENTER THIS ZONE
5. ALL RIVETS WITHIN A 3-INCH RADIUS OF STATIC PORT HOLE MUST BE FLUSH WITH DOUBLER WITHIN 0.003 INCH MAXIMUM. MAKE THE FASTENER SPACING 2.0 TO 3.0 INCHES IN CIRCUMFERENTIAL OR LONGITUDINAL DIRECTIONS.

[B] THE FOLLOWING RESTRICTIONS APPLY:

1. ANY REPAIR WHICH ENTERS ZONE 2 MUST SPAN THE ENTIRE LENGTH OF THE ZONE
2. REPAIRS ENTERING THE ZONE MUST HAVE $L > W$
3. EXTERNAL REPAIRS ARE PERMITTED. THE EDGES MUST BE CHAMFERED TO A 4:1 TAPER RATIO WITH A MAXIMUM EDGE THICKNESS OF 0.02 INCH
4. FLUSH REPAIRS ARE PERMITTED IF THE TAPERED SHIMS END AT LEAST 2 INCHES AWAY FROM THE BORDER WITH ZONE 1. TAPERED SHIMS MUST HAVE AT LEAST A 50:1 TAPER RATIO
5. FLUSH FASTENERS ONLY.

[C] THE FOLLOWING RESTRICTIONS APPLY:

1. EXTERNAL REPAIRS ARE PERMITTED. THE EDGES MUST BE CHAMFERED TO A 4:1 TAPER RATIO WITH A MAXIMUM EDGE THICKNESS OF 0.02 INCH
2. FLUSH REPAIRS ARE PERMITTED IF THE TAPERED SHIMS END AT LEAST 2 INCHES AWAY FROM ZONE 1. TAPERED SHIMS MUST HAVE AT LEAST A 50:1 TAPER RATIO
3. FLUSH FASTENERS ONLY.

[D] ALL RIVETS WITHIN A 3-INCH RADIUS OF STATIC PORT HOLE MUST BE FLUSH WITH DOUBLER WITHIN A 0.003 INCH MAXIMUM. MAKE THE FASTENER SPACING 2.0 TO 3.0 INCHES IN CIRCUMFERENTIAL OR LONGITUDINAL DIRECTIONS.

[E] IN ADDITION TO THE OTHER LIMITS, THE FOLLOWING NOTE APPLIES:

THE SURFACE OF THE SKIN AND PORT FOR A DISTANCE 3 INCHES FORWARD AND AFT OF THE PORT CENTERLINE SHALL BE FLUSH WITHIN 0.010 MAXIMUM MEASURED AS THE CLEARANCE BETWEEN THIS SURFACE AND THE EDGE OF A 6-INCH STRAIGHTEDGE PLACED HORIZONTALLY AGAINST THE SURFACE.

[F] THE DISTANCE "S" APPLIES REGARDLESS OF THE DIRECTION OF THE IRREGULARITY FROM THE STATIC PRESSURE PORT.

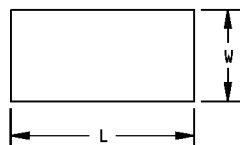
[G] THESE LIMITS RELATE ONLY TO AERODYNAMIC EFFECTS ON THE STATIC PRESSURE PORTS. ANY APPLICABLE STRUCTURAL RESTRICTIONS ON DENTS MUST ALSO BE MET. AN ACCUMULATION OF IRREGULARITIES WHICH MAY BE INDIVIDUALLY ACCEPTABLE CAN HAVE AN ADDITIVE EFFECT AND SHOULD BE AVOIDED.

[H] IN ADDITION TO THE OTHER LIMITS, THE NOTE WHICH FOLLOWS IS APPLICABLE TO THE PRIMARY STATIC PORT OF RVSM APPROVED AIRPLANES, AND OPTIONAL TO **[E]** FOR OTHER AIRPLANES. THE THE SKIN WAVINESS MUST BE LESS THAN THE LIMIT OF 0.010 INCH WHEN MEASURED WITH THE PROCEDURE AS GIVEN IN AMM 51-10-00. FOR RVSM OPERATION, REFER ALSO TO SRM 51-10-03.

[I] FOR RVSM OPERATION, A MAXIMUM OF TWO SURFACE IRREGULARITIES NEAR THE PRIMARY STATIC PORTS ARE PERMITTED. THE TWO IRREGULARITIES CAN BE ON ONE SIDE OF THE AIRPLANE, OR ONE IRREGULARITY CAN BE ON EACH SIDE. EACH SURFACE IRREGULARITY MUST BE WITHIN THE PERMITTED LIMITS AS SHOWN IN DETAIL VII. IF A SURFACE IRREGULARITY IS NOT WITHIN THE PERMITTED LIMITS, CONTACT BOEING. THESE LIMITS ARE BASED ON MAINTAINING SATISFACTORY PERFORMANCE OF THE PRIMARY ALTIMETRY SYSTEM. REFER ALSO TO SRM 51-10-03.

[J] IN ADDITION TO THE SKIN WAVINESS LIMITS, MAKE SURE THE 3-INCH RADIUS AREA AROUND THE PRIMARY STATIC PORTS HAS NO PAINT, STENCILS, OR SEALANT.

[K] THE LIMITS SHOWN ARE BASED ON MAINTAINING OPTIMUM PERFORMANCE OF THE PRIMARY AIRSPEED SYSTEM. LARGER IRREGULARITIES MAY BE ACCEPTABLE ON A TEMPORARY BASIS OR FOR ALTERNATE PORTS.



REPAIR DIMENSIONS

Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors
Figure 7 (Sheet 7 of 7)



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GENERAL - INSPECTION AND REMOVAL OF DAMAGE

1. Applicability

- A. Use this chapter-section-subject for the investigation, inspection and removal of any type of damage to the airplane skin and structure.
- B. This chapter-section-subject also gives the general definitions for the types of damage that are given in the different chapters of this structural repair manual.

2. References

Reference	Title
51-00-06, GENERAL	Structural Repair Definitions
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-10-05, GENERAL	Instructions to Make it Possible to Operate Airplanes with Missing Fasteners in Secondary Structure
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-02, GENERAL	Heat Treat Verification - Hardness and Conductivity Testing
51-20-05, GENERAL	Repair Sealing
51-20-07, GENERAL	Freeze Plug Installation
51-40-02, GENERAL	Fastener Installation and Removal
51-40-05, GENERAL	Fastener Hole Sizes
51-60	CONTROL SURFACE BALANCING
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
AMM 28-11-00	Aircraft Maintenance Manual
AMM 51-20-00	Structures Finishes - Description and Operation
AMM 51-21-00	Aircraft Maintenance Manual
CPM 20-40-00	Corrosion Removal
NDT Part 1, 51-00-01	Airplane Reference Data
NDT Part 1, 51-06-00	Eddy Current
NDT Part 6, 51-00-01	Aluminum Part Surface Inspection (Meter Display)
NDT Part 6, 51-00-04	Aluminum Part Fastener Hole Inspection (Meter Display)
NDT Part 9, 51-00-01	Inspection for Ice or Water in Honeycomb Parts
SOPM 20-20-02	Penetrant Methods of Inspection
SOPM 20-30-03	Standard Overhaul Practices Manual
SOPM 20-30-80	Solvents For General Cleaning of Metal (Series 80)
SOPM 20-41-02	Application of Chemical and Solvent Resistant Finishes
SOPM 20-43-02	Anodizing of Magnesium Alloys
SOPM 20-60-04	Miscellaneous Materials

3. Damage Classification

- A. Make sure that you refer to the applicable chapter-section-subject for "Allowable Damage" in Chapters 52 through 57 of this structural repair manual for the correct rework limits and the specified shot peening data.

STRUCTURAL REPAIR MANUAL

- B. Use your good judgement to find the type of damage and an estimate of the cross-sectional area changes by a visual inspection of a specified area.

NOTE: Measure the damage or the combination of damage for both the correct depth and the correct length.

- C. In this structural repair manual, the term "damage" is defined as a cross-sectional area change or a permanent distortion of a structural member. Use the terms that follow:

- (1) Allowable Damage: is defined as damage that is permitted with no other flight restrictions
- (2) Repairable Damage: is defined as damage that can be reworked or repaired.
- (3) Replacement of Damaged Parts: is defined as damage where the part must be replaced.

- D. You must decide what type of damage has occurred to a structural member or to a structural material. The definitions of the different types of damage that can occur to the external skin of the airplane panels are given in the paragraphs that follow:

- (1) Abrasion: A damaged area that is the result of scuffing, rubbing, scraping, or other surface erosion. This type of damage is usually rough and has an irregular shape.
- (2) Corrosion: Damage that is the result of a complex electro-chemical action, and gives a cross-sectional area change. The depth of this damage must be determined by a cleanup or a removal operation. This type of damage occurs on the surfaces, hole bores, or edges of structural elements.
- (3) Crack:: A partial fracture or a full break in the material that causes a significant cross-sectional area change. This damage usually has an irregular line and is often the result of fatigue in the material.
- (4) Crease: A damaged area that is depressed or folded back so that its boundaries are sharp or with well-defined lines or ridges. Consider a crease to be equal to a crack.
- (5) Delamination: A type of disbond that occurs between adjacent plies of material. If an allowable damage section or repair section does not give limits for disbonds, then use the limits specified for delaminations.
- (6) Dent: A damaged area that is pushed in from its contour with no change in the cross-sectional area of the material. The edges of the damaged area are smooth. This damage is usually caused by a hit from a smoothly contoured object. The length of the dent is the longest distance from one end to the other end. The width of the dent is the second longest distance across the dent, measured at 90 degrees to the direction of the length.

NOTE: A dent-like form of damage to a panel area with a thick skin can be the possible result of the peening action of a smoothly contoured object. If the inner surface of skin shows no contour change, then the damage can be thought of as a local cross-sectional area change.

- (7) Disbond: A disbond occurs when there is a separation between two or more plies of bonded material. Also a disbond occurs when there is a separation between a bonded skin and core. A disbond does not have to occur across the full surface. If an allowable damage section or repair section does not give limits for disbonds, then use the limits specified for delaminations.
- (8) Gouge: A damaged area where the result is a cross-sectional change caused by a sharp object and gives a continuous, sharp or smooth groove in the material.
- (9) Hole: A puncture or cutout that is fully surrounded by undamaged material. Other types of damage can be removed by making an oversized hole or a hole that has an irregular shape, if this hole stays in the allowable damage limits or can be repaired with an approved procedure.



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- (10) Nick:: A local gouge with sharp edges. You can consider a series of nicks in a line pattern to be equal to a gouge.
- (11) Puncture: A puncture is damage that goes fully through a part thickness and has no regular shape. For example, a puncture can occur when a part is hit by a sharp object. A repair of the damage must be less than the allowable damage limits. Refer to the applicable chapters in the Structural Repair Manual for the allowable damage limits and the approved repair procedures.
- (12) Scratch: A line of damage in the material where the result is a cross-sectional area change. This damage is usually caused by contact with a very sharp object.

4. Allowable Damage

- A. Make sure that you refer to the applicable allowable damage chapter-section-subject in Chapters 52 thru 57 of this structural repair manual for the rework limits and the necessary shot peening data.
- B. Some types of damage or distortion are permitted, with no flight restrictions if the damage condition can be corrected by a simple procedure. For example, damage that can be corrected when you smooth out nicks or gouges is called "Allowable Damage".
 - (1) The allowable damage limits for the major assemblies and component parts are defined in the applicable chapter-section-subject of this structural repair manual.
 - (2) The Boeing Company recommends that you use an optical micrometer with a tripod base to find the depth of the damage in the material.
 - (a) The data for the optical micrometer is as follows:

Optical Micrometer - Model Number 906A1 Manufactured by:
Monocle Industries
P.O. Box 2426 618 Hawk Lane
Coppell, Texas USA 75019
Telephone Number - (972) 393-9920
 - (b) As an alternative measurement system, you can use the tool that follows:

Scratch Measurement System Measurement Systems, Inc.
2262 Northwest Parkway, Suite B
Marietta, Georgia USA 30067
Telephone Number - (770) 951-0878
- C. Hidden cracks can be included with other types of damage, such as dents, nicks, gouges, scratches, cracks and punctures. Refer to the Nondestructive Test Manual NDT for the applicable nondestructive inspection method to find hidden cracks.

NOTE: Once the damage inspection is done and the damage is found to be in the allowable rework limits, no additional inspections are necessary before the airplane returns to service. However, during the rework process, other inspection steps may be necessary to make sure that all of the damage was identified and all the necessary rework actions were done.

5. Procedures to Remove Nicks, Scratches and Gouges

NOTE: It is possible to burnish damage that does not go all the way through the clad aluminum. Refer to par. 15.H. for the clad penetration test. Refer to Paragraph 6./GENERAL for burnishing requirements and procedures.

- A. Aluminum Metal Alloys



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CAUTION: DO NOT USE A CARBON STEEL BRUSH OR STEEL WOOL ON ALUMINUM METAL SURFACES.

IF YOU DO, TINY DISSIMILAR METAL PARTICLES WILL BECOME IMBEDDED IN THE SURFACE OF THE METAL. THIS CAN CAUSE CORROSION AND MORE DAMAGE TO THE PART.

- (1) Abrade or use chemicals to remove all of the paint in the damaged area.

CAUTION: COMPLETE DAMAGE REMOVAL IS NECESSARY TO ESTABLISH APPROPRIATE REPAIR ACTIONS AND TO AVOID DEVELOPMENT OF FATIGUE CRACKING. DAMAGE THAT IS NOT COMPLETELY REMOVED CAN REDUCE THE FATIGUE STRENGTH OF THE PART, WHICH CAN RESULT IN CRACKING. IN EXTREME CASES, UNDETECTED CRACKING COULD COMPROMISE STRUCTURAL INTEGRITY.

- (2) Use the abrasives given in Figure 5/GENERAL to blend out the damaged area.
- (3) After you complete the surface rework, then you must use an applicable nondestructive test procedure to make sure that the area does not have cracks.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (4) Clean the damaged area with a soft cloth moist with cleaning solvent. Refer to SOPM 20-30-03 for the applicable cleaning solvent and general cleaning procedures.
- (5) Apply a protective treatment and primer to the base metal surface as given in 51-20-01, GENERAL.
- (6) If necessary, apply a decorative finish to the area. Refer to AMM 51-20-00.

B. Titanium

WARNING: USE CARE WHEN YOU WORK WITH TITANIUM. SMALL PARTICLES OF TITANIUM ARE FLAMMABLE. IN A SUFFICIENT CONCENTRATION, AN EXPLOSION CAN OCCUR. EXTINGUISH ALL FIRES OF TITANIUM WITH FULLY DRY TALC, CALCIUM CARBONATE, SAND OR GRAPHITE. APPLY THE POWDER TO A DEPTH OF 0.50 INCH (12.7MM) OR MORE ON THE AREA THAT IS ON FIRE. DO NOT USE FOAM, WATER, CARBON TETRACHLORIDE, OR CARBON DIOXIDE. WHEN WATER TOUCHES MOLTEN TITANIUM, A STEAM EXPLOSION CAN OCCUR.

- (1) Clean up the damage by sanding manually or with power tools. Do not use a mechanical grinder. Use cloth, or paper-backed silicon carbide or aluminum oxide abrasive that is 80 grit or finer. Wet sanding is the recommended procedure. As an alternative, use stainless steel wool or pumice (350 mesh or finer). Make an abrasive finish as follows:
 - (a) Select the abrasive as given in Figure 5/GENERAL.
 - (b) Use supporting disks for disk sanders that are made from rubber or other flexible material.
 - (c) If applicable, use support drums for drum sanders that have an outer layer of rubber or other flexible material that is 0.10 inch (2.54 mm) thick.
 - (d) Do not use too much pressure, dwell time, or speed (2000 surface feet per minute, maximum).

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- (e) Parts that show discoloration that cannot be removed with Series 80 solvent, must be rejected. Refer to SOPM 20-30-80 for applicable solvents.
- (f) Make the surface finish to 32 microinches Ra or smoother.
- (g) When you remove damage on an edge, make the direction of the marks made by the tools to be parallel to the edge.

C. Magnesium

WARNING: USE CARE WHEN YOU REWORK MAGNESIUM. SMALL PARTICLES AND FINE SHAVINGS OF MAGNESIUM ARE HIGHLY FLAMMABLE. MAGNESIUM DUST IS HIGHLY FLAMMABLE AND CAN CAUSE AN EXPLOSION. WATER WITH HOT MAGNESIUM CAN CAUSE A STEAM EXPLOSION.

EXTINGUISH ALL FIRES OF MAGNESIUM WITH FULLY DRY TALC, CALCIUM CARBONATE, SAND OR GRAPHITE. APPLY THE POWDER TO A DEPTH OF 1/2 INCH OR MORE OVER THE BURNING METAL. DO NOT USE FOAM, WATER, CARBON TETRACHLORIDE, OR CARBON DIOXIDE. IF YOU DO, YOU CAN CAUSE INJURY TO PERSONS.

CAUTION: DO NOT USE CARBON STEEL BRUSH OR STEEL WOOL ON MAGNESIUM SURFACES. TINY DISSIMILAR METAL PARTICLES WILL BECOME IMPEDDED IN THE MAGNESIUM CAUSING FURTHER CORROSION AND SUBSEQUENT DAMAGE TO PART.

DO NOT USE SILICON CARBIDE ABRASIVES ON MAGNESIUM SURFACES.

- (1) Identify the material as magnesium.
- (2) Fully clean the damaged area.
- (3) Sand all of the paint film in the damaged area to make a smooth surface.

NOTE: Sand down through the metal surface, as necessary, to remove all of the damage.

- (4) Do an inspection to measure the damage.
 - (a) Do a visual inspection with a 10-power magnifying glass to make sure all of the damage was removed.
 - (b) If, after the above visual inspection, you think there could be more damage below the surface, then do an eddy current inspection or a penetrant inspection on the repair area.
 - (c) To find damage below the surface, refer to NDT Part 1, 51-06-00 and NDT Part 1, 51-00-01, and NDT Part 9, 51-00-01 of the NDT Manual for eddy current inspections. Refer to SOPM 20-20-02 for the penetrant inspections.
 - (d) All of the damage must be removed. Repeat this inspection procedure until no more damage can be found by these inspection procedures.
- (5) After all of the damage is removed, apply a protective treatment to the bare metal surface as given in SOPM 20-43-02.

D. Metallic and Non-Metallic Composite Materials

- (1) For the cleanup of damage for Aramid Fiber, Carbon Fiber, Glass Fiber and Hybrid Fiber composite structures, refer to the allowable damage section in the component section of the specified chapter-section-subject.

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- (2) Refer to 51-70-16, GENERAL for specific machining methods of non-metallic composite materials.
- (3) Also, see Figure 6/GENERAL for recommended methods when a band saw is used on metallic and non-metallic honeycomb core materials.

6. Burnishing

- A. Unless the allowable damage section specifies differently, burnishing is a procedure that you can use to remove small nicks, scratches, and gouges in an unpainted, clad aluminum surface.
- (1) Refer to Paragraph 16.H./GENERAL for the clad penetration test.
 - (2) You can burnish clad aluminum surfaces of secondary structure if the damage does not go through the clad. It is not necessary to do supplemental inspections or to record the location of the damage. If the damage goes through the clad aluminum, refer to the applicable allowable damage section for instructions to remove the damage.
 - (3) You can burnish clad aluminum surfaces of primary structure if the damage agrees with the conditions in Figure 7/GENERAL.

NOTE: If Figure 7/GENERAL does not let you burnish the damage, you can do one of the alternatives that follow:

- Get an inspection plan from Boeing, or
 - Refer to the SRM allowable damage and repair sections, or
 - Replace the part.
- (a) Burnished areas that agree with the conditions in Figure 7/GENERAL can be inspected at intervals specified in the airline maintenance planning data. It is not necessary to do supplemental inspections or to record the location of the damage.
 - (b) Remove damage that goes through the clad aluminum as given in the applicable allowable damage or repair sections. Refer to Paragraph 5./GENERAL.

- B. To burnish an area with a small defect:

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (1) Clean the damaged area with a soft cloth moist with cleaning solvent. Refer to SOPM 20-30-03 for the applicable cleaning solvent and general cleaning procedures.
- (2) Use an ST990, ST994 or equivalent burnishing tool.
- (3) Put a petroleum jelly lubricant (or equivalent) on the area to be burnished.
- (4) Rub along the sides of the defect while you push the clad aluminum to the center of the damaged area.
- (5) Stay at less than 0.25 inch (6 mm) from the edge of the damage while you push on the clad aluminum.
- (6) Gradually decrease the pressure until the burnished area is smooth.
- (7) Remove the lubricant from the aluminum.
- (8) Clean and then apply a chemical conversion coating to the bare metal of the skin. Refer to 51-20-01, GENERAL.



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7. Damage That Can Be Repaired

- A. Unless the repair procedure is specified as a temporary repair, all of the repair procedures in this structural repair manual are permanent repairs. It is not necessary for permanent repairs to have more aircraft inspections other than the specified maintenance inspections given by the FAA regulations.

CAUTION: DURING A REPAIR PROCEDURE, YOU MUST USE EXTREME CARE TO MAKE SURE THAT THE DRAIN HOLES HAVE NOT BEEN COVERED BY REPAIR PARTS. ALSO, THE DRAIN HOLE LOCATIONS MUST NOT BE REMOVED DURING THE REMOVAL OF THE DAMAGED AREA. WHEN YOU DO A REPAIR, THE DRAIN HOLES MUST BE KEPT IN THEIR INITIAL POSITIONS, IF POSSIBLE. ALL REPAIR FASTENERS MUST BE SPACED CORRECTLY, SO THAT YOU CAN INSTALL DRAIN HOLES INTO THE REPAIR PARTS.

- B. Make repairs to:

- (1) Repairable external surface damage by an external or a flush-type repair as given in Paragraph 7.C./GENERAL and Paragraph 7.D./GENERAL.
- (2) Repairable internal region damage as applicable in repairs that are called out in subjects throughout this manual.

- C. An external repair is a repair that can be applied quickly. It is used to keep airplane down-time to a minimum. It is usually a field-oriented type repair, as opposed to a repair that is done in a shop. This type of repair protrudes in relationship to a damaged aerodynamic surface. You can replace this type of repair if necessary for appearance or aerodynamic reasons. Refer to Paragraph 7.D./GENERAL.

- D. A flush repair is a repair that can be used to replace an external repair as described in Paragraph 7.C./GENERAL above. It is normally a shop-type procedure, opposite a field-oriented type repair. This type of repair is flush in relationship to a damaged aerodynamic surface.

- E. The repair types given in Paragraph 7.C./GENERAL and Paragraph 7.D./GENERAL above are structural equivalents of each other for static strength. The operator has the option to use either type for a structurally airworthy, FAA approved repair. Some repairs are designed so that fastener holes that are made during a field-type repair can be used for a subsequent shop-type repair.

NOTE: The performance of the airplane can be affected by external-type repairs made in aerodynamic critical areas. Refer to 51-10-01, GENERAL.

- F. All of the other repairs that are given in this manual that cover internal metal structural components:

- (1) Are structurally airworthy
- (2) Are FAA approved for the service life of the airplane
- (3) Can be flush or external type of repairs.

- G. Category B (Interim) and Category C (Time-Limited) Repairs.

- (1) Refer to 51-00-06, GENERAL for the correct definitions of these types of repairs.
- (2) Category B (interim) repairs can stay on the airplane indefinitely, if you find that there are no signs of deterioration of the repair area during regular supplemental maintenance inspections.
 - (a) Interim repairs must be inspected at specified intervals and replaced if any deterioration is evident. These times are usually defined as flight hours, flight cycles or letter checks. The letter checks are different from model to model for Boeing airplanes.
 - (b) The repairs are FAA approved contingent on the accomplishment of inspections at the intervals specified in this document.

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- (3) Category C (Time-Limited) types of repairs given in this manual are temporary repairs. These types of repair designations can provide a practical solution to a specific repair problem.
 - (a) Time-limited repairs must be replaced after a specified time with a permanent repair. These times are usually defined as flight hours, flight cycles or letter checks. The letter checks are different for different models of Boeing airplanes. The letter checks are specified in the Maintenance Planning Data document. Periodic inspection requirements may be imposed to ensure the integrity of the repair.
 - (b) These repairs are FAA approved contingent on the accomplishment of inspections at the intervals specified and the installation of a permanent repair by a specified time.
- (4) The SRM contains some allowable damage and repairs that use letter checks to define when a subsequent inspection and repair must be done. Examples are A-check or C-check. If an operator does not use letter checks or divides letter checks into segments, an equivalent time interval to the letter checks must be used. Refer to the Airline Maintenance Inspection Intervals document, D6-26100. Example: An operator divides a C-check into four segments (Segments 1 through 4). During segment 2, damage that is found must be repaired by the next C- check as given in the SRM. Thus, the damage must be repaired by segment 2 of the next C- check interval.

8. Replacement of the Part

- A. The option to replace a part is given when the repair of the component is not a recommended solution.
 - (1) Sometimes, the amount of damage to the part will make it necessary to replace it.
 - (2) These situations are specified in the different allowable damage and repair chapter-section-subjects given in this manual.
- B. The repair procedures specified in Chapters 52 through 57 give the approved repairs for the repairable structural items.
- C. The structural items that do not have entries are called repairable by replacement.

9. Repair of Damage that is more than the Allowable Damage Limits

NOTE: Refer to the repair sections in Chapters 52 through 57 to see if more applicable repair instructions are available.

- A. Remove the initial finish as necessary to apply a sealant or to apply a protective treatment to the surface.
- B. Remove the damaged components to be replaced and the damaged areas to be repaired.

NOTE: Use the router and template (Figure 2/GENERAL), or the hole saw (Figure 3/GENERAL), to cut circular holes in aluminum honeycomb or fiberglass structure.
- C. Remove all the nicks, scratches, burrs, and sharp edges from repair parts and the surfaces of the initial parts as given in this chapter-section-subject.
- D. Apply a chemical conversion coating to the surfaces or edges of the initial aluminum parts and the aluminum repair parts as given in 51-20-01, GENERAL.
- E. Apply the protective finish as necessary to the initial and repair parts.
- F. Determine the sealing level and the type of sealing procedures necessary. Refer to 51-20-05, GENERAL for sealant materials and substitute sealant materials.
 - (1) For external surfaces when access is limited, seal the mating surfaces with the sealant materials that follow:
 - (a) For pressure requirements, use BMS 5-95.

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- (b) For high temperature requirements, use BMS 5-63.
- (c) For moisture protection requirements, use BMS 5-95.

NOTE: You can use the squeegee shown in Figure 4/GENERAL to apply the sealant.

- (2) For flush repairs on external surfaces when access is available to the pressurized side, use the fillet seal and fastener seal procedures. Use mating surface sealants for flush repairs when access is limited or not available. Apply fillet and fastener sealants with the sealant materials that follow:
 - (a) For integral tank requirements, use BMS 5-26 or BMS 5-45 (refer to 51-20-05, GENERAL).
 - (b) For pressure requirements, use BMS 5-70 or 5-95.
 - (c) For high temperature requirements, use BMS 5-63 (refer to SOPM 20-60-04).
 - (d) For moisture requirements, use BMS 5-95.

G. Make the Repair Parts

- (1) Refer to the specified chapter-section-subject to make the repair parts.
- (2) See Figure 5/GENERAL to machine the metallic or non-metallic honeycomb core parts.

H. Prepare the mating surfaces for the installation of the repair parts.

- (1) For external repairs:
 - (a) Clean the mating surfaces.
 - (b) Apply the correct sealant material as given in par. F. above.
 - (c) Install the repair parts.
 - (d) Install the necessary fasteners. Refer to 51-40-02, GENERAL.
 - (e) Apply the protective finish if necessary as given in AMM 51-21-00.
- (2) For flush repairs:
 - (a) Clean the mating surfaces.
 - (b) Apply the adhesive to the mating surfaces. You can use the squeegee shown in Figure 4/GENERAL.
 - (c) Install the repair parts.
 - (d) Apply the necessary fillet seal and the sealant to the fasteners.
 - (e) Apply the aerodynamic smoother (BMS 5-95) to the gaps as necessary in the aerodynamically critical areas.
 - (f) Apply the protective finish as necessary. Refer to AMM 51-21-00.

I. Do the other necessary post repair checks.

- (1) Balance the control surfaces again as necessary. Refer to CONTROL SURFACE BALANCING, SECTION/51-60.

10. Hole Preparation for Repairs

CAUTION: USE SUFFICIENT PRECAUTIONS TO MAKE SURE THAT SYSTEM COMPONENTS, AIRPLANE ELECTRICAL WIRES AND STRUCTURES, ARE NOT DAMAGED BY DRILLS, METAL SHAVINGS AND OTHER CONTAMINATION WHILE YOU DO WORK. METAL SHAVINGS OR CONTAMINATION LEFT IN THE AIRPLANE CAN TOUCH WIRE BUNDLES AND CAUSE CHAFING DAMAGE TO ELECTRICAL WIRES. CHAFFED WIRES CAN CAUSE ARCING DAMAGE.

A. Drilling a Fastener Hole in Metal Structure

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- (1) Refer to 51-40-05, GENERAL for fastener hole sizes.
- (2) All of the repair procedures given in the manual strongly recommend that you use properly sized and properly maintained drills and drill bits.
- (3) When necessary to prepare a hole, use a bushing tool as a guide to obtain a hole that is not larger than the drill size. Also use the bushing tool to hold the drill perpendicular to the repair surface.
- (4) Use the correct drill speed, in feet per minute, which will give a smooth, bright finish throughout the hole surface.
- (5) If the hole has a rough or galled surface, then manually hand-ream the hole until the inside surface is smooth.
- (6) You must follow the recommendations given in the repair procedures, so that the repairs and preventive modifications will stay on the airplane during its service life.

B. Removal of Small Cracks and Fatigue Damaged Material from an Existing Hole (Zero-Timing)

- (1) This procedure is recommended for the initial fastener holes before a repair part is installed. Zero-Timing makes the repair durability better. If this procedure is done for all existing fastener holes in the critical rows of the repair (which are usually the perimeter fasteners of the repair doubler in a skin repair) then the inspection threshold will start from the time of repair installation. If not, then the threshold starts from the time the airplane was delivered.
- (2) Visually inspect all of the existing holes for irregular surface conditions such as burrs, galling, corrosion and out-of-round holes.

These irregular surface conditions can interfere with the High Frequency Eddy Current (HFEC) inspection. For this reason you can use a Borescope, an Endoscope or other types of optical aids to help the visual inspection.

NOTE: If a "clean-up" is necessary to remove one or more of these conditions, ream the hole to 1/64 inch oversize from its existing size. A surface finish of 125 Microinches Ra or better is necessary.

- (3) Inspect the fastener hole by the HFEC method. Refer to NDT Part 6, 51-00-01 for the inspection of the open hole.
 - (a) If no cracks are found, make the hole diameter 1/16 inch oversize to remove any fatigue damaged material.
 - (b) If cracks are found, make the hole diameter larger by 1/64 inch increments until HFEC inspection shows no more cracks. Then, make the hole another 1/16 inch larger to remove any fatigued damaged material.

NOTE: The limit to make the hole larger is different for each situation and depends on the load pattern and the stress levels in the rework area. Sometimes, it may be necessary to install a plug through which a fastener that is the same size as the initial fastener can be installed. Refer to 51-20-07, GENERAL for freeze plug installation.

- (4) Ream the hole, as necessary, to the finished size for installation of the fastener or the plug.
- (5) If coldworking is necessary, ream the hole to the correct size and do the coldworking procedure.

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11. Procedure for Stop-Drilling of Cracks

NOTE: Stop-drilling a crack prevents its growth. You can use this procedure for stop-drilling of a crack, only if it is referred to in the applicable allowable damage or repair chapter-section-subject or other approved repairs. If this procedure for stop-drilling of cracks is not referred to in the applicable allowable damage or repair procedure or other approved repairs, then all of the cracks must be cut out and a repair for the cutout must be done.

A. The correct procedure for stop-drilling a crack is as follows:

- (1) Drill or counterbore a 0.25-inch stop hole through the structure at each end of the crack. Drill the hole in a position so that the center of the hole is 0.10 inch past the visible end of the crack.
- (2) Do an HFEC inspection of each drilled stop hole. Refer to NDT Part 6, 51-00-04 for the inspection of the open hole. Make sure that there are no more cracks on the side opposite from the initial crack.
 - (a) If a crack is not found, make the hole 1/16 inch in diameter larger to remove any fatigue damaged material.
 - (b) If a crack is found, make the hole larger by 1/64 inch increments until no crack remains. Then, make the hole another 1/16 inch larger to remove any fatigue damaged material.

NOTE: The limit to make the hole larger is different for each situation and depends on the load pattern and the stress levels in the rework area.

- (c) In aluminum structures, install a 2017-T3 or 2017-T4 aluminum plug rivet into the stop-holes, if necessary.
- (d) In titanium, corrosion-resistant steel (CRES), and inconel structures, install a monel plug rivet into the stop-holes, if necessary.

12. Missing or Loose Fasteners in Secondary Structure

A. Refer to 51-10-05, GENERAL to see if it is possible to operate an airplane with missing fasteners in secondary structure.

13. Corrosion Damage and Rework Limits

NOTE: Make sure that you refer to the applicable allowable damage chapter-section-subject for the rework limits and the necessary shot peening.

- A. Corrosion evaluation will be necessary after you do an initial inspection and cleaning procedure to determine the nature and the extent of repair or rework.
- B. Examine the corrosion to make an analysis of the damage. It is difficult to give a distinct and specific dividing line between the various conditions. Thus, the first requirement for evaluation of corrosion damage is good and sound maintenance judgement. Evaluate corrosion as follows:
- (1) Light corrosion: A discoloration or pitting to a depth of approximately 0.001 inch maximum. This type of damage is normally removed with light sanding by hand or a mild chemical treatment.
 - (2) Moderate corrosion: Almost the same as Light corrosion, but there can be evidence of flaking, scaling, or blistering. Pitting can be to the depth of 0.010 inch. This type of damage is normally removed by vigorous manual sanding or by using mechanical sanding equipment.
 - (3) Severe corrosion: More severe than Moderate corrosion. There is evidence of severe blistering, exfoliation, and scaling or flaking. Pitting is deeper than 0.010 inch. This type of damage is removed by hard mechanical sanding or grinding.
- C. For corrosion damage it is necessary to do rework to the damaged area to find the penetration depth of the damage into a structural member, before you can establish its classification as allowable damage or damage requiring repair.

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- D. All corrosion products must be removed completely when corroded structures are reworked as the corroding process will continue even though the affected surface is refinished.

14. Corrosion Damage Removal Procedure and Inspection**A. Aluminum, Steel, and Tungsten**

NOTE: Make sure that you refer to the applicable allowable damage chapter-section-subject for the rework limits and the necessary shot peening.

- (1) Remove all the sludge or powdery material you find in the integral fuel tank area as given in AMM 28-11-00.

CAUTION: WHEN YOU MAKE THE SURFACE ROUGH ON STEEL, MAKE SURE THAT YOU CHANGE THE SPEED AND THE FEEDS TO PREVENT HEAT OR SPARKS. DO NOT PERMIT THE SURFACE TEMPERATURE TO BE MORE THAN WHAT YOU CAN TOUCH WITH YOUR BARE SKIN. IF YOU DO, YOU CAN CAUSE DAMAGE TO THE PART.

WHEN YOU DO ABRASIVE BLAST PROCEDURES IN AREAS WHERE LUBRICATION FLUIDS OR GREASE ARE APPLIED, USE CARE TO PREVENT CONTAMINATION OF THE LUBRICANT WITH THE BLAST RESIDUE. THIS CONTAMINATION CAN AFFECT THE LUBRICATION PROPERTIES AND THE RESULT CAN BE INCREASED WEAR OF THE LUBRICATED PARTS.

- (2) To remove the corrosion, use a rotary file, a rubber-backed disc sander, a carbide-tipped scraper, or aluminum oxide abrasive as necessary. See Figure 5/GENERAL to find the permitted abrasives. Use air motors for all of the power tools. See Figure 1/GENERAL for the tools that are permitted for use.

NOTE: As an alternative, you can use the glass bead blasting procedure to remove filiform corrosion from aluminum clad skins. Do not use glass bead blasting to remove other corrosion on aluminum. Refer to the CPM 20-40-00.

- (3) Make a group of several corrosion spots in a local area so that you have an elliptical-shaped rework surface.
- (4) Carefully blend the edges into the adjacent areas. Make the rework surface equal to 125 microinches Ra or smoother, unless a different surface smoothness is specified in the component repair section.
- (5) Do an inspection for damage caused by corrosion.

CAUTION: ALL CORROSION MUST BE REMOVED TO PREVENT FURTHER CORROSION DAMAGE AND TO ESTABLISH THE APPROPRIATE REPAIR ACTION. CORROSION THAT IS NOT FULLY REMOVED WILL CONTINUE TO PROPAGATE EVEN IF THE PART IS REFINISHED. IN EXTREME CASES, CONTINUED CORROSION PROPAGATION COULD COMPROMISE STRUCTURAL INTEGRITY.

- (a) Do a visual inspection with a 10-power magnifying glass to make sure all of the corrosion was removed and to find possible cracks. You can remove an additional 0.002 inch of material as given in CPM 20-40-00 to make sure that the corrosion has been fully removed. Alternatively, for aluminum structure where the corrosion has attacked the grain boundary of the material, the use of a dye penetrant inspection as given in SOPM 20-20-02 will assist in detecting intergranular corrosion that could have been hidden by the blending process.

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- (b) If, after the above visual inspection, you think there could be cracks, do an eddy current inspection or a penetrant inspection on the repair area. Refer to the applicable Corrosion Preventive Manual for additional data.

NOTE: If the allowable damage or repair subject that refers to this chapter-section-subject for corrosion removal, and the subject has a requirement for the inspection for cracks, then do the eddy current inspection or penetrant inspection.

- (c) Refer to NDT Part 1, 51-06-00 NDT Part 1, 51-06-00 and NDT Part 1, 51-00-01 for eddy current inspections. Refer to SOPM 20-20-02 for the penetrant inspections.
- (d) All of the corrosion and all of the cracks must be removed. Repeat the applicable corrosion damage removal procedure and inspection, until no more corrosion or cracks can be found by these inspection procedures.

WARNING: USE CARE WHEN YOU REWORK MAGNESIUM. SMALL PARTICLES AND FINE SHAVINGS OF MAGNESIUM ARE HIGHLY FLAMMABLE. MAGNESIUM DUST IS HIGHLY FLAMMABLE AND CAN CAUSE AN EXPLOSION. WATER WITH HOT MAGNESIUM CAN CAUSE A STEAM EXPLOSION.

EXTINGUISH ALL FIRES OF MAGNESIUM WITH FULLY DRY TALC, CALCIUM CARBONATE, SAND OR GRAPHITE. APPLY THE POWDER TO A DEPTH OF 1/2 INCH OR MORE OVER THE BURNING METAL. DO NOT USE FOAM, WATER, CARBON TETRACHLORIDE, OR CARBON DIOXIDE. IF YOU DO, YOU CAN CAUSE INJURY TO PERSONS.

CAUTION: MAGNESIUM IS THE MOST CHEMICALLY ACTIVE METAL THAT IS USED TO BUILD AIRPLANES AND IT IS THE MOST DIFFICULT TO PROTECT FROM CORROSION. IF A LOSS IN THE PROTECTIVE COATING OCCURS, YOU MUST ACT IMMEDIATELY TO PREVENT FURTHER CORROSION. IF YOU DO, THE RESULT CAN BE SERIOUS STRUCTURAL DAMAGE.

DO NOT USE SILICON CARBIDE ABRASIVES ON MAGNESIUM SURFACES. DO NOT USE A CARBON STEEL BRUSH OR STEEL WOOL ON MAGNESIUM SURFACES. TINY DISSIMILAR PARTICLES WILL BECOME IMBEDDED IN THE MAGNESIUM CAUSING FURTHER CORROSION AND SUBSEQUENT DAMAGE TO THE PART.

B. Magnesium:

- (1) Identify the material as magnesium.

NOTE: You can find corrosion in magnesium easily. When the corrosion begins, its products can be several times larger than the initial volume of the magnesium metal. The corrosion starts with a separation of the paint film, and as white spots on the surface of the metal which can quickly grow into mound that looks like snow.

You must fully remove the corrosion and apply a chemical treatment and restore the protective coating.

- (2) Fully clean the damaged area.
- (3) If necessary, remove the paint.
- (4) Find the type of corrosion damage and remove it. Refer to Paragraph 5./GENERAL.
- (a) Refer to Paragraph 6./GENERAL to remove light corrosion damage.

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- (b) Refer to Paragraph 7./GENERAL to remove moderate to severe corrosion damage.
- (5) Remove the "light corrosion damage" as follows:

CAUTION: DO NOT USE THIS PROCEDURE FOR:

- ADHESIVE BONDED PARTS OR ASSEMBLIES
- AREAS WHERE THE BRUSH-ON SOLUTION CAN BECOME TRAPPED
- AREAS THAT WERE MADE BARE BY GRINDING FOR ELECTRICAL BONDING

IF YOU DO, DAMAGE TO THE ADHESIVE SYSTEMS CAN OCCUR.

- (a) Remove the loose corrosion with aluminum wool.
- (b) Do an inspection for damage caused by corrosion.
- 1) Do a visual inspection with a 10-power magnifying glass to make sure all of the corrosion was removed and to find possible cracks.
 - 2) If, after the above visual inspection, you think there could be cracks, do an eddy current inspection or a penetrant inspection on the repair area. Refer to the applicable Corrosion Preventive Manual for additional data.

NOTE: If the allowable damage or repair subject that refers to this chapter-section-subject for corrosion removal, and the subject has a requirement for the inspection for cracks, then do the eddy current inspection or penetrant inspection.

- 3) Refer to NDT Part 1, 51-06-00 NDT Part 1, 51-06-00 and NDT Part 1, 51-00-01 for eddy current inspections. Refer to SOPM 20-20-02 for the penetrant inspections.
 - 4) All of the corrosion and all of the cracks must be removed. Repeat the applicable corrosion damage removal procedure and inspection, until no more corrosion or cracks can be found by these inspection procedures.
- (c) Isolate other parts such as rubber parts, bearings, and cast or pressed inserts from the treating solution and its fumes.
- (d) Immediately after all damage is removed, apply DOW 17 (preferred), or DOW 19 (alternative) as given in SOPM 20-43-02.
- (e) Apply two layers of BMS 10-11, Type I primer. Refer to SOPM 20-41-02.
- (f) Apply two layers of BMS 10-60, Type I or II enamel.
- (6) Remove "moderate to severe corrosion damage" as follows:

WARNING: WEAR PROTECTIVE GOGGLES OR A FACESHIELD WHEN YOU REMOVE THE CORROSION. IF YOU DO, THE RESULT CAN BE INJURY TO PERSONS.

CAUTION: DO NOT USE CARBON STEEL WIRE BRUSHES OR SILICON CARBIDE ABRASIVES ON MAGNESIUM. USE CARE NOT TO CAUSE OTHER DAMAGE FROM THE CORROSION PRODUCTS TO THE AREAS ADJACENT TO THE DAMAGE. IF YOU DO, YOU CAN CAUSE MORE DAMAGE TO THE PARTS.

- (a) Remove the heavy corrosion products with a stainless steel wire brush.
- (b) Remove the remaining corrosion by sanding. Use the applicable abrasive as given in Figure 5/GENERAL.
- (c) Do an inspection for damage caused by corrosion.

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- 1) Do a visual inspection with a 10-power magnifying glass to make sure all of the corrosion was removed and to find possible cracks.
- 2) If, after the above visual inspection, you think there could be cracks, do an eddy current inspection or a penetrant inspection on the repair area. Refer to the applicable Corrosion Prevention Manual for additional data.

NOTE: If the allowable damage or repair subject that refers to this chapter-section-subject for corrosion removal, and the subject has a requirement for the inspection for cracks, then do the eddy current inspection or penetrant inspection.

- 3) Refer to NDT Part 1, 51-06-00 NDT Part 1, 51-06-00 and NDT Part 1, 51-00-01 for eddy current inspections. Refer to SOPM 20-20-02 for the penetrant inspections.
- 4) All of the corrosion and all of the cracks must be removed. Repeat the applicable corrosion damage removal procedure and inspection, until no more corrosion or cracks can be found by these inspection procedures.

CAUTION: APPLY PROTECTION TO THE BARE MAGNESIUM SURFACE. CORROSION BEGINS WITH THE SEPARATION OF THE PAINT FILM FROM THE METAL.

- (d) Immediately after all damage is removed, apply DOW 17 (preferred), or DOW 19 (alternative) as given in SOPM 20-43-02.
- (e) Apply two layers of BMS 10-11, Type I to the reworked area. Refer to SOPM 20-41-02.
- (f) Apply two layers of BMS 10-60, Type I or II enamel.

15. Safety Procedures for Working with Chemicals

NOTE: Paragraph 15.A./GENERAL contains the general safety precautions, which contain specific rules for handling chemicals with hazardous physical properties. Paragraph 15.B./GENERAL contains emergency procedures for the immediate treatment of personnel who have inadvertently come into contact with one of the harmful chemicals. Chemicals having hazardous physical properties are given in the manufacturer's safety precautions and emergency safety procedures. All personnel that use or handle hazardous chemicals must fully know the safety data contained in the paragraphs that follow.

A. General Safety Precautions

- (1) When it is necessary to use or handle any of the solvents, special cleaners, paint strippers (strong alkalis and acids), etchants (corrosion removers containing acids), or surface activation material (chemical conversion coatings), you must obey the safety precautions that follow:
 - (a) Avoid long term breathing of solvents or acid vapors. Do not use solvents and acids in confined spaces without sufficient ventilation or approved respiratory protection.
 - (b) Never add water to acid. Always add acid to water.
 - (c) Do not mix chemicals except as given in a specified mixing procedure.
 - (d) Clean water that you use for emergencies must be available in the immediate work area before you work with chemicals.
 - (e) Avoid long term or repeated contact of solvents, cleaners, etchants (acid), or chemical conversion coating material with skin.
 - 1) Rubber or plastic gloves must be worn when you use solvents, cleaners, paint strippers, etchants, or conversion coating materials.
 - 2) Goggles or plastic faceshields and suitable protective clothing must be worn when cleaning, stripping, etching, or applying a conversion coating to overhead surfaces.



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- (f) When you mix alkalies with water or other substance, use containers which are made to withstand heat generated by this process.
- (g) Wash any paint stripper, etchant, or conversion coating material immediately from body skin or clothing.
- (h) Materials splashed in the eyes must be immediately flushed out with water. Get immediate medical aid for the injured personnel.
- (i) Do not eat or keep food in areas where it can absorb toxic poisons. Always wash your hands before eating or smoking.
- (j) All equipment must be cleaned after work has been completed.
- (k) Implement all company specified safety precautions in your work area.

B. Emergency Safety Procedures

WARNING: PERSONNEL MUST BE THOROUGHLY FAMILIAR WITH THE FOLLOWING EMERGENCY SAFETY PROCEDURES BEFORE THEY CAN USE ANY MATERIALS WHICH ARE REFERENCED IN ANY EMERGENCY SAFETY PROCEDURE PARAGRAPHS.

- (1) If one or more persons are exposed to physical contact with these materials, then use the safety procedures that follow:
 - Methyl Alcohol
 - Methyl Ethyl Ketone
 - Methyl Isobutyl Ketone
 - Toluene
 - Trichloroethylene
 - Epoxy resin
 - Methylene Chloride
 - Chemical conversion coatings
 - Xylene
 - Petroleum Naphthas
 - Chromates
 - Dichromates
 - Acetates
 - Cyclohexanone
 - Cellosolve
 - Carbon Tetrachloride
- (a) If a chemical is splashed into the eyes, do not rub them.
- (b) Flush the eyes immediately with water for at least 15 minutes. Lift upper and lower eyelids frequently to make sure of complete washing.
- (c) If a chemical is splashed on clothing or large areas of the body, immediately remove contaminated clothing and wash the body with plenty of soap and water. Also, wash the clothing before they are worn again.
- (d) If a chemical is splashed onto an easily accessible part of the body, immediately wash with soap and water.

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- (e) If a person is suffering headache or other obvious symptoms resulting from overexposure to chemicals, move the person to fresh air immediately.
 - (f) If a person inhales chemical vapors and the persons breathing has slowed down or stopped, then remove the person from the area and start artificial respiration immediately. Call for medical aid and continue this procedure until medical aid arrives.
- (2) If one or more persons are exposed to physical contact with any of the materials that follow:
- Hydrofluoric acid
 - Nitric acid
 - Phosphoric acid
 - Phenol
 - Cresols
 - Tricresyl phosphate

Treat as follows:

WARNING: IT CANNOT BE OVEREMPHASIZED THAT IMMEDIATE TREATMENT IS MOST IMPORTANT WITH SKIN, EYE AND INHALATION EXPOSURE TO THESE MATERIALS.

- (a) Eyes: If splashed into the eyes, do not rub them. Flush them immediately with water for at least 15 minutes. Lift upper and lower eyelids frequently to make sure of complete washing. Call for medical aid immediately.
- (b) Exposed Skin: If splashed on skin, wash affected area with large amounts of water for at least 15 minutes. Get medical aid as soon as possible.
- (c) Clothing: If splashed on clothing or large area of body, remove contaminated clothing and wash body under a shower for at least 15 minutes. Wash clothing before reuse. Get medical aid as soon as possible.
- (d) Inhalation: If vapors are inhaled, remove worker to fresh air and apply artificial respiration, if necessary. Call for medical aid immediately.

NOTE: Tricresyl phosphate is not considered an inhalation hazard.

- (e) Internally: Use one of the procedures that follow:
 - 1) Worker is unconscious:
 - a) Do not give any liquid.
 - b) Begin artificial respiration and have someone call for medical aid immediately.
 - 2) Worker is conscious:
 - a) Phenols and Cresols: Do not attempt to induce vomiting. Encourage him to wash out his mouth with large amounts of water. Call for medical aid immediately.
 - b) Phosphoric Acid: Do not induce vomiting. Call for medical aid immediately.
 - c) Hydrofluoric Acid: Drink water to dilute acid, then cause vomiting by placing finger in the back of throat. Repeat. Wash out mouth repeatedly. Call for medical aid immediately.
 - d) Nitric Acid: Do not induce vomiting. Drink copious amounts of water, if possible. Call for medical aid immediately.



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- e) Tricresyl Phosphate: Cause vomiting by placing finger in the back of the worker's throat. If necessary, have him drink water, then use finger to induce vomiting. Call for medical aid immediately.

16. Identification of Metals

- A. Make sure that you refer to the applicable subjects in Chapters 52 through 57 in this manual to identify the metal material. If positive identification cannot be made, then chemical spot testing can be done.

WARNING: PERSONNEL MUST BECOME THOROUGHLY FAMILIAR WITH THE SAFETY PRECAUTIONS AND EMERGENCY SAFETY PROCEDURES, PAR. 14., PRIOR TO PERFORMING ANY CHEMICAL TESTING.

CAUTION: CHEMICAL SPOT TESTING SHOULD BE USED ONLY WHEN ALL OTHER MEANS OF IDENTIFICATION HAVE BEEN EXHAUSTED.

FASTENERS MUST NOT BE IDENTIFIED BY CHEMICAL SPOT TESTS.

- B. A serious problem encountered in corrosion control is the identification of the metal on which corrosion occurs. The importance of this identification arises from the fact that all metals possess certain chemical characteristics that are common only to themselves; and which vary greatly from metal to metal, and from alloy to alloy of the same metal.
- C. Since these characteristics are common to all metals and their alloys, chemical cleaning solutions and chemical protective films will react differently with various metals, and in some cases, produce adverse reactions which can severely weaken or destroy the structural capabilities of the metal. Aluminum, steel, and magnesium sheet and plate are stenciled on the back for identification.
- D. When these markings are not distinguishable or the metal is not identified in the applicable section, or when a plating material needs to be identified, positive identification can be made by chemical spot testing, hardness testing, or a combination of the two methods.
- E. Chemical Testing

- (1) The chemical identification of the various types of metals used in airplane construction should be accomplished. Before any tests are conducted, the preliminary surface preparation and primary classification of the metal should be accomplished by the following procedure:

CAUTION: MASK ANY ADJACENT STRUCTURE MADE OF ADVANCED COMPOSITES. PAINT REMOVER CAN DAMAGE THE RESIN SYSTEM IN FIBERGLASS, ARAMID AND CARBON FIBER STRUCTURE.

- (a) On the surface to be tested, choose an area where there is no corrosion and remove paint (if present) from a 1-inch square.
Paint may be stripped with a cloth soaked in methyl ethyl ketone or paint remover or any equivalent material.
- (b) Clean area of surface to be tested.
- (c) Try to identify the exposed metal surface by visually comparing it with samples of previously identified materials.
- (d) Identify the metal as ferrous or nonferrous by placing a magnet on the exposed surface.
 - 1) Magnetic attraction classifies the base metal as a ferrous magnetic material (iron or steel).

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- 2) The absence of magnetic attraction classifies the base metal as either an austenitic steel or a nonferrous metal (aluminum, magnesium, etc.).
- (e) If the metal is magnetic, refer to par. F. for chemical spot testing. If the metal is nonmagnetic, refer to par. G. Refer to par. H. for clad aluminum penetration test.

F. Chemical Spot Analysis of Magnetic Metals

- (1) The magnetic metals usually employed in airplane construction are ferrous alloys (low alloy steel and chromium-nickel-iron alloys sometimes called stainless steels). These magnetic alloys, when plated, are generally plated with either chromium, nickel, zinc, cadmium, silver, or with a combination of these platings. If a magnetic alloy has been plated with cadmium, zinc, or chromium, it will exert magnetic attraction. Nickel plating will show slight magnetic attraction even if the substrate or base metal is not magnetic.
- (2) If positive identification of the metal plating is necessary, identification by chemical spot analysis should be made after accomplishing a hardness test as detailed in 51-20-02, GENERAL.

CAUTION: DO NOT PERFORM CHEMICAL SPOT TEST ON STEELS HEAT-TREATED TO 220,000 PSI AND ABOVE.

- (a) Place a drop of 10% hydrochloric acid (HCl) on the prepared metal surface. Make sure that the surface is dry before applying acid.
 - 1) A rapid reaction producing a dark deposit indicates that the metal is zinc.

WARNING: THE ADDITION OF SODIUM SULFIDE (Na₂S) TO ACID PRODUCES A POISONOUS GAS. ADEQUATE VENTILATION MUST BE PROVIDED WHEN THESE TESTS ARE BEING PERFORMED. DO NOT ALLOW LARGE QUANTITIES OF SODIUM SULFIDE (Na₂S) AND ACID TO BE MIXED.

- 2) A slow or no reaction indicates that the metal may be cadmium, chromium, nickel, or steel.
- (b) After 1 minute, add a drop of sodium sulfide (Na₂S) to the drop of hydrochloric acid (HCl).
 - 1) A white precipitate identifies the metal as zinc.
 - 2) A yellow ring formed around a white precipitate identifies the metal as cadmium.
 - 3) A black ring formed around a white precipitate identifies the metal as iron or steel.
 - 4) A black precipitate indicates that the metal is chromium or nickel.
- (c) Confirm the cadmium, zinc, iron, or steel test by placing a drop of 20% nitric acid (HN0₃) on a fresh spot. After 1 minute, add a drop of sodium sulfide (Na₂S) to the drop of nitric acid (HN0₃).
 - 1) A white precipitate identifies the metal as zinc.
 - 2) A yellow precipitate identifies the metal as cadmium.
 - 3) A black spot identifies the metal as iron or steel.
- (d) Confirm the chromium test by placing a drop of 10% hydrochloric acid on a fresh spot. Add a drop of concentrated sulfuric acid (H₂SO₄) to the drop of hydrochloric acid.
 - 1) A color change to green after 1 or 2 minutes identifies the metal as chromium.
- (e) Confirm the nickel test by placing a drop of ammonium hydroxide (NH₄OH) to the drop of dimethylgloxime solution.
 - 1) A pink to red precipitate identifies the metal as nickel.
- (f) Clean and refinish as given in Paragraph 16.I./GENERAL.

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G. Chemical Spot Analysis of Nonmagnetic Metals

- (1) The most common nonmagnetic metals used in airplane construction are aluminum, magnesium, and austenitic steels (generally used as 18-8 stainless steel). The positive identification of these nonmagnetic metals is accomplished by the following procedure:
- (a) Place a drop of 10% hydrochloric acid (HCl) on the prepared metal surface and allow to stand for 1 minute. Make sure that the surface is dry before applying acid.
- NOTE:** Zinc deposits on nonmagnetic metals will react with 10% hydrochloric acid but will not produce a black spot.
- 1) A rapid or violent reaction that produces a black spot indicates that the metal is magnesium.
 - 2) A slow reaction indicates that the metal is aluminum.
 - 3) No reaction indicates that the metal is an austenitic steel or a nonmagnetic plating material.
- (b) If a reaction that did not produce a black spot is noted in step (a), determine if zinc is present as detailed in Paragraph 16.E./GENERAL
- (c) If the results of step (b) preceding are negative, confirm the magnesium and aluminum tests by placing a drop of 10% sodium hydroxide (NaOH) on a fresh spot. Check for the following:
- 1) No reaction which will identify the metal as magnesium.
 - 2) A reaction that produces a colorless spot to identify the metal as a clad-aluminum alloy.
 - 3) A reaction that produces a black spot to identify the metal as a bare-aluminum alloy.
- (d) If an aluminum alloy is identified in step (a), then do a test to distinguish the different alloys by placing a drop of 10 percent cadmium chloride on a fresh spot.
- 1) A dark gray deposit forming within a few seconds will identify the metal as Series 7000 bare-aluminum alloy.
 - 2) A dark gray deposit forming within 2 minutes will identify the metal as Series 7000 clad-aluminum alloy.
 - 3) No deposit formation in the time specified for Series 7000 clad will identify the metal as Series 2000 aluminum alloy (a faint deposit will form after 15 to 20 minutes).
- (e) Confirm the austenitic steel test by dissolving 10 grams of cupric chloride.
- 1) Place (CuCl₂, 2H₂O) in 100 milliliters (cubic centimeters) of hydrochloric acid and placing a drop of the solution on a fresh spot.
 - 2) After 2 minutes, add 3 or 4 drops of distilled water to the drop of hydrochloric acid solution and dry the surface.
 - 3) The appearance of a brown spot identifies the metal as an austenitic steel.
- (f) If no reaction was noted in step (a) or (e) preceding, test for a plating material as detailed in steps (a) through (c).
- (g) If step (f) reveals the presence of plating on the nonmagnetic metal, the plating must be removed by mechanical abrasion and the base metal identified by the visual and/or chemical methods.
- (h) Clean and refinish as given by Paragraph 16.I./GENERAL.

H. Clad Penetration Test

- (1) Clean the area to be tested by swabbing with a soft wiper moistened with BMS 3-2 solvent.



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- (2) Wipe the surface dry.
- (3) Mask off damage to prevent staining of adjacent areas by test solution. Allow no more than 1/32 inch bare metal around periphery of damage.

WARNING: DO NOT ALLOW TEST SOLUTION TO CONTACT SKIN OR EYES. WEAR PROTECTIVE CLOTHING AND EYE PROTECTION. THE TEST SOLUTION IS CAUSTIC AND WILL CAUSE INJURY TO PERSONNEL.

- (4) Mix the test solution. Use the following proportions:
 - Potassium Nitrate - 200 grams
 - Sodium Hydroxide - 100 grams
 - Water to make one liter of solution

CAUTION: DO NOT ALLOW TEST SOLUTION TO CONTACT ANY OTHER AREA THAN THAT TO BE TESTED. THE TEST SOLUTION IS CAUSTIC AND WILL DAMAGE STRUCTURE.

- (5) Apply 1 drop of test solution to the deepest point of the damage. Use the sharp point of a toothpick. Use the minimum amount of test solution necessary to penetrate to the bottom of the damage.
 - (6) If the bottom of the damage reveals a distinct black indication, the damage has penetrated the cladding to the base material.
 - (7) Do not allow test solution to stand over 3 minutes. Rinse thoroughly with water.
- I. Post Identification Cleaning

WARNING: OBEY ALL THE APPLICABLE SAFETY PRECAUTIONS. THE MATERIALS USED IN THE SPOT TEST ARE DANGEROUS. IF YOU DO NOT, THE RESULT CAN BE INJURY TO PERSONS.

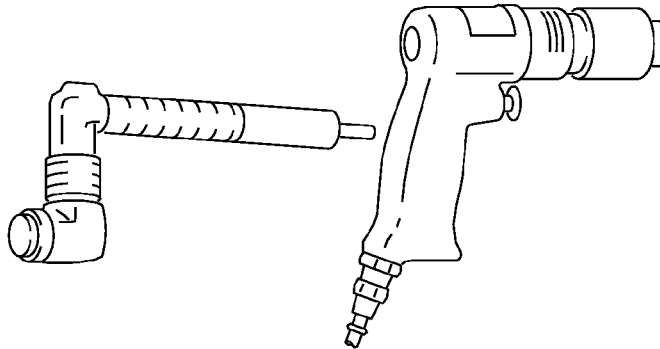
- (1) After identification of the metal is completed, clean the area as follows:
 - (a) Blot any remaining chemicals with a dry cloth.
 - (b) Swab the area several times with a water-moistened cloth.
 - (c) Test the surface by placing a piece of litmus paper on the moistened surface.

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90° AIR MOTOR, 1800 TO 6000 RPM RANGE
MANUFACTURED BY COOPER POWER TOOLS
P.O. BOX 1410
670 INDUSTRIAL DRIVE
LEXINGTON, SOUTH CAROLINA 29071
TELEPHONE NUMBER 1-800-845-5629

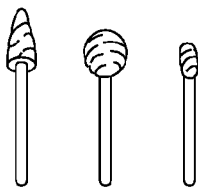
AS AN ALTERNATIVE, YOU CAN USE A
90° AIR MOTOR MANUFACTURED BY
DESOUTTER INCORPORATED
24415 HALSTEAD ROAD
FARMINGTON HILLS, MISSOURI 48335
TELEPHONE NUMBER 1-248-476-5358
OR AN EQUIVALENT SUPPLIER



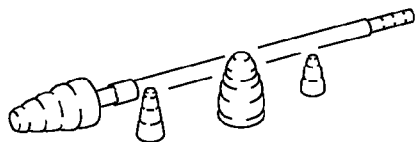
90° AIR MOTOR, 1800 TO 6000 RPM RANGE
MANUFACTURED BY COOPER POWER TOOLS
P.O. BOX 1410
670 INDUSTRIAL DRIVE
LEXINGTON, SOUTH CAROLINA 29071

AS AN ALTERNATIVE, YOU CAN USE A 90° AIR MOTOR
MANUFACTURED BY DESOUTTER INCORPORATED
24415 HALSTEAD ROAD
FARMINGTON HILLS, MISSOURI 48335
TELEPHONE NUMBER 1-248-476-5358
OR AN EQUIVALENT SUPPLIER

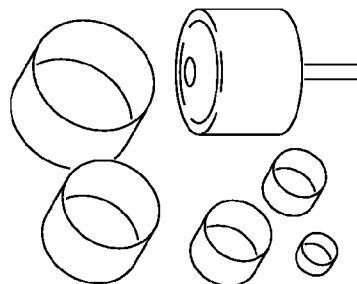
ALSO SHOWN IS A 360° ADAPTER MANUFACTURED BY AN
INDUSTRIAL SUPPLIER OR AN EQUIVALENT SUPPLIER.



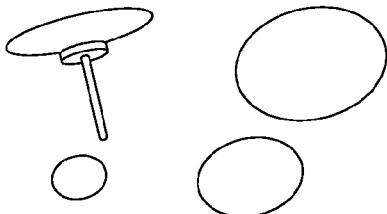
ROTARY FILES. BALL AND CONICAL SHAPES.
MANUFACTURED BY AN INDUSTRIAL SUPPLIER
OR AN EQUIVALENT TYPE OF SUPPLIER.



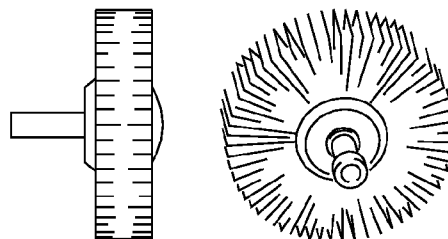
SPIRAPOINT CONES WITH 1/2 INCH DIAMETER ADAPTER
CONE. SIZES 3/4 BY 1-1/2 INCHES, 1/2 BY 3/4
INCH AND 5/8 BY 1-1/2 INCHES. MANUFACTURED BY
AN INDUSTRIAL SUPPLIER OR AN EQUIVALENT TYPE
OF SUPPLIER.



DRUM SANDER. 1/4 INCH DIAMETER DRIVE DRUM.
3/4 INCH AND 1 BY 1 INCH SLEEVE. ALUMINUM OXIDE
ABRASIVE. MANUFACTURED BY AN INDUSTRIAL SUPPLIER
OR AN EQUIVALENT TYPE OF SUPPLIER.



MUSHROOM SANDING PAD WITH 1, 2, AND 3 INCH
DIAMETER ALUMINUM OXIDE ABRASIVE DISCS. 1/4
INCH DIAMETER SHANK FOR AIR MOTOR. 1/4-28
SIZE THREADED SHANK FOR 90° AIR MOTOR
MANUFACTURED BY AN INDUSTRIAL SUPPLIER OR
AN EQUIVALENT TYPE OF SUPPLIER.



FLEXIBLE SANDING WHEEL. "GRIND-O-FLEX," 1/2 BY
2 INCHES AND 1 BY 3 INCHES. 80 GRIT, ALUMINUM
OXIDE ABRASIVE. MANUFACTURED BY AN INDUSTRIAL
SUPPLIER OR AN EQUIVALENT TYPE OF SUPPLIER.

Corrosion Removal Tools Figure 1

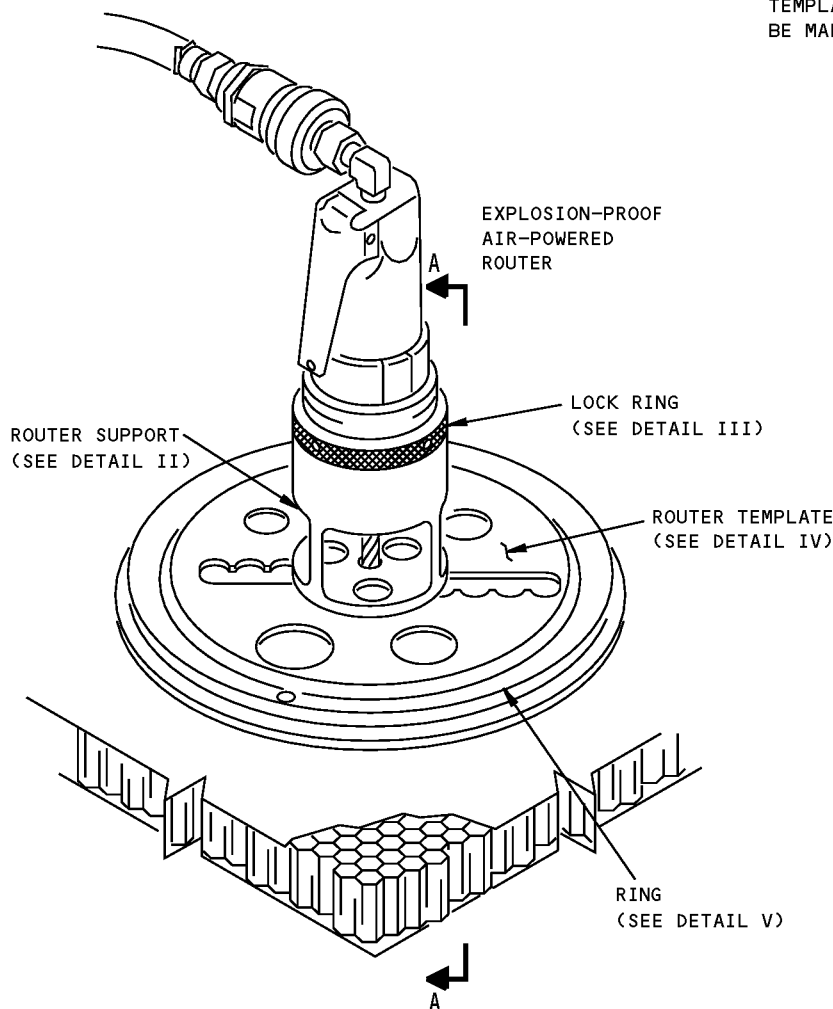
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WARNING: WEAR A FACE SHIELD OR PROTECTIVE EYE GOGGLES WHEN YOU USE THIS ROUTER. DISCONNECT THE AIR SUPPLY WHEN YOU MOUNT OR ADJUST THE ROUTER HEIGHT. IF YOU DO NOT OBEY, INJURY TO PERSONNEL CAN OCCUR.

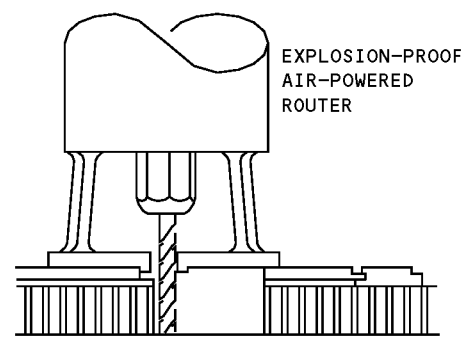
NOTES

- ALL DIMENSIONS ARE IN INCHES.
- AN EXPLOSION-PROOF AIR-POWERED ROUTER ASSEMBLY IS RECOMMENDED FOR THE REMOVAL OF THE SKIN AND DAMAGED CORE IN A FLAT PANEL.
- YOU CAN USE THE ROUTER ASSEMBLY SETUP, SHOWN IN DETAIL I, TO CUT HOLES IN FLAT METAL PANELS OR NON-METAL COMPOSITE PANELS, INCLUDING THOSE WITH A HONEYCOMB CORE.

- HOLD THE ROUTER ASSEMBLY PERPENDICULAR TO THE REPAIR SURFACE AS SHOWN IN DETAIL I.
 - THE ROUTER SUPPORT AND THE LOCK RING ARE DESIGNED TO KEEP THE ROUTER PERPENDICULAR TO THE REPAIR SURFACE.
 - USE THE ROUTER SUPPORT TO ADJUST THE DEPTH OF THE CUT.
- USE THE ROUTER TEMPLATE ASSEMBLY, AS SHOWN IN DETAIL IV, TO TRIM THE DAMAGE FROM THE REPAIR AREA. THIS TEMPLATE IS DESIGNED FOR USE WITH A 0.25-INCH (6mm) ROUTER BIT.
 - THE ROUTER TEMPLATE AND RING ARE DESIGNED TO PERMIT YOU TO CUT CIRCULAR HOLES OF DIFFERENT SIZES.
 - AS AN ALTERNATIVE, YOU CAN USE A PLYWOOD TEMPLATE THAT IS DESIGNED TO PERMIT CUTS TO BE MADE IN OTHER SHAPES AND SIZES.

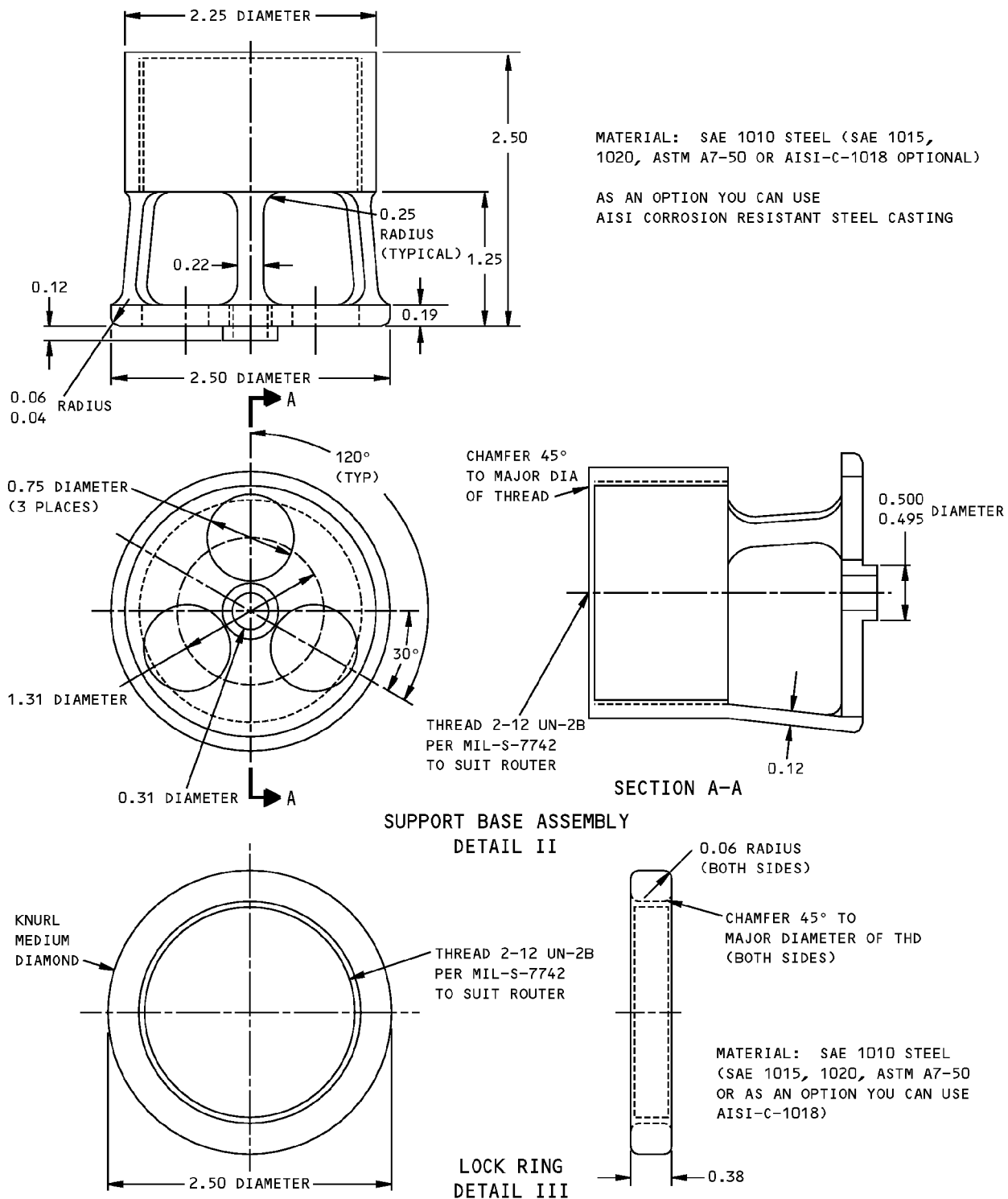


DETAIL I
TYPICAL ROUTER ASSEMBLY



Router and Template
Figure 2 (Sheet 1 of 4)

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INSTRUCTIONS TO USE THE ROUTER TEMPLATE

NOTE: The router template is designed to guide the air-powered router assembly while it cuts out damage in a circular outline with 0.25 inch router bit. see detail iv.

1. To cut out larger diameters from the repair area, put the template ring over the center of the damage.

2. Put masking tape down over the template to hold it in position for cutting.

NOTE: The template turns freely inside the ring. The heads of the two screws prevent the template from moving out of its seated position.

3. Start routing the area from the center of the damage. Put the router into the semicircular slot labeled "Slot 1" shown in Detail IV.

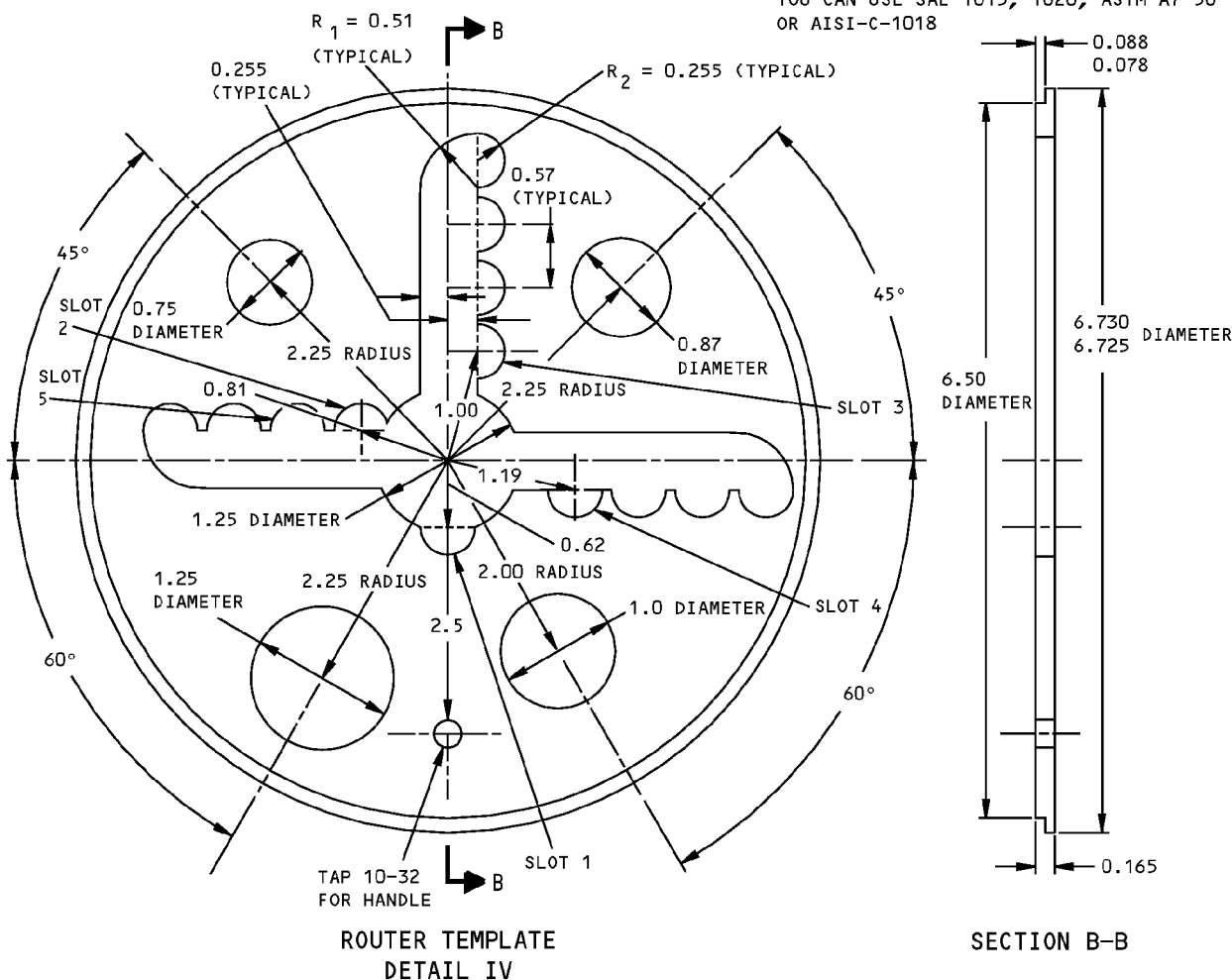
4. Start the air-powered router and turn the template in a clockwise direction to remove the damage.

NOTE: You can put a handle into the tapped hole to help turn the template in the correct direction.

5. After you complete the circle with the router in slot 1, then put the router into next numbered slot, shown in Detail IV as "Slot 2, Slot 3, Slot 4, Slot 5 and so on, until the damage is removed.

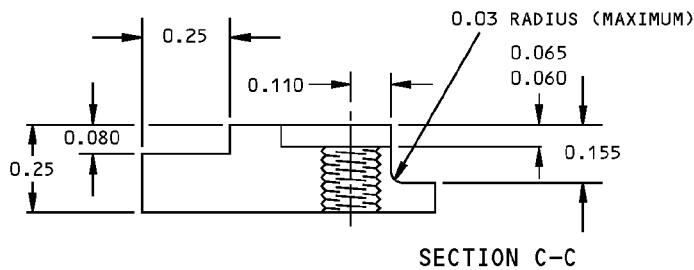
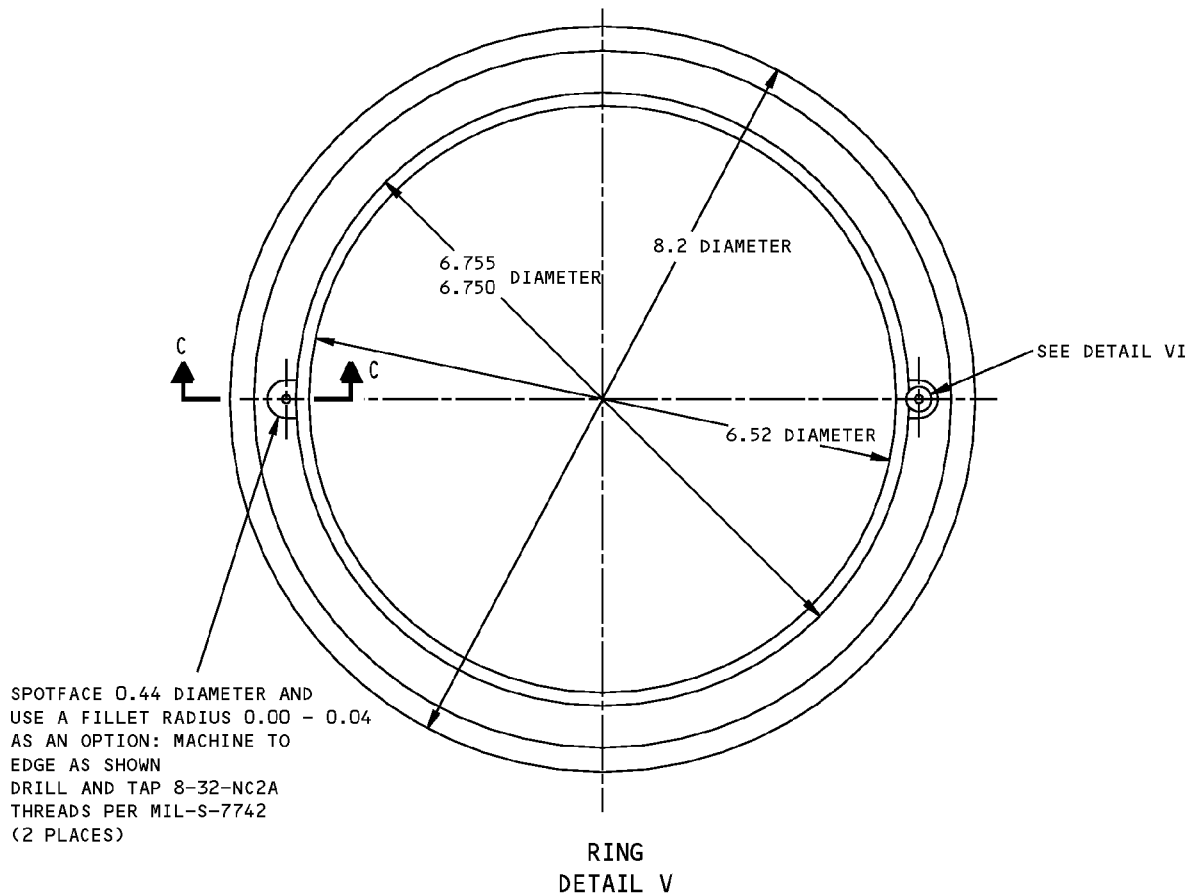
NOTE: Use the router sequence given in Detail IV for each next larger slot diameter to cut out the damage.

MATERIAL: SAE 1010 STEEL (AS AN OPTION YOU CAN USE SAE 1015, 1020, ASTM A7-50 OR AISI-C-1018

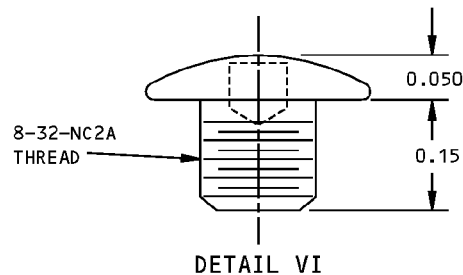


**Router and Template
Figure 2 (Sheet 3 of 4)**

757-200 STRUCTURAL REPAIR MANUAL



MATERIAL: SAE 1010 STEEL (AS AN
OPTION, YOU CAN USE SAE 1015,
1020, ASTM A7-50 OR AISI-C-1018)



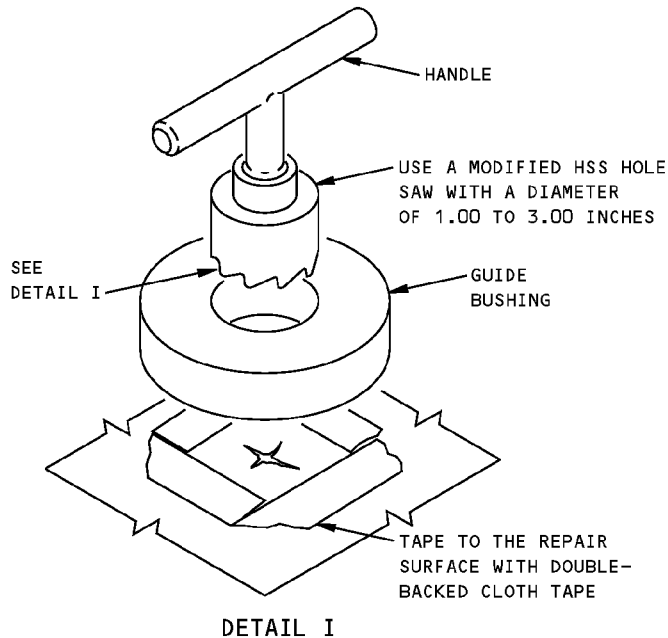
Router and Template
Figure 2 (Sheet 4 of 4)

757-200 STRUCTURAL REPAIR MANUAL

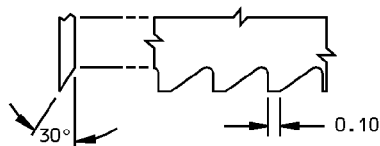
INSTRUCTIONS TO USE THE HOLE SAW

1. The hole saw and guide is used to cut holes in damaged aluminum skin or aluminum panels. You can cut 1.0, 2.0 and 3.0 inch diameters holes.
- NOTE:** As an alternative, you can use the power router shown in Figure 2.
2. Make the guide bushing from 0.75 inch thick aluminum plate. Cut out the center hole in the bushing to a size that will permit you to turn the hole saw freely.
3. Put the guide bushing on the surface of the repair area. Use double-backed tape to hold the guide in position.
4. Put the hole saw in the guide bushing hold the saw perpendicular to the surface while you cut.

NOTE: Use a light pressure as you slowly turn the saw to cut the surface.



DETAIL I



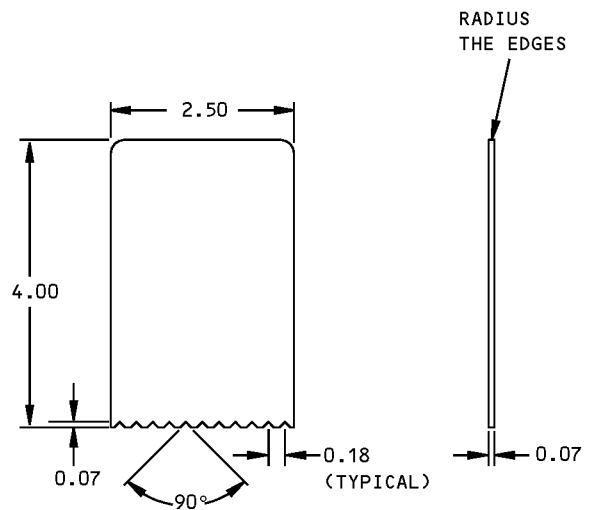
DETAIL II

The Use of the Hole Saw
Figure 3

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STRUCTURAL REPAIR MANUAL

INSTRUCTIONS TO USE THE SQUEEGEE

1. Make squeegee from 0.07 inch thick plexiglass or an equivalent material.
2. Use the edge with notches to impregnate fiberglass cloth with adhesive resin, or you can remove trapped air bubbles from a wet layup.



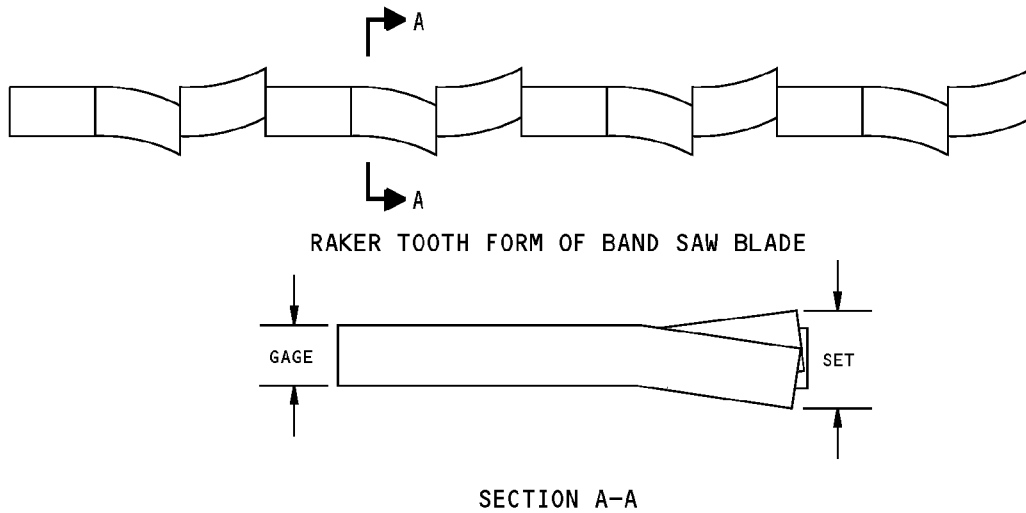
The Use of the Squeegee
Figure 4

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METALS OR MATERIALS TO BE PROCESSED	RESTRICTIONS	OPERATION	ABRASIVE PAPER OR CLOTH			ABRASIVE FABRIC OR PAD	WOOL		PUMICE 350 MESH OR FINE	SCOTCH-BRITE TYCRO WHEELS
			ALUMINUM OXIDE	SILICON CARBIDE	GARNET		ALUMI-NUM	STAIN-LESS STEEL		
FERROUS ALLOYS HEAT TREATED TO 220,000 PSI AND ABOVE	DO NOT USE ACID BASE RUST REMOVERS. DO NOT USE HAND-HELD POWER TOOLS GRINDING IS NOT PERMITTED	CORROSION REMOVAL OR FAIRING	150 OR FINER	150 OR FINER		FINE TO ULTRAFINE	X	X	X	
		FINISHING	400				X	X	X	
FERROUS NICKEL AND COBALT ALLOYS	DOES NOT APPLY TO STEEL HEAT TREATED TO 220,000 PSI AND ABOVE	CORROSION REMOVAL OR FAIRING	150 OR FINER	180 OR FINER		FINE TO ULTRAFINE	X	X	X	5A OR 7S MEDIUM
		FINISHING	400				X	X	X	7S FINE
ALUMINUM ALLOYS EXCEPT CLAD ALUMINUM	DO NOT USE SILICON CARBIDE ABRASIVE.	CORROSION REMOVAL OR FAIRING	60 OR FINER		7/0 OR FINER	VERY FINE AND ULTRAFINE	X		X	5A MEDIUM
		FINISHING	400				X		X	
CLAD ALUMINUM	SANDING LIMITED TO THE REMOVAL OF MINOR SCRATCHES.	CORROSION REMOVAL OR FAIRING	240 OR FINER		7/0 OR FINER	VERY FINE AND ULTRAFINE			X	
		FINISHING	400						X	
MAGNESIUM ALLOYS	DO NOT USE CARBON STEEL BRUSHES OR SILICON CARBIDE ABRASIVES.	CORROSION REMOVAL OR FAIRING	240 OR FINER			VERY FINE AND ULTRAFINE	X		X	
		FINISHING	400				X		X	
TITANIUM		CORROSION REMOVAL OR FAIRING	80 OR FINER	80 OR FINER				X	X	5A OR 7S MEDIUM
		CLEANING AND FINISHING	150 OR FINER	180 OR FINER				X	X	7S FINE

Abrasives for Sanding or Scouring
Figure 5

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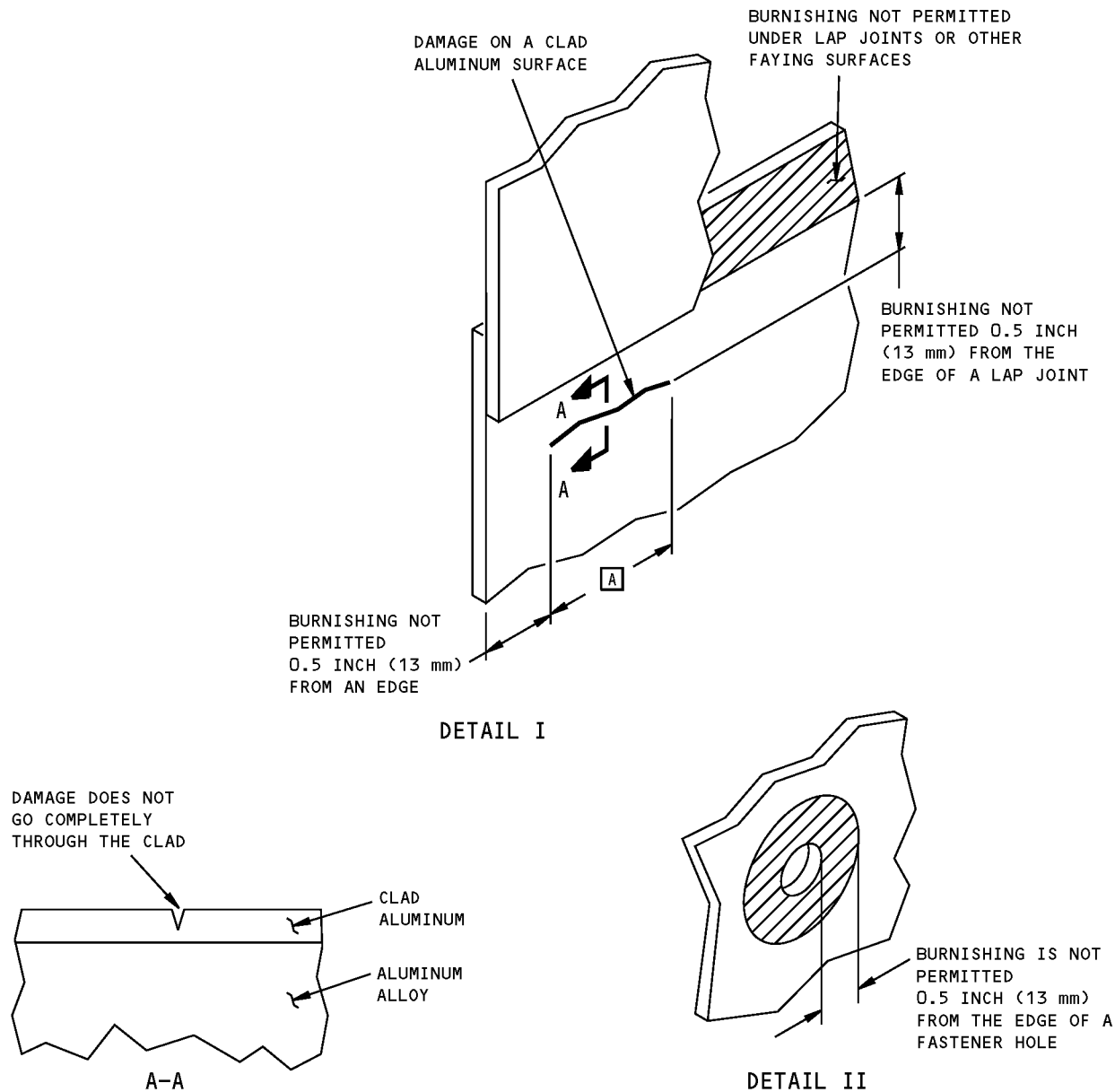


WORKPIECE MATERIAL	WORKPIECE THICKNESS	BAND TYPE	TOOTH FORM	PITCH	BAND SPEED (FOOT/MINIMUM)	CUTTING RATE (SQUARE INCH/MINIMUM)	CUTTING FLUID
ALUMINUM METAL HONEYCOMB CORE (CUT PARALLEL TO CELL WALLS)	LESS THAN 6.0 INCHES (15.24 cm)	WELD EDGE	RAKER	14	4000	100	NONE
NON-METAL NOMEX HONEYCOMB CORE (CUT PARALLEL TO CELL WALLS)	LESS THAN 12.0 INCHES (30.5 mm)	CONTINUOUS DIAMOND EDGE	60 TO 80 GRIT		6000	100	NONE (VACUUM REMOVAL OF DUST)
		CONTINUOUS REMINGTON TUNGSTEN CARBIDE	70 TO 100 GRIT		6000	100	

RECOMMENDED CONDITIONS FOR BAND SAWING HONEYCOMB CORE MATERIALS

Band Sawing of Metallic and Non-Metallic Honeycomb Core Materials
Figure 6

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NOTES

- A** DAMAGE MUST BE LESS THAN OR EQUAL TO THE MAXIMUM LENGTH GIVEN IN THE ALLOWABLE DAMAGE LIMITS OF THE APPLICABLE CHAPTER-SECTION-SUBJECT GIVEN IN THIS MANUAL, OR 2.0 INCHES (50 mm) IF NO LIMIT IS GIVEN IN THE ALLOWABLE DAMAGE LIMITS SECTION.

**Burnishing Restrictions on Primary Structure
Figure 7**



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GENERAL - SKIN WAVINESS INSPECTION FOR REDUCED VERTICAL SEPARATION MINIMUM (RVSM) OPERATION

1. Scope

- A. Do the subsequent procedures for aircraft that are approved to operate in Reduced Vertical Separation Minimum (RVSM) airspace. RVSM airspace is airspace where airplanes are separated by 1,000 feet (vertical), between Flight Level 290 and 410.
- B. These procedures are for airplanes that are approved for flight in RVSM airspace. You cannot use these procedures to get the initial approval for the airplane for flight in RVSM airspace.
- C. When you have damage in the area of the primary static ports, you must measure the skin waviness. These procedures tell you how to return a RVSM-certified airplane to service after repair of damage in the area of the primary static ports.
- D. The area of the primary static ports is from Body Station 460 to 520, and from Stringer S-19 to S-22 on both sides of the airplane. See Figure 1/GENERAL.
- E. Dents and surface irregularities in the area of the primary static ports are permitted if they are less than the limits that are shown in Figure 7/51-10-01, GENERAL. A maximum of two surface irregularities, as given in Figure 7/51-10-01, GENERAL, are permitted in the area of the primary static ports. The two irregularities can be on one side of the airplane, or one irregularity can be on each side.
- F. A maximum of two external skin repairs, as given in 53-00-01, REPAIR 8 (for passenger airplanes) or 53-00-01, REPAIR 17 (for 757-SF airplanes) or two internal skin repairs which extend across a frame or stringer, are permitted in the area of the primary static ports.

NOTE: The two repairs can be on one side of the airplane, or one repair can be on each side.

- G. Refer also to AMM 51-10-00-6. The AMM will tell you:
 - (1) How to use the 6-inch scale measurement tool.
 - (2) How to measure the skin waviness.
 - (3) How to make an analysis of the results.

2. References

Reference	Title
53-00-01, REPAIR 17	Fuselage Skin Repair Near the Primary Static Ports - 757-SF
53-00-01, REPAIR 8	Fuselage Skin Repair Near the Primary Static Ports
53-00-01, REPAIR P/B REPAIR	FUSELAGE SKIN - REPAIRS
AMM 34-11-03	Aircraft Maintenance Manual
AMM 51-10-00-6	Aircraft Maintenance Manual

3. Procedures For Surface Irregularities and General Repairs

- A. Visually examine the 3-inch radius area around the primary static ports. There should not be paint or stencils or excess sealant within the 3-inch radius.
- B. Find the dimensions of the dent or surface irregularity that are in the area of the primary static ports.
- C. Refer to Figure 7/51-10-01, GENERAL, Aerodynamic Smoothness - Static Ports and Angle of Attack Sensors. This will tell you the limits that are permitted for dents and surface irregularities in the area of the primary static ports.

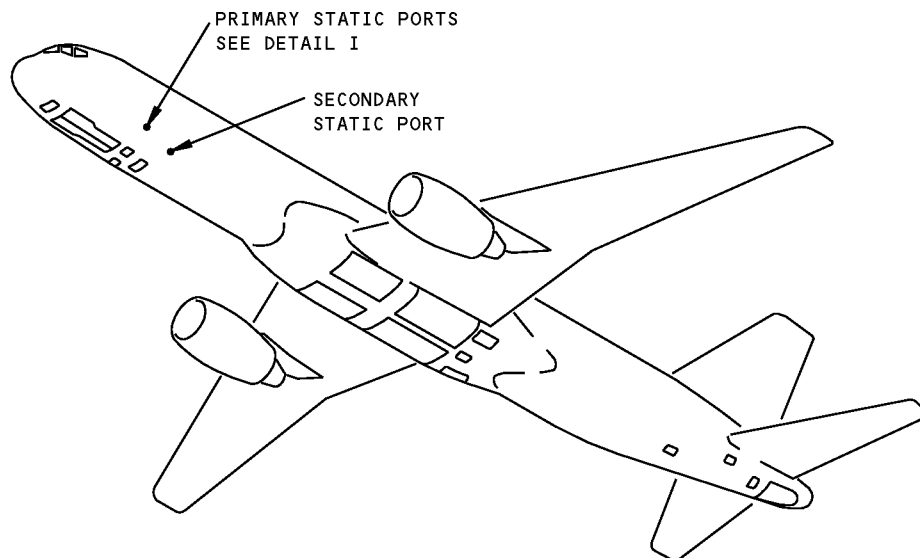


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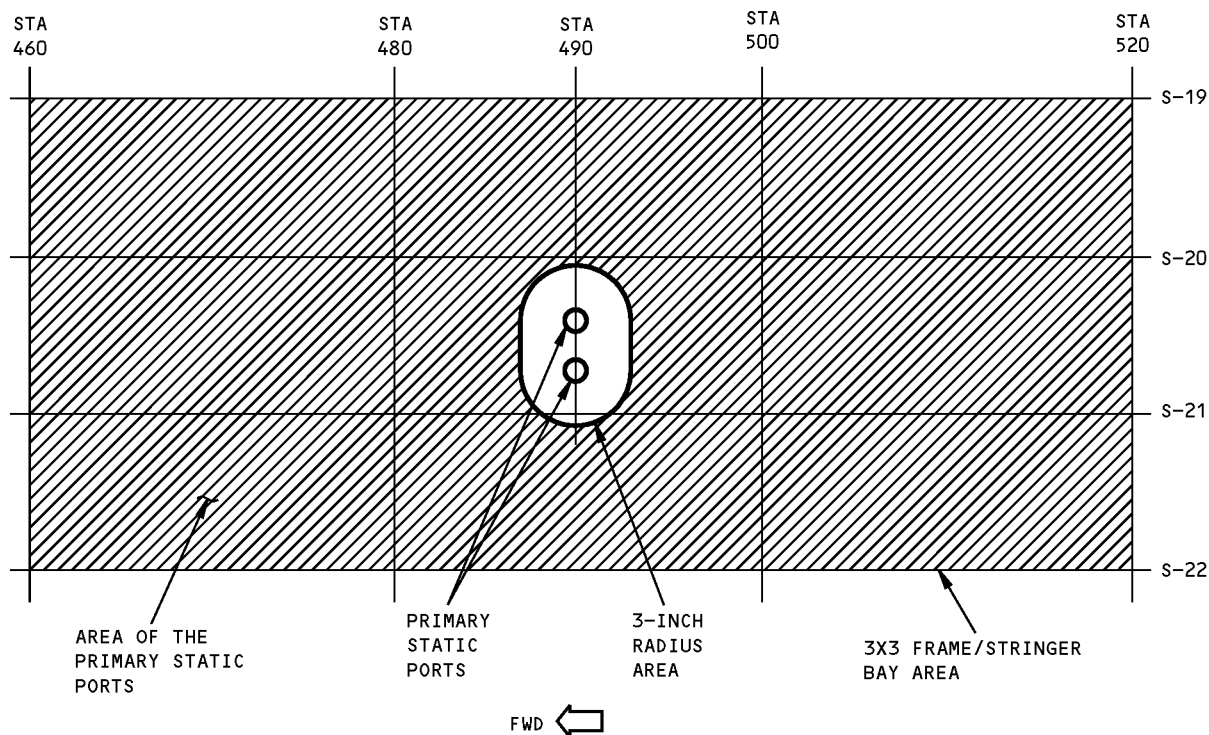
STRUCTURAL REPAIR MANUAL

- D. You must also measure the skin waviness in the 3-inch radius area around the primary static ports. Use the average measurement method as given in AMM 51-10-00-6. The skin waviness must be less than the limit of 0.010 inch when measured with the average measurement procedure.
- E. For RVSM operation, an airplane can have a maximum of two surface irregularities in the area of the primary static ports. The two irregularities can be on one side of the airplane, or one irregularity can be on each side.
- F. If a repair is necessary, you can make an external repair or flush repair. Refer to FUSELAGE SKIN - REPAIRS, PAGEBLOCK 53-00-01, REPAIR for the two types of repairs. If you use an external repair, use the repair procedure that is given in 53-00-01, REPAIR 8 (for passenger airplanes) or 53-00-01, REPAIR 17 (for 757-SF airplanes), Fuselage Skin Repair Near the Primary Static Ports.
- NOTE:** The data in 53-00-01, REPAIR 8 (for passenger airplanes) or 53-00-01, REPAIR 17 (for 757-SF airplanes) is also applicable to an internal repair that extends across a frame or stringer.
- G. For RVSM operation, an airplane can have a maximum of two such repairs. The two repairs can be on one side of the airplane, or one repair can be on each side.
- H. Visually examine the primary static ports for cleanliness, blockage, corrosion and general smoothness.
- I. Measure the step height of the primary static ports. See Figure 2/GENERAL. The step height is the amount of offset between the surfaces of the skin (or external doubler, if the part is installed through an external doubler), and the primary static ports. If the primary static ports are below -0.002 inch, then replace the ports. If the primary static ports are above +0.006 inch, then microshave the ports.
- NOTE:** This tolerance is for installed primary static ports. When new primary static ports are being installed, the tolerance is -0.000 to +0.003 inch.
- J. Make sure the surfaces of the ports are smooth, free of burrs, and that there is a chemical conversion coating. Refer to AMM 34-11-03 for more information on removal and installation of the primary static ports.

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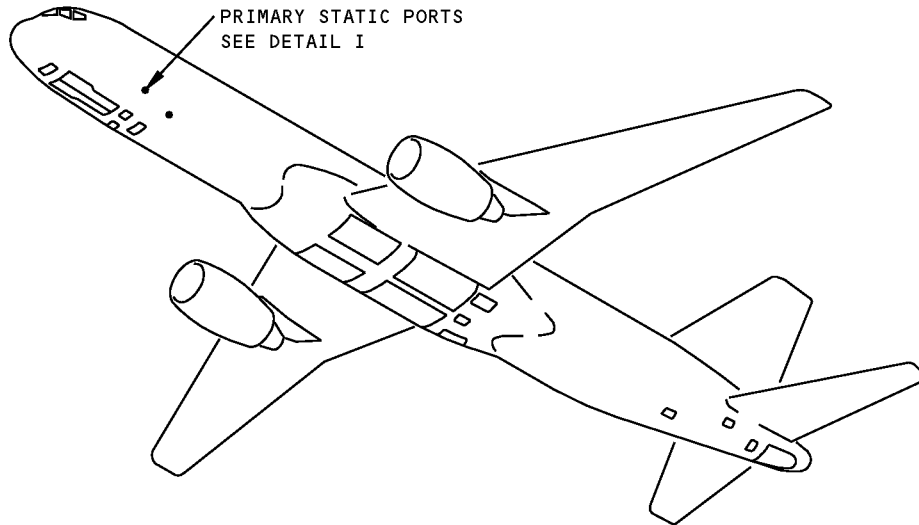
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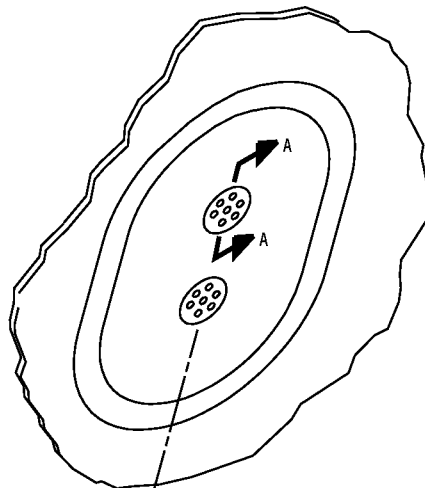
DETAIL I

**Skin Waviness Inspection for RVSM Operation
Figure 1**

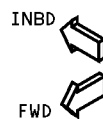
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LEFT SIDE SHOWN
RIGHT SIDE OPPOSITE



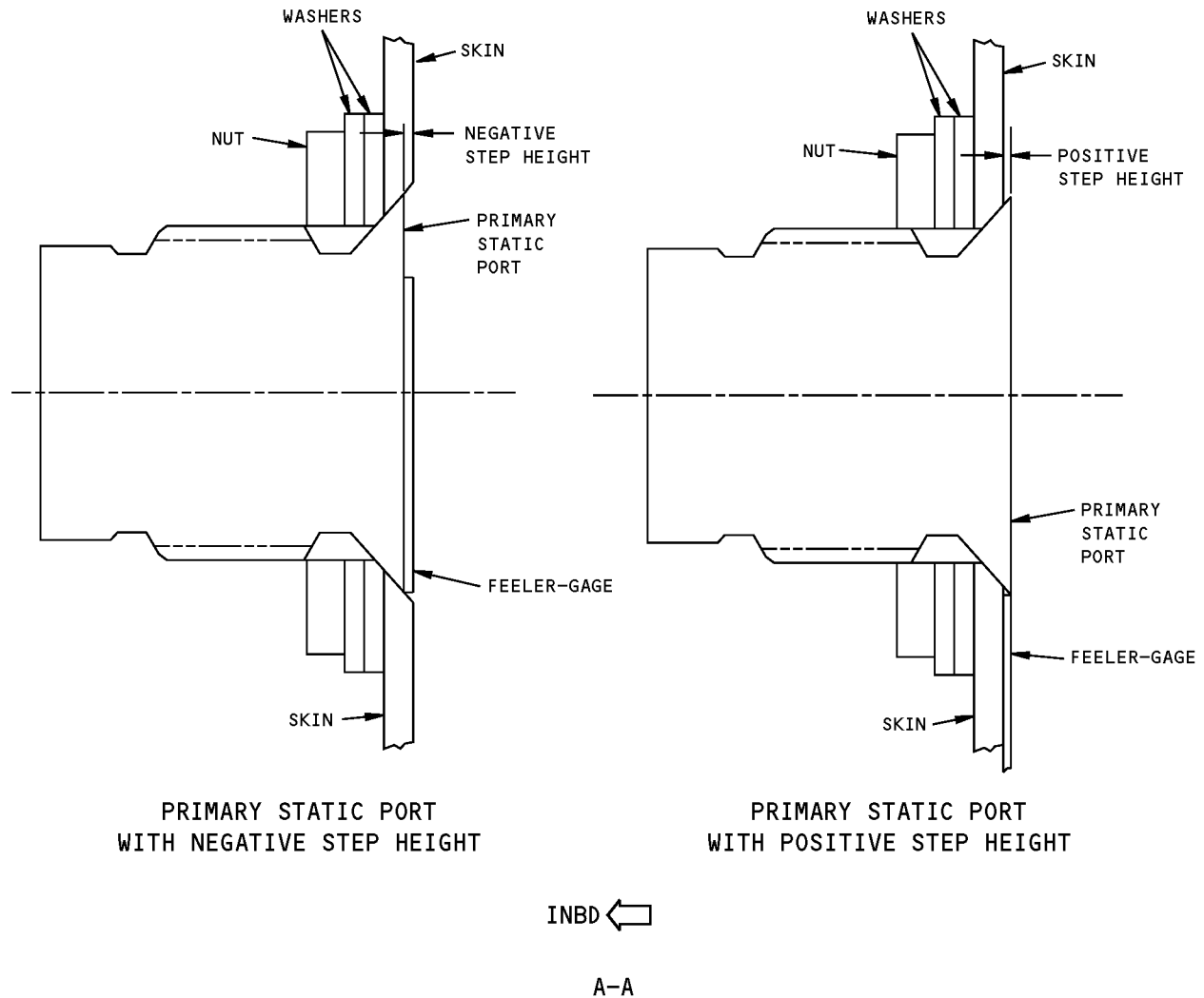
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DETAIL I

Port Step Height Inspection for RVSM Operation
Figure 2 (Sheet 1 of 2)

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Port Step Height Inspection for RVSM Operation
Figure 2 (Sheet 2 of 2)



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ALLOWABLE DAMAGE GENERAL - THE ANALYSIS AND CONTINUED SERVICE OF AIRPLANES WITH ON-GROUND HAIL DAMAGE

1. General

- A. On-ground hail damage is defined as multiple damage sites caused by a hailstorm while the airplane is on the ground.
- B. This subject gives the allowable damage data necessary to help in the analysis and continued service of airplanes with on-ground hail damage. It collects the referenced Structural Repair Manual (SRM) subject's allowable damage limits into one subject. It is limited to the lightweight composite and aluminum structure on the exposed surfaces of the wing and the horizontal and vertical stabilizers.
- C. This subject does not change the allowable damage limits in the referenced SRM subjects. It does however, give expanded allowable damage limits due to on-ground hail damage for the identified areas. Expanded allowable damage limits given in this subject can be more than the referenced SRM subjects allowable damage limits. However, you must do a permanent repair to these damage sites before 60 days from when the damage occurred.
- D. All damage that occurred before the hailstorm must be included in the analysis of on-ground hail damage unless a permanent repair was done.
- E. Some types of damage must be sealed as given in Paragraph 5./ALLOWABLE DAMAGE GENERAL. The allowable damage limits are only applicable if a temporary repair or seal is done before the airplane is returned to service.
- F. Refer to 51-10-01, GENERAL for the aerodynamic smoothness requirements. If the smoothness does not agree with the limits given in 51-10-01, GENERAL, refer to Paragraph 6./ALLOWABLE DAMAGE GENERAL for the effect on airplane performance.
- G. Refer to 51-60-01, GENERAL for the aileron rebalance procedure. The aileron is the only control surface that is balance critical. The effect of a temporary repair or seal can change its balance condition.

2. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-60-01, GENERAL	Aileron Rebalance Procedures
51-70-01, REPAIR 1	Procedures to Rework Allowable Dents on the External Aerodynamic Surfaces of Metallic Parts

3. Inspection

- A. Refer to the flow chart in Figure 101/ALLOWABLE DAMAGE GENERAL for the analysis of airplanes with on-ground hail damage.
- B. The on-ground hail damage to airplanes can vary from one airplane to another and on different surfaces of the same airplane. For this reason, all airplanes near a hailstorm must have a visual inspection of their lightweight composite and aluminum structure. You must do a closer inspection if you find indication of damage.
- C. Do an inspection of the upper wing and horizontal and vertical stabilizer surfaces.
 - (1) Use anti-fatigue mats to protect composite surfaces from more damage.
 - (2) Do an inspection of the suspected damaged areas.

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- (3) Make a note of each damage site. Include (as a minimum): location; length; width; depth; edge-to-edge distance to other damage, fasteners, or panel edge; and delamination data.

NOTE: All damage that occurred before the hailstorm must be included in the analysis of on-ground hail damage unless a permanent repair was done.

- (4) Do an inspection of the underlying structure if panel damage is found close to the internal supporting members. Analyze, for allowable damage, the internal structure as given in the applicable SRM subjects.

D. Find the allowable damage for the applicable individual component panels (Figure 102/ALLOWABLE DAMAGE GENERAL).

- (1) Find, as shown on Figure 102/ALLOWABLE DAMAGE GENERAL, the applicable component and the reference to its individual figure number. The individual component figures (Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL) collect the referenced SRM subjects allowable damage limits and material data. If necessary, refer to the applicable SRM subjects for the complete data.

- (2) Use the noted damage site data to see if it is satisfactory to the allowable damage limits.

NOTE: Where applicable, areas of high load transfer are shown on the individual component figures (Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL). Areas of high load transfer were not identified as critical areas or zones in the referenced SRM allowable damage subjects. However, damage to these areas must not be more than the limits in the applicable SRM subjects.

- (3) Small damage sites with spacing less than permitted by the referenced SRM subjects can be put together as one damage site (Figure 103/ALLOWABLE DAMAGE GENERAL, Detail II). Use the maximum dimension of this larger damage site to find the allowable spacing.

E. Is the damage satisfactory to the component's referenced SRM subjects allowable damage limit (Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL).

- (1) If yes, go to Paragraph 5.A./ALLOWABLE DAMAGE GENERAL

- (2) If no, do what follows:

- (a) Record the damage site data. This data will be used to do an analysis of the damage for final disposition of the airplane.

This data will also be used to determine if additional damage has occurred on subsequent inspection before permanent repairs are done.

- (b) Go to Paragraph 4./ALLOWABLE DAMAGE GENERAL.

4. Expanded Allowable Damage Limits for On-Ground Hail Damage

CAUTION: DO NOT USE THE EXPANDED ALLOWABLE DAMAGE LIMITS FOR DAMAGE SITES THAT ARE IN CRITICAL AREAS OR AREAS OF HIGH LOAD TRANSFER. DO NOT USE THE EXPANDED ALLOWABLE DAMAGE LIMITS FOR THE LEADING EDGE (SLAT) OR THE SLAT TRAILING EDGE WEDGE. THESE AREAS MUST HAVE PERMANENT REPAIRS DONE IF THE DAMAGE IS MORE THAN THE LIMITS GIVEN IN THE APPLICABLE SRM SUBJECTS.

- A. Do what follows for damage that is not satisfactory to the referenced SRM subjects allowable damage limits (Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL).

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- (1) Find the allowable spacing for on-ground hail damage using the expanded allowable damage limits.
 - (a) Use the recorded damage site data found in Paragraph 3./ALLOWABLE DAMAGE GENERAL.
 - (b) Find the spacing requirement for the damaged components as given in Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL. Example: As shown on Figure 105/ALLOWABLE DAMAGE GENERAL, the distance between any two damage sites must be at least three times the diameter of the largest damage.
 - (c) Find the required minimum edge-to-edge distance (s) for the recorded damage diameter (D) from the details as shown in Figure 103/ALLOWABLE DAMAGE GENERAL.

NOTE: Use the average damage diameter $((D + d) \text{ divided by } 2)$ as the damage diameter (D) to find the required minimum edge-to-edge distance between adjacent damage sites.

- 1) Use Detail III for components that have a spacing requirement equal to three times the diameter of the damage (3D).
 - 2) Use Detail IV for components that have a spacing requirement equal to four times the diameter of the damage (4D).
 - 3) Use Detail V for components that have a spacing requirement equal to six times the diameter of the damage (6D).
 - (d) Add, to the required minimum edge-to-edge distance (s), a correction factor (Figure 103/ALLOWABLE DAMAGE GENERAL) for damage sites that have a dent diameter to depth ratio (A/Y) less than 30.
- B. Is the damage satisfactory to the expanded allowable damage limits (Figure 103/ALLOWABLE DAMAGE GENERAL)?
 - (1) If yes, go to Paragraph 5.B./ALLOWABLE DAMAGE GENERAL.
 - (2) If no, repair the damage before the airplane is returned to service.
- C. The example that follows gives the allowable spacing for a 1-inch diameter dent, with an A/Y ratio of 20, and a spacing requirement of three times the dent diameter.
 - (1) Refer to Figure 103/ALLOWABLE DAMAGE GENERAL, Detail III (3D spacing requirement) and find the required minimum edge-to-edge distance (s) for a 1-inch dent.
 - (2) Add a correction factor, for a dent with an A/Y ratio of 20, to the required minimum edge-to-edge distance (s).
 - (3) The allowable spacing in this example is equal to 3.5 inches (2.5 inches from the graph plus a 1-inch correction factor).
- D. See Figure 104/ALLOWABLE DAMAGE GENERAL for more example applications of the expanded allowable damage limits.
 - (1) Sheets 1 and 2 show an example of a damaged component that is satisfactory to the expanded allowable damage limits.
 - (2) Sheets 3 and 4 show an example of a damaged component that is not satisfactory to the expanded allowable damage limits.

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5. Temporary Repair or Seal (if necessary)

- A. Do what follows for damage that is satisfactory to the referenced SRM subjects allowable damage limits (Paragraph 3./ALLOWABLE DAMAGE GENERAL and Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL).
- (1) Remove contaminants or water from the surface of the damaged area.
 - (2) For the aluminum sheet structure, do a temporary repair to holes and punctures.
 - (a) Clean out the holes and punctures to 0.25 inch diameter maximum.
 - (b) Fill the hole with a 2117-T3 or T4 aluminum rivet installed wet with BMS 5-95 sealant.
 - (c) Apply BMS 5-95 (chromate) sealant to the top of the area.
 - (3) For the aluminum honeycomb and composite structure, do a temporary seal to holes and punctures.
 - (a) Remove the moisture from the damaged area. Boeing recommends that you use vacuum and heat to remove the moisture from the honeycomb cells (maximum temperature of 125°F (52°C)).
 - (b) Apply an aluminum foil tape (speed tape). Make an overlap of 2 inches more than the edges of the damage as a minimum.

NOTE: As an option for a more durable temporary seal, apply BMS 5-95 sealant in the damage site before you apply the aluminum foil tape. It is not necessary to wait for the BMS 5-95 sealant to cure before the airplane is returned to service.
 - (c) Keep a record of the location.
 - (d) Do an inspection of the aluminum foil tape to make sure it is in satisfactory condition at the specified times for the individual components (Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL).
 - (e) Do a permanent repair of the damage at the specified times for the individual components. Refer to the applicable referenced SRM subjects for the repair information.
- B. Do what follows for damage that is not satisfactory to the referenced SRM subjects allowable damage limits (Figure 105/ALLOWABLE DAMAGE GENERAL thru Figure 127/ALLOWABLE DAMAGE GENERAL), but is satisfactory to the expanded allowable damage limits of this subject (Paragraph 4./ALLOWABLE DAMAGE GENERAL).
- (1) Remove any contaminants or water from the surface of the damaged area.
 - (2) Fill all damage sites that are more than 1.5 inches in diameter with an A/Y ratio less than 30.
 - (a) For aluminum sheet structure, refer to 51-70-01, REPAIR 1 for the filling of dents.
 - (b) For aluminum honeycomb and composite structure, apply BMS 5-95 sealant to restore the contour before the aluminum foil tape is applied.
 - (3) For the aluminum sheet structure, do a temporary repair to holes and punctures.
 - (a) Clean out the holes and punctures to 0.25 inch diameter maximum.
 - (b) Fill the hole with a 2117-T3 or T4 aluminum rivet installed wet with BMS 5-95 sealant.
 - (c) Apply BMS 5-95 (chromate) sealant to the top of the area.
 - (4) For the aluminum honeycomb and composite structure, do a temporary seal to holes and punctures.



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- (a) Remove the moisture from the damaged area. Boeing recommends that you use vacuum and heat to remove the moisture from the honeycomb cells (maximum temperature of 125° (52°C)).
- (b) Apply aluminum foil tape (speed tape). Make an overlap of 2 inches more than the edges of the damage as a minimum.

NOTE: As an option for a more durable temporary seal, apply BMS 5-95 sealant in the damage site before you apply the aluminum foil tape. It is not necessary to wait for the BMS 5-95 sealant to cure before the airplane is returned to service.

- (c) Keep a record of the location.
- (5) Inspect the damage sites at each "A" check and do a permanent repair before 60 days from when the damage occurred. Refer to the applicable referenced SRM subjects for the repair information.

6. Effect on Airplane Performance as a Result from On-Ground Hail Damage

A. General

- (1) Any deviation from a smooth aerodynamic surface will have an effect on the airflow over that surface. On-ground hail damage, if not repaired or filled, can increase drag and reduce control effectiveness. Compliance with FAA flight safety requirements can be satisfied if you apply performance restrictions (gross weight and center of gravity loading restrictions).
- (2) The effect on stall speed is negligible from on-ground hail that is satisfactory to the allowable damage limits of this subject.
- (3) Damage that is filled and sealed (aluminum foil tape) do not have a performance restriction. However, you must count the damage sites that are sealed but not filled. This is because the aluminum foil tape can bulge in flight.
- (4) The performance restrictions in this subject are for on-ground hail damage and are not sufficient for damage caused by hail while in flight.
- (5) The performance restrictions are given in the Airplane Flight Manual appendix titled Configuration Deviations List (CDL). Table 101/ALLOWABLE DAMAGE GENERAL gives an example form that can be used to communicate the required damage information to the Dispatcher for calculation of the performance restrictions.
- (6) All damage sites that are more than 1.5 inches in diameter with an A/Y ratio less than 30 must be filled. Refer to Paragraph 5.B.(2)/ALLOWABLE DAMAGE GENERAL

B. Performance Restrictions

NOTE: The performance restrictions for the rudder are not sufficient if there are more than 20 damage sites that are not filled with an A/Y ratio less than 30. Do a permanent repair or fill the damage sites that are more than this limit.

- (1) Do what follows for the applicable component panels (Table 101/ALLOWABLE DAMAGE GENERALI):
 - (a) Count the number of damage sites that are not filled with an A/Y ratio less than 30.
 - (b) Record, by placing an "X" on the form (Table 101/ALLOWABLE DAMAGE GENERALI) in the applicable square, the panels that have more than five (5) damage sites with an A/Y ratio less than 30.
 - (c) Complete the form for all applicable panels.
 - (d) Count and record, for each line, the total number of panels with an "X".

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- (e) Include on the form your name, the tail number of the airplane, and the date.
- (2) Give the completed form to the Dispatcher for the calculation of the performance restrictions. The performance restrictions listed in the Airplane Flight Manual, CDL appendix, must be applied for each damaged panel indicated with an "X".

7. FAA Approval

- A. These allowable damage limits and performance restrictions have FAA approval only if the inspections, sealing, and repairs as given in this subject are completed at the specified times.

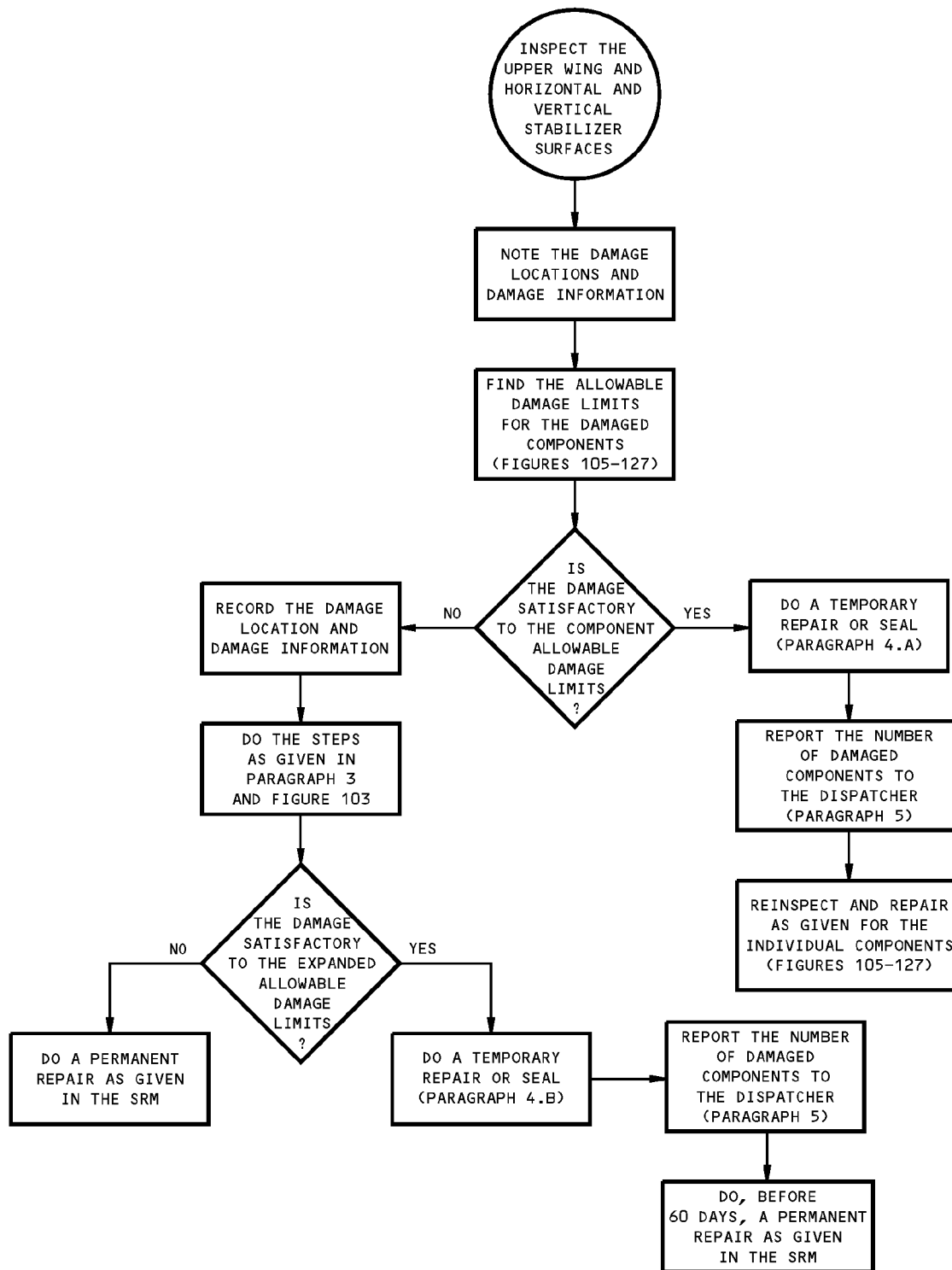
INSTRUCTIONS:

- For each panel, count the number of damage sites that are not filled with an A/Y ratio less than 30.
- Record, by placing an "X" in the applicable square, the panels that have more than five (5) damage sites with an A/Y ratio less than 30.
- Include your name, the tail number of the airplane, and the date and give to the Dispatcher for calculation of the performance restrictions.

Table 101: Example Form - Number of Damaged Panels

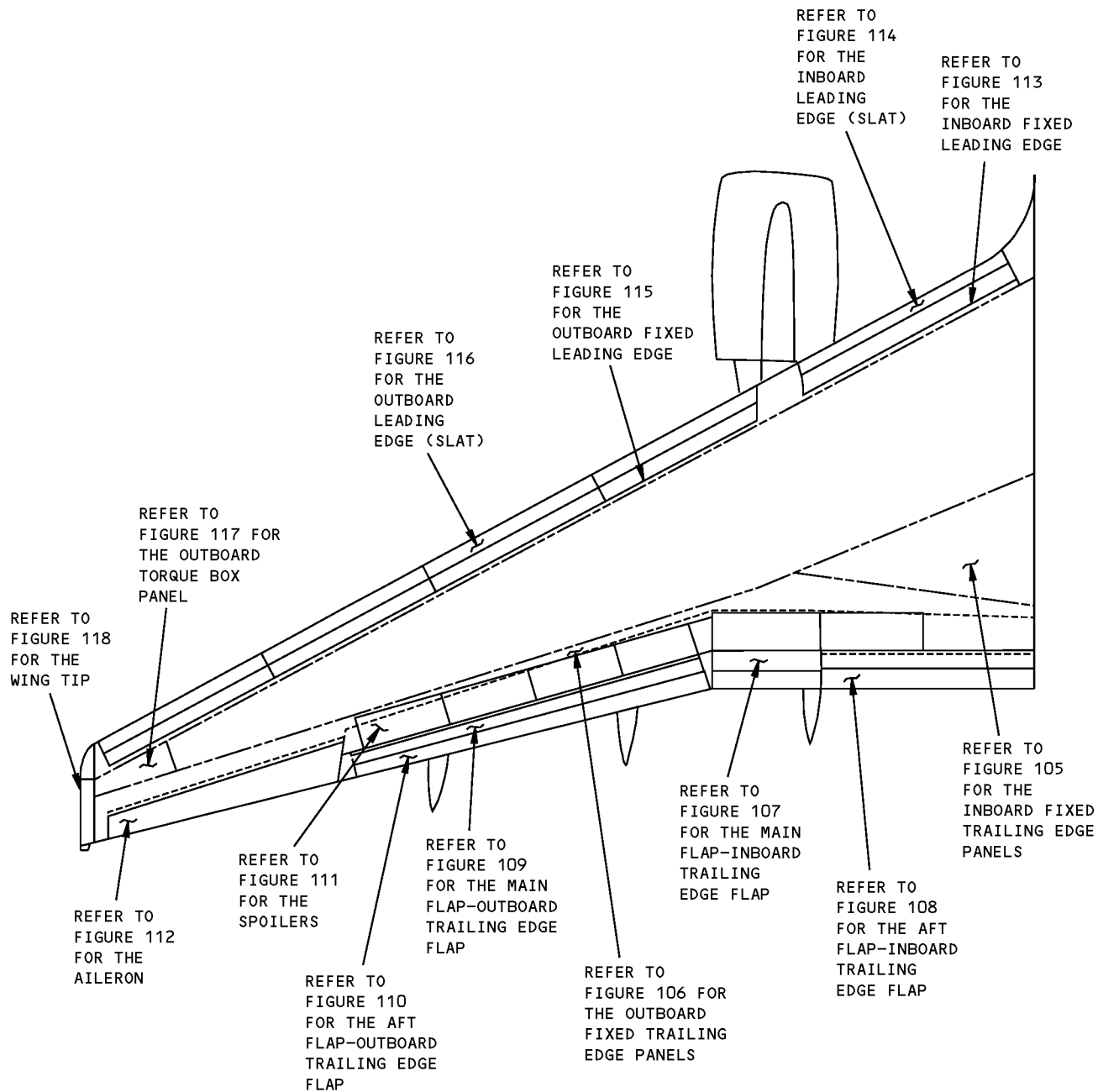
COMPONENT	NUMBER OF PANELS												TOTAL												
Wing Slat Trailing Edge Wedge Panel - SRM 57-43-02	1	2	3	4	5		6	7	8	9	10														
Spoiler Panel - SRM 57-70-01	1	2	3	4	5	6	7	8	9	10	11	12													
Aileron - SRM 57-60-01	Left						Right																		
Trailing Edge Flap Panel - SRM 57-53-01	Left Outbd			Left Inbd			Right Inbd			Right Outbd															
Wing Fixed Trailing Edge Panel - SRM 57-51-01	Left						Right																		
Horizontal Stabilizer Leading Edge - SRM 55-10-01	Left						Right																		
Horizontal Stabilizer Fixed Trailing Edge - SRM 55-10-01	Left						Right																		
Elevator - SRM 55-20-01	Left						Right																		
Rudder - 55-40-01																									
NAME: _____ AIRPLANE TAIL NUMBER: _____ DATE: _____																									

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Analysis of Airplanes With On-Ground Hail Damage
Figure 101

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LEFT WING IS SHOWN,
RIGHT WING IS OPPOSITE

Applicable Components - On-Ground Hail Damage Analysis Figure 102 (Sheet 1 of 2)

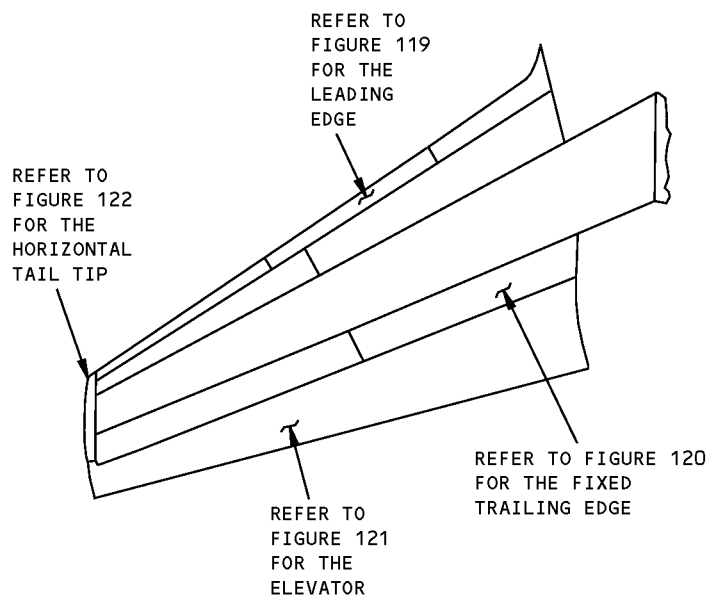
ALLOWABLE DAMAGE GENERAL

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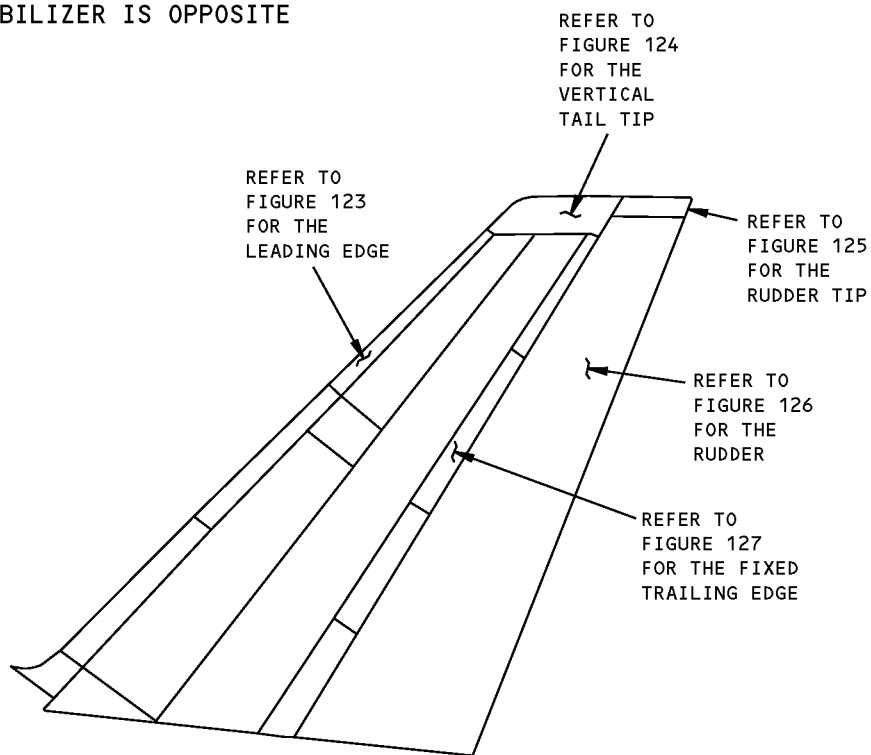
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LEFT HORIZONTAL STABILIZER IS SHOWN,
RIGHT HORIZONTAL STABILIZER IS OPPOSITE



VERTICAL STABILIZER

Applicable Components - On-Ground Hail Damage Analysis
Figure 102 (Sheet 2 of 2)

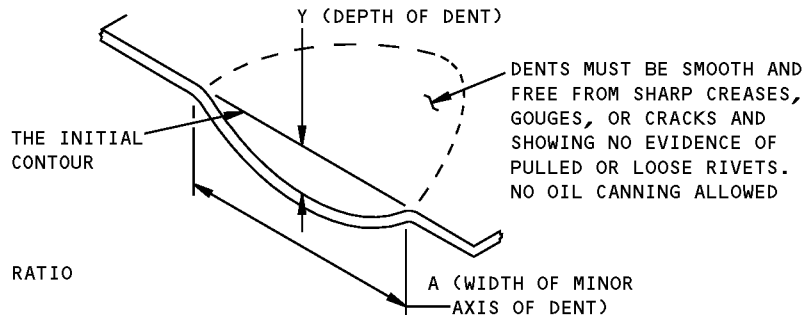
ALLOWABLE DAMAGE GENERAL

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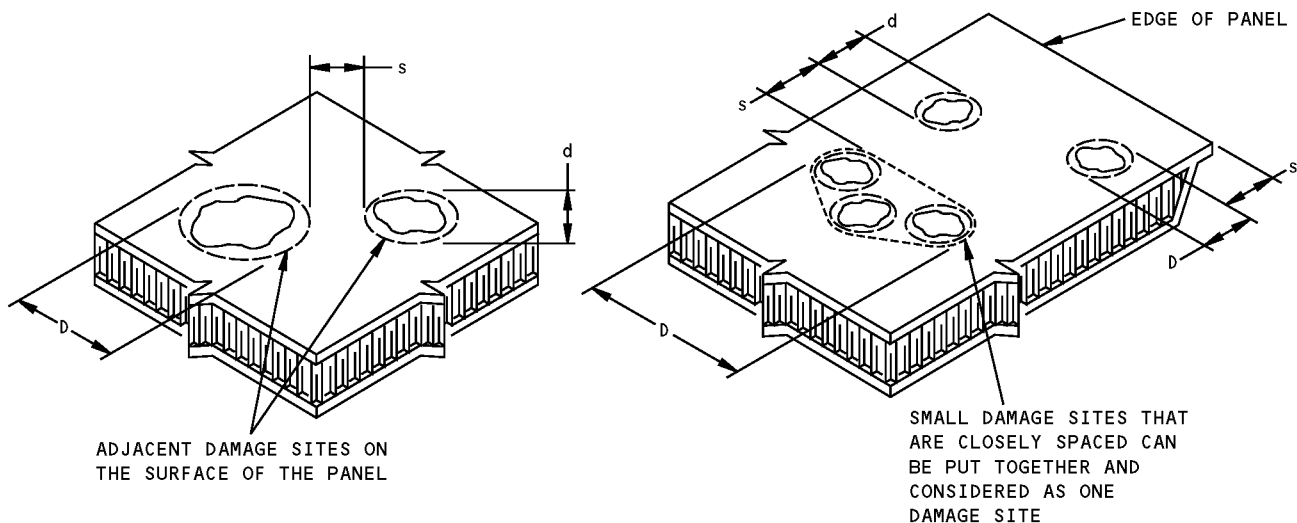
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757-200 STRUCTURAL REPAIR MANUAL



- A/Y IS THE DENT TO DEPTH RATIO

ALLOWABLE DAMAGE FOR DENTS IN ALUMINUM PANELS DETAIL I



- DAMAGE TO COMPOSITE PANELS EXPOSED TO MULTIPLE IMPACTS CAN BE DETECTED BY USING INSTRUMENTED NON-DESTRUCTIVE INSPECTION METHODS OR BY TAPPING THE SUSPECT DAMAGE AREA WITH A SMALL METALLIC DISK OBJECT. INSPECTION SHOULD COVER THE AREA WITHIN 3 DIAMETERS AROUND THE EDGE OF THE VISIBLE DAMAGE SITE. FOR TAP TEST, USE A SOLID METAL DISK AND TAP THE DAMAGE AREA LIGHTLY BUT FIRMLY. VOID AREAS SHOULD PRODUCE A DULL SOUND AS OPPOSED TO A SHARP RING ON A SOLID BONDED AREA
- A DAMAGE SITE IS ANY SINGLE AREA OF A PANEL WHERE A DENT, DELAMINATION, PUNCTURE OR ANY COMBINATION OF THESE EXIST. SMALL DAMAGE SITES THAT ARE CLOSELY SPACED CAN BE PUT TOGETHER AND CONSIDERED AS ONE DAMAGE SITE
- "D" IS DETERMINED BY MEASURING THE MAXIMUM DIMENSION OF A DAMAGE SITE
- "s" IS THE EDGE TO EDGE DISTANCE BETWEEN TWO ADJACENT DAMAGE SITES, EDGE OF DAMAGE TO A FASTENER OR EDGE OF DAMAGE TO THE EDGE OF PANEL
- "d" IS THE MAXIMUM DIMENSION OF THE SMALLER OF TWO ADJACENT DAMAGE SITES
- DAMAGE IS ALLOWED WHEN "s" IS EQUAL TO OR MORE THAN THE SPACING REQUIREMENT GIVEN FOR THE INDIVIDUAL COMPONENTS (FIGURES 105 - 127) OR FOUND IN DETAILS I THRU V

DAMAGE SIZING AND SPACING DATA DETAIL II

Expanded Allowable Damage Limits Figure 103 (Sheet 1 of 4)

ALLOWABLE DAMAGE GENERAL

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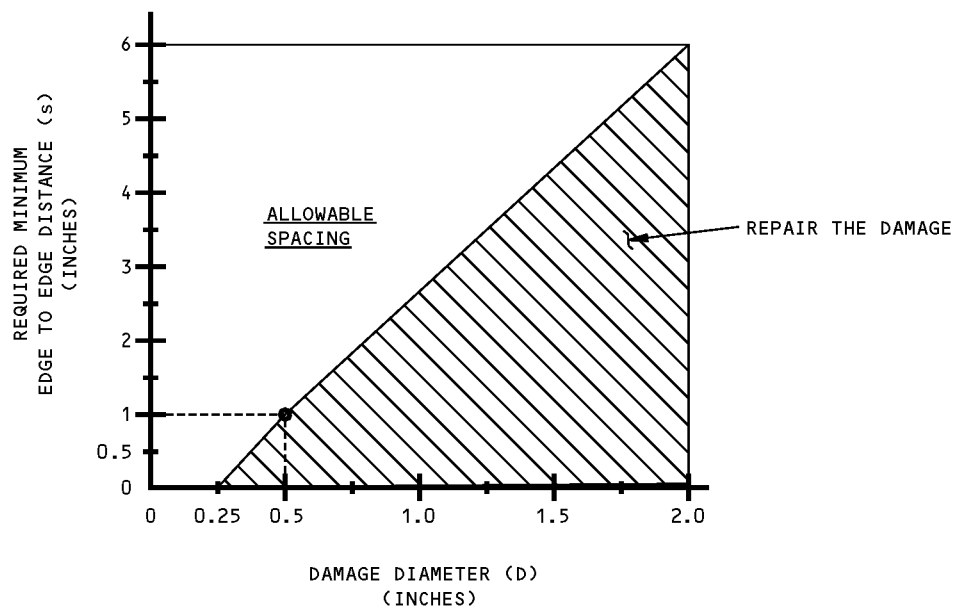
STRUCTURAL REPAIR MANUAL

NOTE: FOR COMPONENTS WITH A 3(D) SPACING AND 2-INCH MAXIMUM DIAMETER REQUIREMENT.

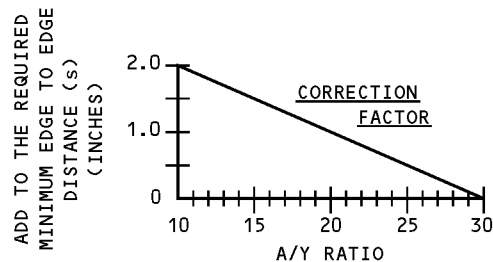
APPLICABILITY: WING - INBOARD AND OUTBOARD FIXED TRAILING EDGE; MAIN FLAP - INBOARD AND OUTBOARD TRAILING EDGE FLAPS; AFT FLAP - INBOARD AND OUTBOARD TRAILING EDGE FLAPS; SPOILERS; INBOARD AND OUTBOARD FIXED LEADING EDGE

HORIZONTAL STABILIZER - LEADING EDGE (DELAMINATIONS ONLY FROM THE AUXILIARY SPAR TO FRONT SPAR); FIXED TRAILING EDGE; ELEVATOR

VERTICAL STABILIZER - LEADING EDGE (DELAMINATIONS ONLY FROM THE AUXILIARY SPAR TO FRONT SPAR); TAIL TIP; RUDDER; FIXED TRAILING EDGE



- USE $\frac{D+d}{2}$ AS THE DAMAGE DIAMETER (D) TO FIND THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) BETWEEN ADJACENT DAMAGE SITES
- ADD A CORRECTION FACTOR TO THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s), FOUND ON THE ABOVE GRAPH, FOR DENTS ON ALUMINUM PANELS WITH AN A/Y RATIO OF LESS THAN 30. USE THE LOWEST A/Y RATIO, BUT NOT LESS THAN 10, WHEN DAMAGE SITES ARE GROUPED TOGETHER



3(D) DAMAGE SPACING DETAIL III

Expanded Allowable Damage Limits Figure 103 (Sheet 2 of 4)

ALLOWABLE DAMAGE GENERAL

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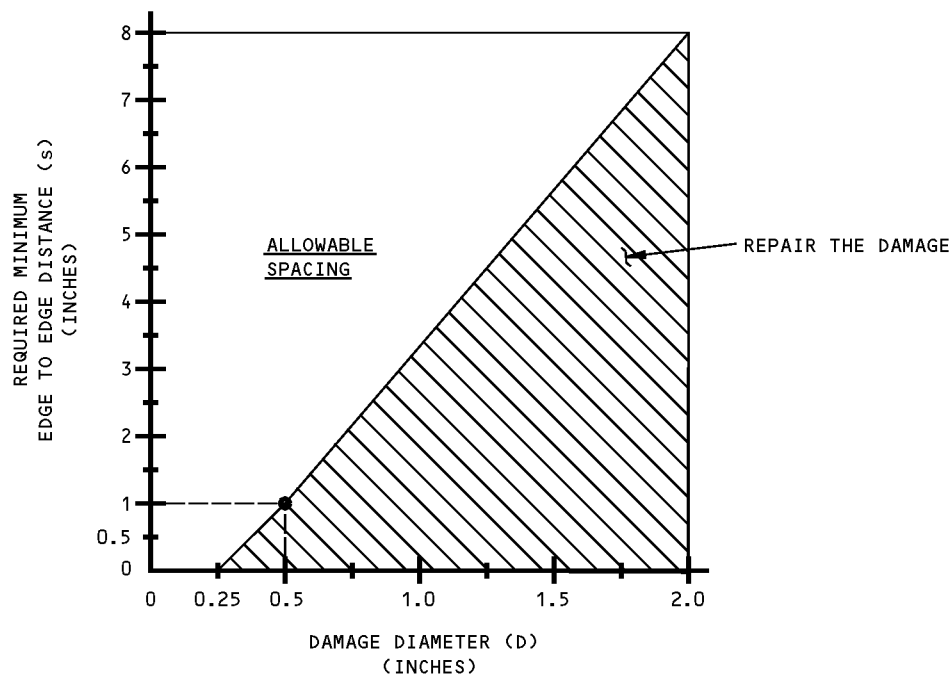
STRUCTURAL REPAIR MANUAL

NOTE: FOR COMPONENTS WITH A 4(D) SPACING AND 2-INCH MAXIMUM DIAMETER REQUIREMENT.

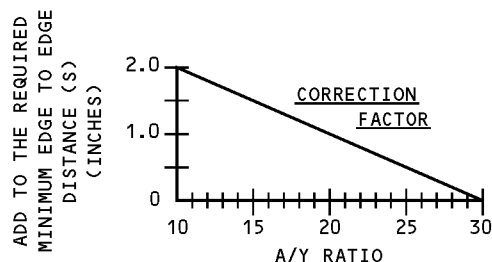
APPLICABILITY: WING - OUTBOARD TORQUE BOX

HORIZONTAL STABILIZER - LEADING EDGE (DENTS ONLY FROM THE AUXILIARY SPAR TO FRONT SPAR)

VERTICAL STABILIZER - LEADING EDGE (DENTS ONLY FROM THE AUXILIARY SPAR TO FRONT SPAR)



- USE $\frac{D+d}{2}$ AS THE DAMAGE DIAMETER (D) TO FIND THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) BETWEEN ADJACENT DAMAGE SITES
- ADD A CORRECTION FACTOR TO THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s), FOUND ON THE ABOVE GRAPH, FOR DENTS ON ALUMINUM PANELS WITH AN A/Y RATIO OF LESS THAN 30. USE THE LOWEST A/Y RATIO, BUT NOT LESS THAN 10, WHEN DAMAGE SITES ARE GROUPED TOGETHER



4(D) DAMAGE SPACING DETAIL IV

Expanded Allowable Damage Limits Figure 103 (Sheet 3 of 4)

ALLOWABLE DAMAGE GENERAL

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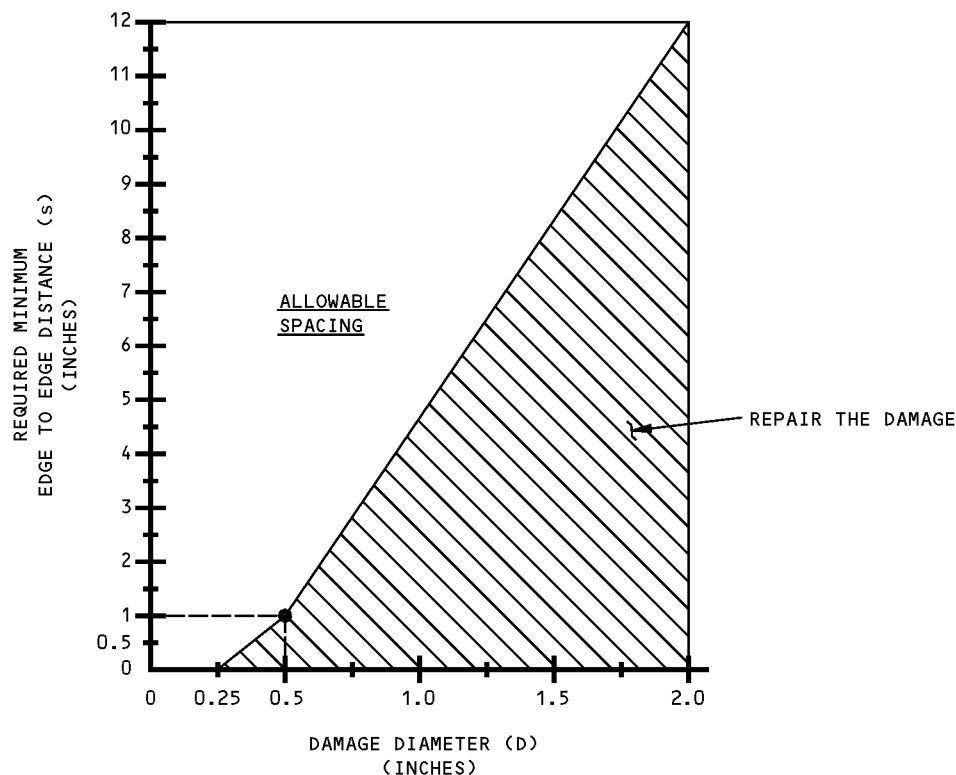
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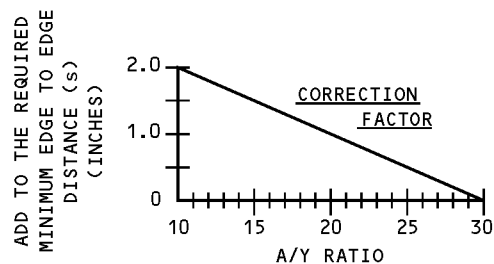
757-200 STRUCTURAL REPAIR MANUAL

NOTE: FOR COMPONENTS WITH A 6(D) SPACING AND 2-INCH MAXIMUM DIAMETER REQUIREMENT.

APPLICABILITY: HORIZONTAL STABILIZER – HORIZONTAL TAIL TIP



- USE $\frac{D+d}{2}$ AS THE DAMAGE DIAMETER (D) TO FIND THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) BETWEEN ADJACENT DAMAGE SITES
- ADD A CORRECTION FACTOR TO THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s), FOUND ON THE ABOVE GRAPH, FOR DENTS ON ALUMINUM PANELS WITH AN A/Y RATIO OF LESS THAN 30. USE THE LOWEST A/Y RATIO, BUT NOT LESS THAN 10, WHEN DAMAGE SITES ARE GROUPED TOGETHER



6(D) DAMAGE SPACING DETAIL V

Expanded Allowable Damage Limits Figure 103 (Sheet 4 of 4)

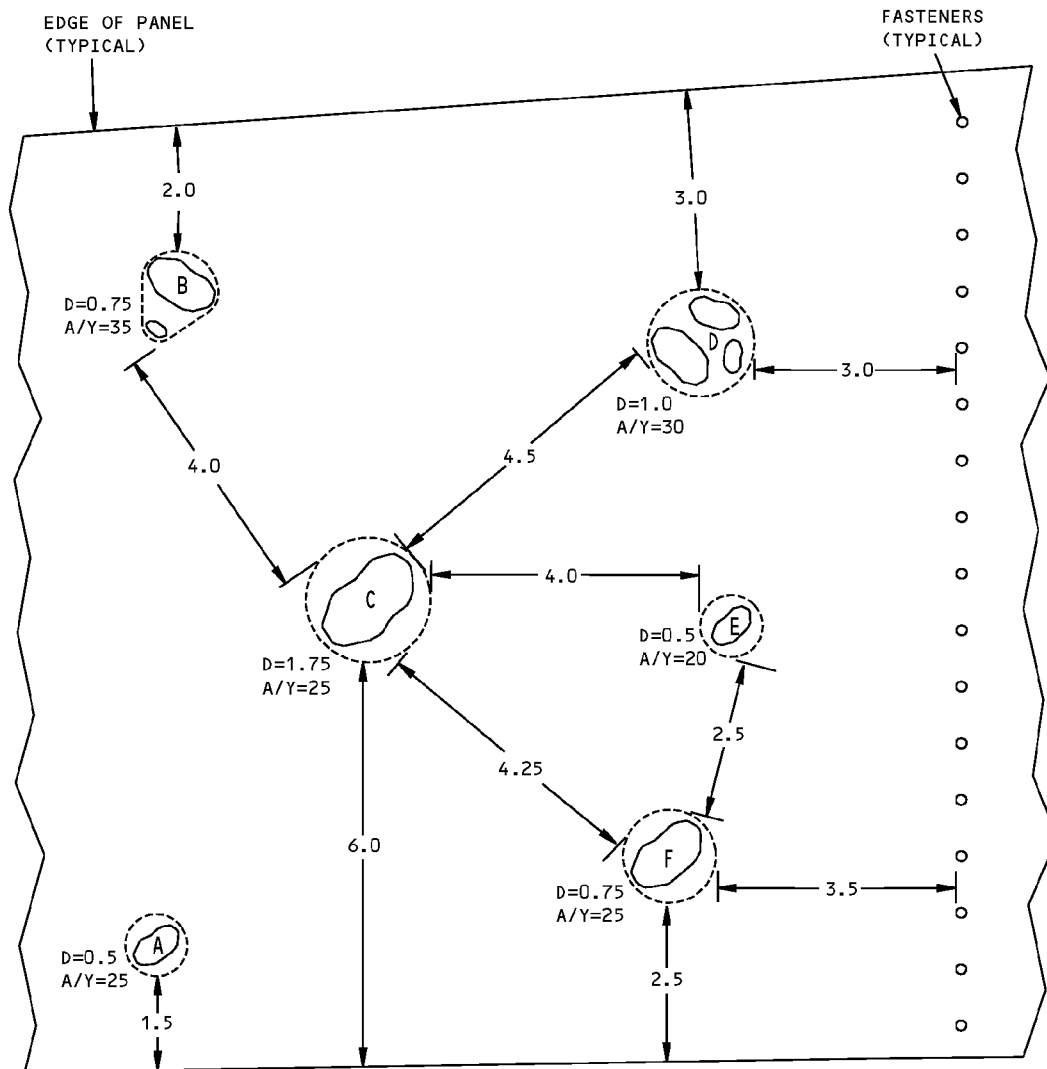
ALLOWABLE DAMAGE GENERAL

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757-200 STRUCTURAL REPAIR MANUAL



NOTES

- ALL DIMENSIONS ARE IN INCHES.

ASSUMPTIONS:

- DAMAGE IS NOT IN A CRITICAL AREA OR AREA OF HIGH LOAD TRANSFER.
- MINIMUM DISTANCE FROM THE DAMAGE TO EDGE OF PANEL, FASTENER, OR OTHER DAMAGE IS $3(D)$.

INSTRUCTIONS:

- PUT TOGETHER THE CLOSELY SPACED DAMAGE SITES.
- USE THE RECORDED DAMAGE INFORMATION AS SHOWN AND FIND THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) AS GIVEN IN THE EXPANDED ALLOWABLE DAMAGE LIMITS. FOR THIS EXAMPLE, REFER TO FIGURE 103, DETAIL III.
- USE $\frac{D+d}{2}$ AS THE DAMAGE DIAMETER TO FIND THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) BETWEEN ADJACENT DAMAGE SITES.
- ADD A CORRECTION FACTOR TO THE DAMAGE SITES WITH AN A/Y RATIO LESS THAN 30.

Example - Expanded Allowable Damage Limits
Figure 104 (Sheet 1 of 4)

ALLOWABLE DAMAGE GENERAL

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THE ANALYSIS OF DAMAGE SITE A

- D = 0.5
A/Y = 25
1.5 (TO EDGE OF PANEL)
1. THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 1.5 (1.0+0.5).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE A TO THE EDGE OF THE PANEL IS SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE B

- D = 0.75
A/Y = 35
2.0 (TO EDGE OF PANEL)
4.0 (TO ADJACENT DAMAGE SITE C)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF PANEL DISTANCE (s) FROM THE GRAPH IS 2.0.
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE C DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 4.0 (3.5+0.5).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE B AND C, AND TO THE EDGE OF THE PANEL IS SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE C

- D = 1.75
A/Y = 25
6.0 (TO EDGE OF PANEL)
4.0 (TO ADJACENT DAMAGE SITE B)
4.5 (TO ADJACENT DAMAGE SITE D)
4.0 (TO ADJACENT DAMAGE SITE E)
4.25 (TO ADJACENT DAMAGE SITE F)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF PANEL DISTANCE (s) FROM THE GRAPH PLUS A CORRECTION FACTOR IS 5.5 (5.0+0.5).
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE B DISTANCE (s) IS 4.0. SEE ANALYSIS OF DAMAGE SITE B.
 3. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE D DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 4.5 (4.0+0.5).
 4. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE E DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 4.0 (3.0+1.0).
 5. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE F DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 4.0 (3.5+0.5).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE C AND B, D, E, F, AND TO THE EDGE OF THE PANEL IS SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE D

- D = 1.0
A/Y = 30
3.0 (TO EDGE OF PANEL)
4.5 (TO ADJACENT DAMAGE SITE C)
3.0 (TO FASTENER ROW)

1. THE REQUIRED MINIMUM EDGE TO EDGE OF THE PANEL OR FASTENER ROW DISTANCE (s) FROM THE GRAPH IS 2.5.
2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE C DISTANCE (s) IS 4.5. SEE ANALYSIS OF DAMAGE SITE C.

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE D AND C, AND TO THE EDGE OF THE PANEL OR FASTENER ROW IS SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE E

- D = 0.5
A/Y = 20
1.5 (TO EDGE OF PANEL)
4.0 (TO ADJACENT DAMAGE SITE C)
2.0 (TO ADJACENT DAMAGE SITE F)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF PANEL DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 2.0 (1.0+1.0).
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE C DISTANCE (s) IS 4.0. SEE ANALYSIS OF DAMAGE SITE C.
 3. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE F DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 2.5 (1.5+1.0).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE E AND C, F, AND TO THE EDGE OF THE PANEL IS SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE F

- D = 0.75
A/Y = 25
2.5 (TO EDGE OF PANEL)
4.25 (TO ADJACENT DAMAGE SITE C)
2.5 (TO ADJACENT DAMAGE SITE E)
3.5 (TO FASTENER ROW)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF THE PANEL OR FASTENER ROW DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 2.5 (2.0+0.5).
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE C DISTANCE (s) IS 4.0. SEE ANALYSIS OF DAMAGE SITE C.
 3. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE E DISTANCE (s) IS 2.5. SEE ANALYSIS OF DAMAGE SITE E.

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE F AND C, E, AND TO THE EDGE OF THE PANEL OR FASTENER ROW IS SATISFACTORY.

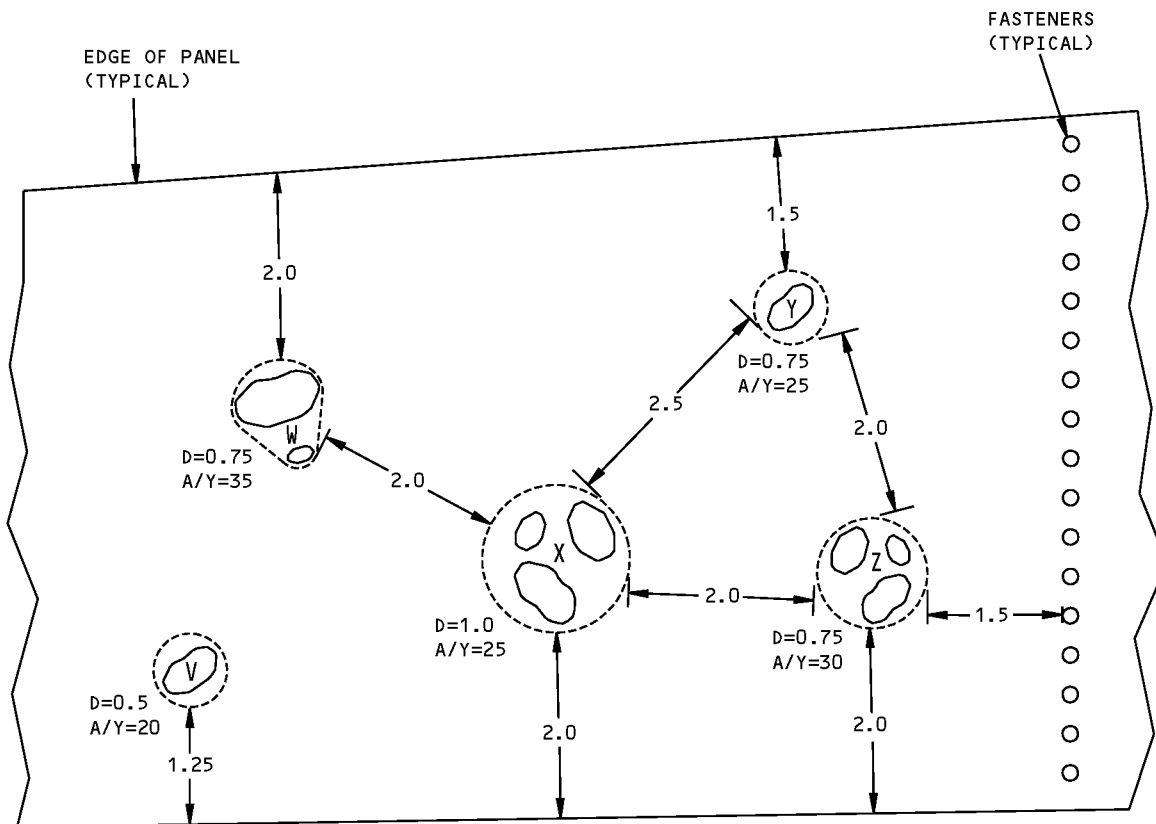
RESULTS OF THE ANALYSIS

THE ALLOWABLE SPACING BETWEEN DAMAGE SITES, FASTENERS, AND EDGE OF THE PANEL IS SATISFACTORY TO THE EXPANDED ALLOWABLE DAMAGE LIMITS. REFER TO PARAGRAPH 4.B FOR THE TEMPORARY REPAIR OR SEALING OF THE DAMAGE.

NOTE: DAMAGE SITE C MUST BE FILLED AS GIVEN IN SRM 51-70-01 BEFORE THE AIRPLANE IS RETURNED TO SERVICE.

**Example - Expanded Allowable Damage Limits
Figure 104 (Sheet 2 of 4)**

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- ALL DIMENSIONS ARE IN INCHES.

ASSUMPTIONS:

- DAMAGE IS NOT IN A CRITICAL AREA OR AREA OF HIGH LOAD TRANSFER.
- MINIMUM DISTANCE FROM THE DAMAGE TO THE EDGE OF PANEL, FASTENER, OR OTHER DAMAGE IS $3(D)$.

INSTRUCTIONS:

- PUT TOGETHER THE CLOSELY SPACED DAMAGE SITES.
- USE THE RECORDED DAMAGE INFORMATION AS SHOWN AND FIND THE EDGE TO EDGE DISTANCE (s) AS GIVEN IN THE EXPANDED ALLOWABLE DAMAGE LIMITS. FOR THIS EXAMPLE, REFER TO FIGURE 103, DETAIL III.
- USE " $\frac{D+d}{2}$ " AS THE DAMAGE DIAMETER TO FIND THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) BETWEEN ADJACENT DAMAGE SITES.
- ADD A CORRECTION FACTOR TO DENTS WITH AN A/Y RATIO LESS THAN 30.

Example - Expanded Allowable Damage Limits
Figure 104 (Sheet 3 of 4)

757-200 STRUCTURAL REPAIR MANUAL

THE ANALYSIS OF DAMAGE SITE V

- D = 0.5
A/Y = 20
1.25 (TO EDGE OF PANEL)
1. THE REQUIRED MINIMUM EDGE TO EDGE DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 2.0 (1.0+1.0).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE V TO THE EDGE OF THE PANEL IS NOT SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE W

- D = 0.75
A/Y = 35
2.0 (TO EDGE OF PANEL)
2.0 (TO ADJACENT DAMAGE SITE X)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF PANEL DISTANCE (s) FROM THE GRAPH IS 2.0.
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE X DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 3.0 (2.5+0.5).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE W AND X IS NOT SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE X

- D = 1.0
A/Y = 25
2.0 (TO EDGE OF PANEL)
2.0 (TO ADJACENT DAMAGE SITE W)
2.5 (TO ADJACENT DAMAGE SITE Y)
2.0 (TO ADJACENT DAMAGE SITE Z)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF PANEL DISTANCE (s) FROM THE GRAPH PLUS A CORRECTION FACTOR IS 3.0 (2.5+0.5).
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE W DISTANCE (s) IS 3.0. SEE ANALYSIS OF DAMAGE SITE W.
 3. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE Y DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 3.0 (2.5+0.5).
 4. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE Z DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 3.0 (2.5+0.5).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE X AND W, Y, Z, AND TO THE EDGE OF THE PANEL IS NOT SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE Y

- D = 0.75
A/Y = 25
1.5 (TO EDGE OF PANEL)
2.5 (TO ADJACENT DAMAGE SITE X)
2.0 (TO ADJACENT DAMAGE SITE Z)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF PANEL DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 2.5 (2.0+0.5).
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE X DISTANCE (s) IS 3.0. SEE ANALYSIS OF DAMAGE SITE X.
 3. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE Z DISTANCE (s) FROM THE GRAPH, PLUS A CORRECTION FACTOR IS 2.5 (2.0+0.5).

THE ALLOWABLE SPACING BETWEEN DAMAGE SITE Y AND X, Z, AND TO THE EDGE OF THE PANEL IS NOT SATISFACTORY.

THE ANALYSIS OF DAMAGE SITE Z

- D = 0.75
A/Y = 30
2.0 (TO EDGE OF PANEL)
2.0 (TO ADJACENT DAMAGE SITE X)
2.0 (TO ADJACENT DAMAGE SITE Y)
1.5 (TO FASTENER ROW)
1. THE REQUIRED MINIMUM EDGE TO EDGE OF THE PANEL OR FASTENER ROW DISTANCE (s) FROM THE GRAPH IS 2.0.
 2. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE X DISTANCE (s) IS 3.0. SEE ANALYSIS OF DAMAGE SITE X.
 3. THE REQUIRED MINIMUM EDGE TO EDGE OF DAMAGE SITE Y DISTANCE (s) IS 2.5. SEE ANALYSIS OF DAMAGE SITE Y.

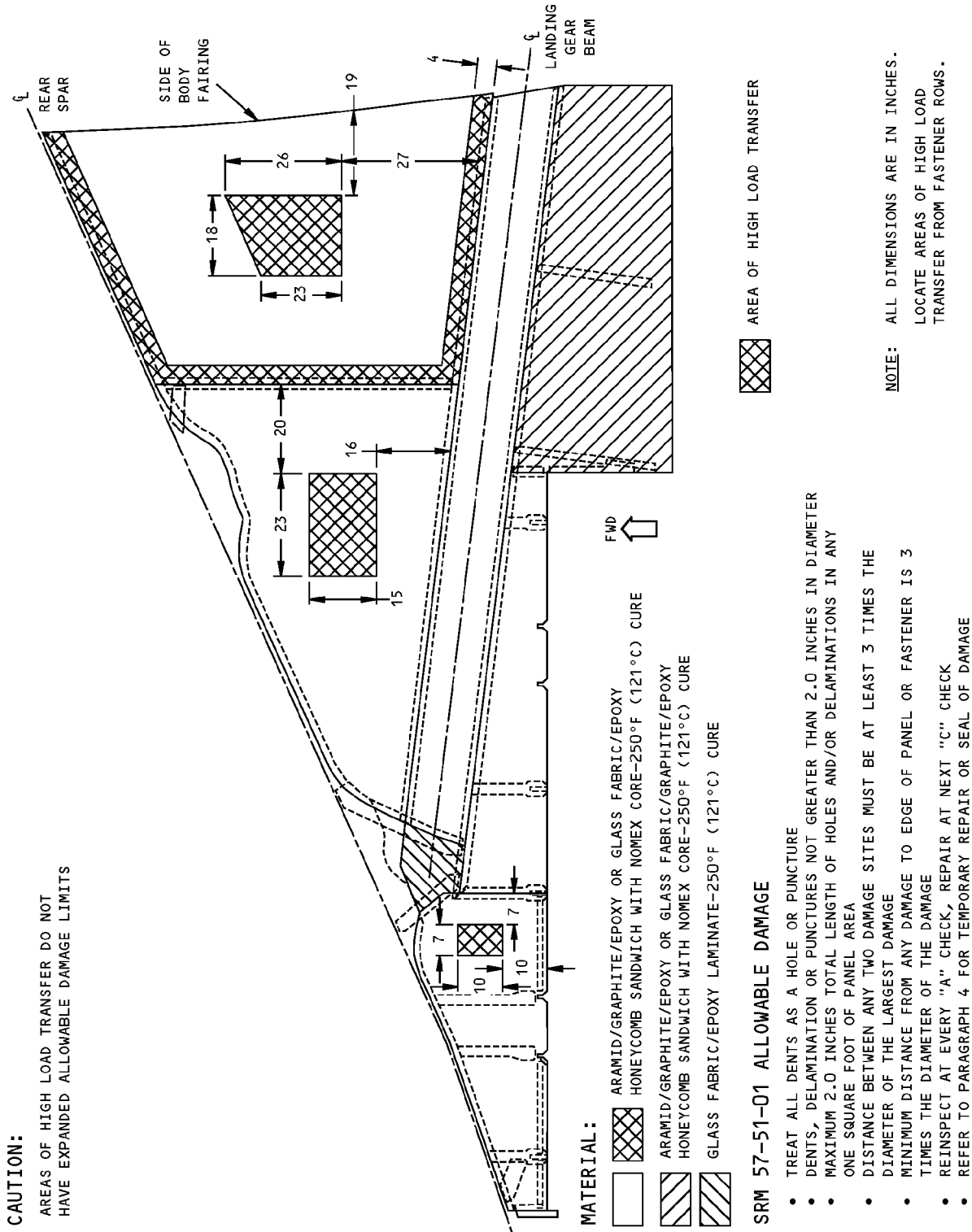
THE ALLOWABLE SPACING BETWEEN DAMAGE SITE Z AND X, Y, AND TO THE EDGE OF THE FASTENER ROW AND PANEL IS NOT SATISFACTORY.

RESULTS OF THE ANALYSIS

THE ALLOWABLE SPACING BETWEEN DAMAGE SITES, FASTENERS, AND EDGE OF THE PANEL IS NOT SATISFACTORY TO THE EXPANDED ALLOWABLE DAMAGE LIMITS. REPAIR THE DAMAGE BEFORE THE AIRPLANE IS RETURNED TO SERVICE.

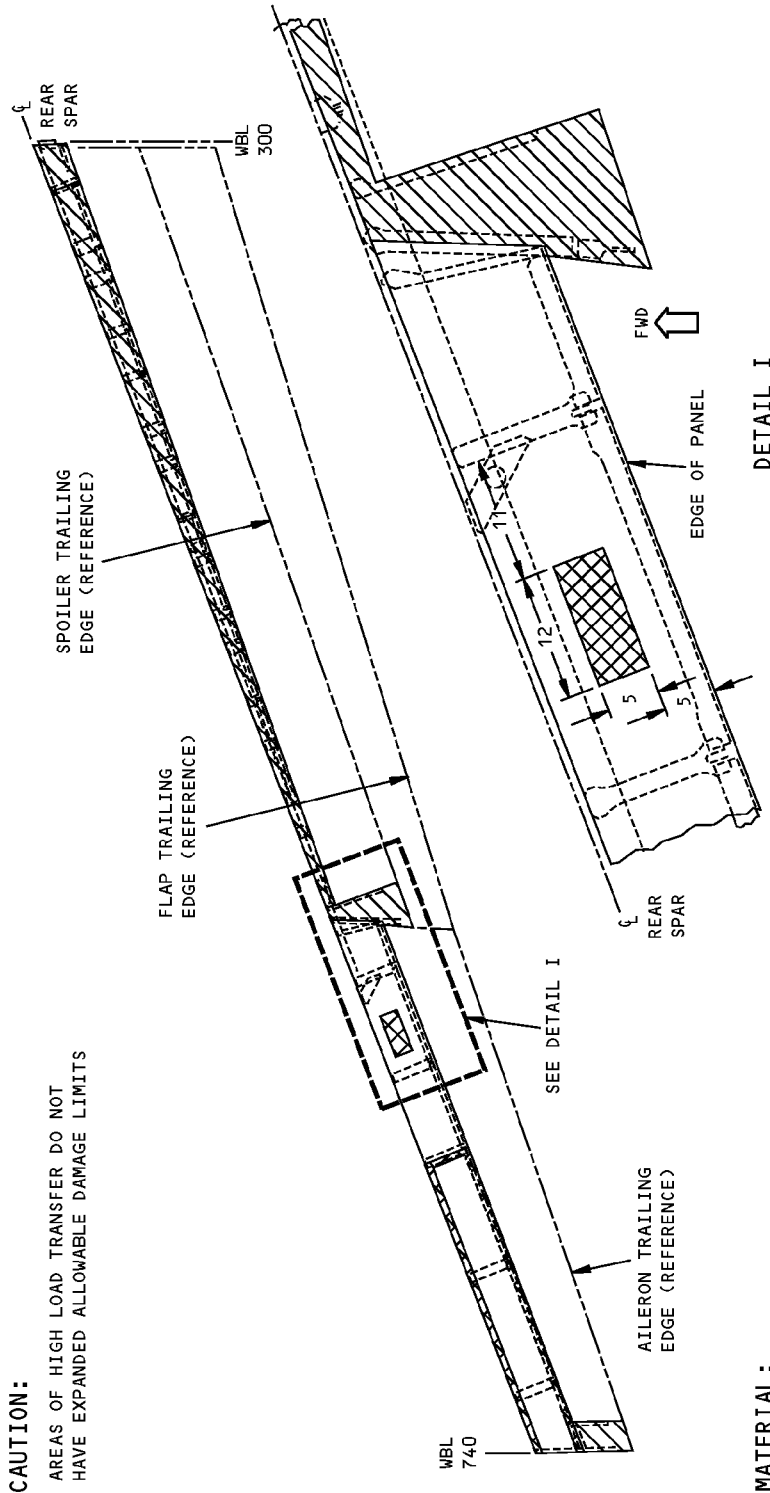
**Example - Expanded Allowable Damage Limits
Figure 104 (Sheet 4 of 4)**

757-200 STRUCTURAL REPAIR MANUAL



Wing-Inboard Fixed Trailing Edge Panels
Figure 105

**757-200
STRUCTURAL REPAIR MANUAL**



CAUTION:
AREAS OF HIGH LOAD TRANSFER DO NOT
HAVE EXPANDED ALLOWABLE DAMAGE LIMITS

MATERIAL:

- GLASS FABRIC/GRAPHITE/EPOXY OR ARAMID/GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE
- GLASS FABRIC/EPOXY OR GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE

SRM 57-51-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS AS A HOLE OR PUNCTURE
- DENTS, DELAMINATION OR PUNCTURES NOT GREATER THAN 2.0 INCHES IN DIAMETER
- MAXIMUM 2.0 INCHES TOTAL LENGTH OF HOLES AND/OR DELAMINATIONS IN ANY ONE SQUARE FOOT OF PANEL AREA
- DISTANCE BETWEEN ANY TWO DAMAGE SITES MUST BE AT LEAST 3 TIMES THE DIAMETER OF THE LARGEST DAMAGE
- MINIMUM DISTANCE FROM ANY DAMAGE TO EDGE OF PANEL OF FASTENER IS 3 TIMES THE DIAMETER OF THE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

AREA OF HIGH LOAD TRANSFER

NOTE: ALL DIMENSIONS ARE IN INCHES.
LOCATE AREAS OF HIGH LOAD
TRANSFER FROM FASTENER ROWS.

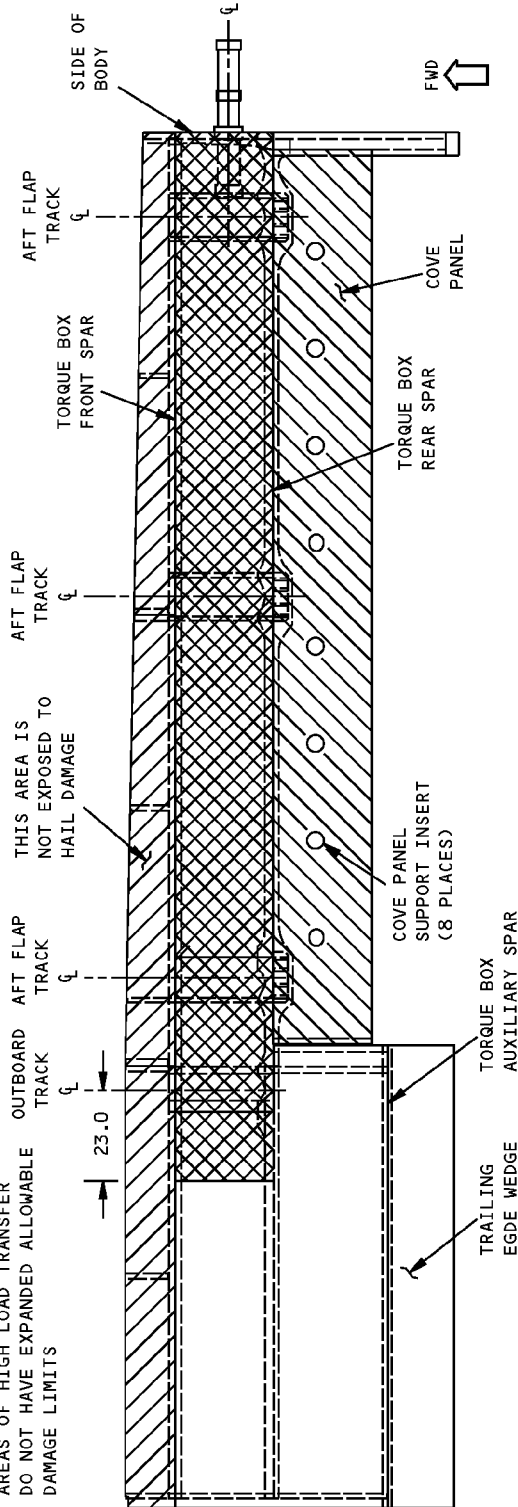
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**Wing-Outboard Fixed Trailing Edge Panels
Figure 106**

757-200 STRUCTURAL REPAIR MANUAL

CAUTION:

AREAS OF HIGH LOAD TRANSFER
DO NOT HAVE EXPANDED ALLOWABLE
DAMAGE LIMITS



NOTES

- ALL DIMENSIONS ARE IN INCHES

MATERIAL:

ALUMINUM HONEYCOMB SANDWICH (2024-T3) WITH ALUMINUM CORE
 OR 2024-T3) WITH ALUMINUM CORE

SRM 57-53-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MAXIMUM HOLE OR PUNCTURE DIAMETER IS 0.25 INCH
- MINIMUM HOLE OR PUNCTURE DISTANCE TO EDGE OF FASTENER IS 3 TIMES DIAMETER OF HOLE
- DISTANCE BETWEEN ADJACENT HOLES IS 3 TIMES DIAMETER OF LARGE HOLE
- MAXIMUM DELAMINATION DIAMETER IS 1.0 INCH
- MINIMUM DISTANCE BETWEEN DELAMINATIONS OR DISTANCE TO EDGE OF FASTENER IS 1.0 INCH
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK OF DAMAGE
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL

DRAWING NO. 113N2003

MATERIAL:

GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE

SRM 57-53-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS HOLE OR PUNCTURE
- MAXIMUM HOLE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MAXIMUM TOTAL OF HOLE DIAMETER OR DELAMINATIONS IN ANY SQUARE FOOT OF PANEL AREA IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN HOLES OR DELAMINATIONS IS 3 TIMES DIAMETER OF LARGE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

MATERIAL:

ALUMINUM SHEET (2024-T6) WITH GLASS FABRIC OUTER PLY

SRM 57-53-01 ALLOWABLE DAMAGE

- ALUMINUM SHEET: SEE ALUMINUM HONEYCOMB SANDWICH ALLOWABLE DAMAGE (57-53-01)
- GLASS FABRIC PLY: SEE GLASS FABRIC/EPOXY HONEYCOMB SANDWICH ALLOWABLE DAMAGE (57-53-01)

Wing-Main Flap-Inboard Trailing Edge Flap
Figure 107

ALLOWABLE DAMAGE GENERAL

51-10-04

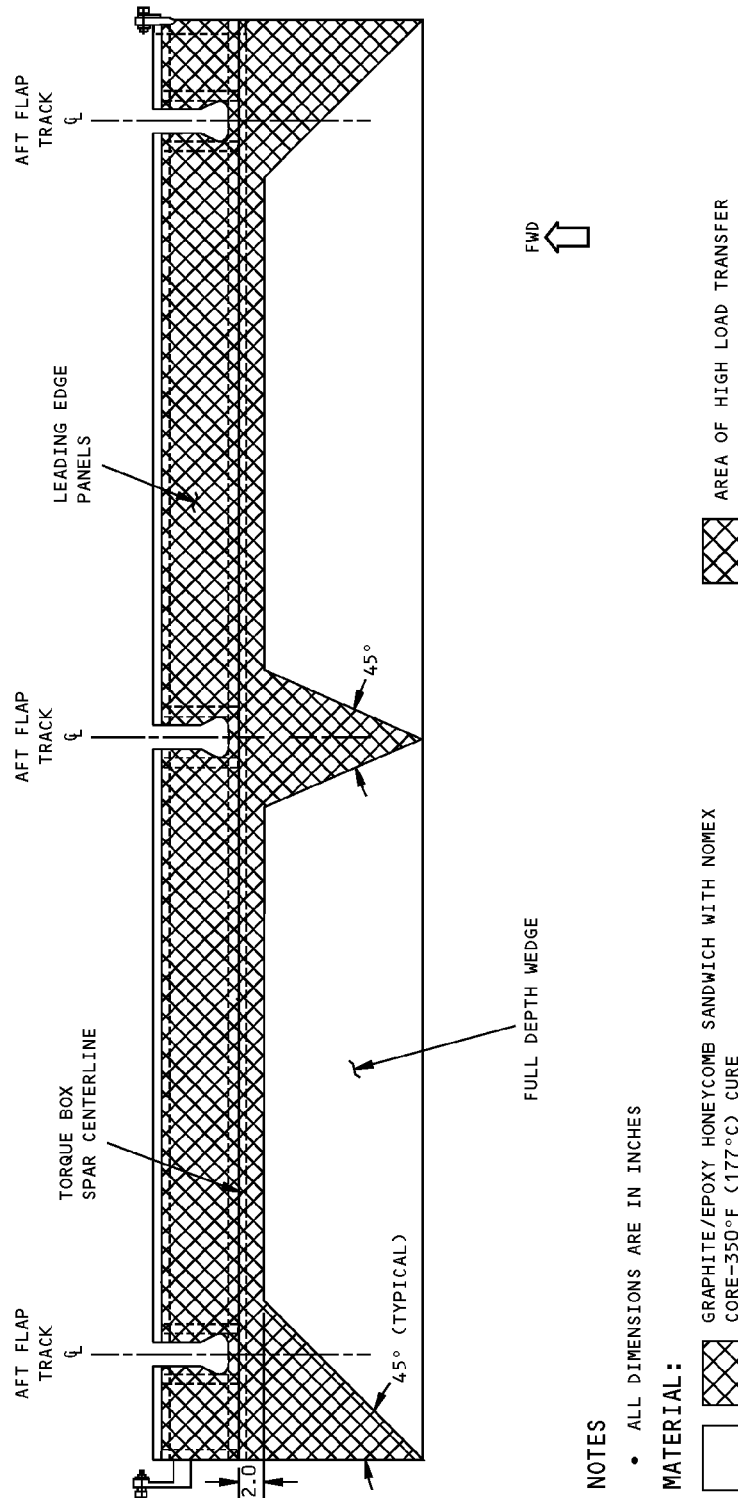
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757-200 STRUCTURAL REPAIR MANUAL

CAUTION:


AREAS OF HIGH LOAD TRANSFER DO NOT HAVE EXPANDED ALLOWABLE DAMAGE LIMITS



NOTES

- ALL DIMENSIONS ARE IN INCHES

MATERIAL:

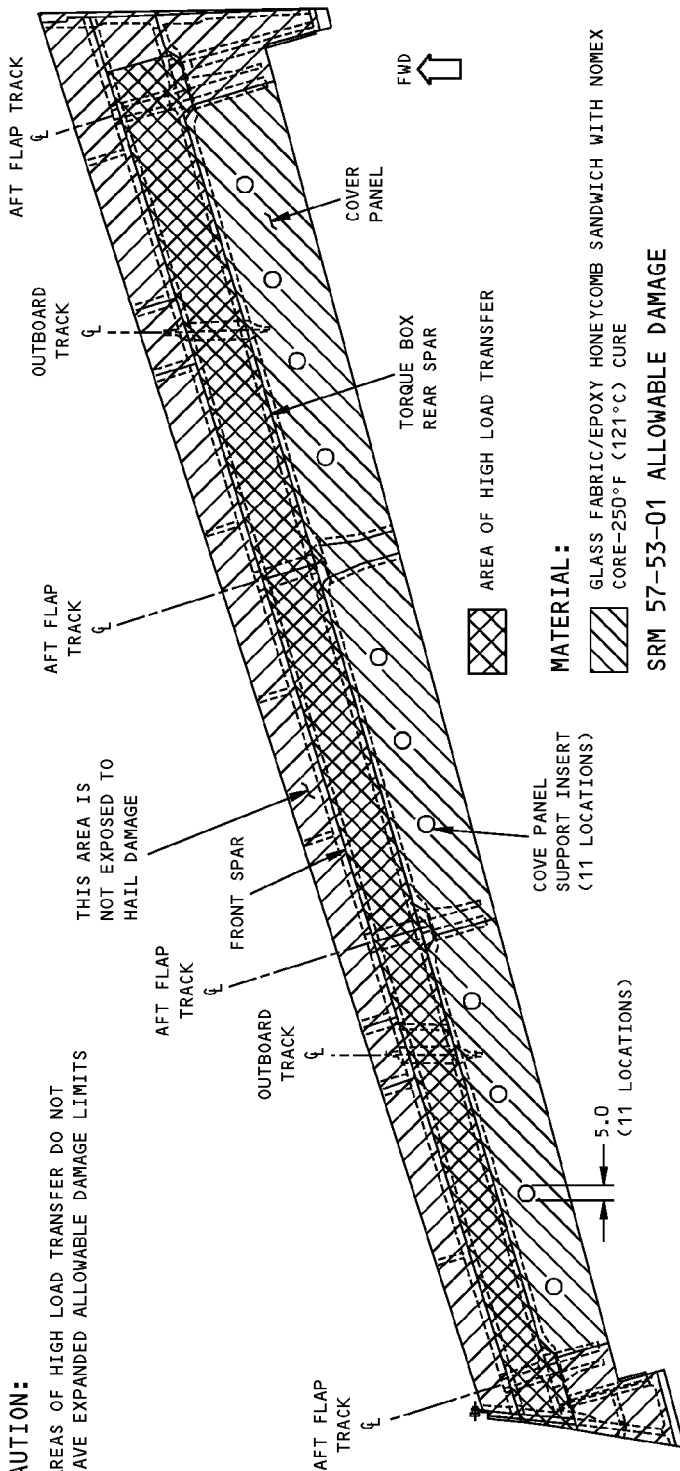
 GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-350°F (177°C) CURE

SRM 57-53-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE
- MAXIMUM HOLE, PUNCTURE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN ANY TWO DAMAGE SITES IS 3 TIMES THE DIAMETER OF THE LARGE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 113N2800

Wing-Aft Flap-Inboard Trailing Edge Flap
Figure 108



CAUTION:

AREAS OF HIGH LOAD TRANSFER DO NOT HAVE EXPANDED ALLOWABLE DAMAGE LIMITS

NOTES

- ALL DIMENSIONS ARE IN INCHES

MATERIAL:

ALUMINUM HONEYCOMB SANDWICH (7075-T76 OR 7075-T73) WITH ALUMINUM CORE

SRM 57-53-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MAXIMUM HOLE OR PUNCTURE DIAMETER IS 0.25 INCH
- MINIMUM HOLE OR PUNCTURE DISTANCE TO EDGE OR FASTENER IS 3 TIMES DIAMETER OF HOLE
- DISTANCE BETWEEN ADJACENT HOLES IS 3 TIMES DIAMETER OF LARGER HOLE
- MAXIMUM DELAMINATION DIAMETER IS 1.0 INCH
- MINIMUM DISTANCE BETWEEN DELAMINATIONS OR DISTANCE TO EDGE OF FASTENER IS 1.0 INCH
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 113N3003

MATERIAL:

GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE

SRM 57-53-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS HOLE OR PUNCTURE
- MAXIMUM HOLE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MAXIMUM TOTAL OF HOLE DIAMETERS OR DELAMINATIONS IN ANY ONE SQUARE FOOT OF PANEL AREA IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN HOLES OR DELAMINATIONS IS 3 TIMES DIAMETER OF LARGE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

MATERIAL:

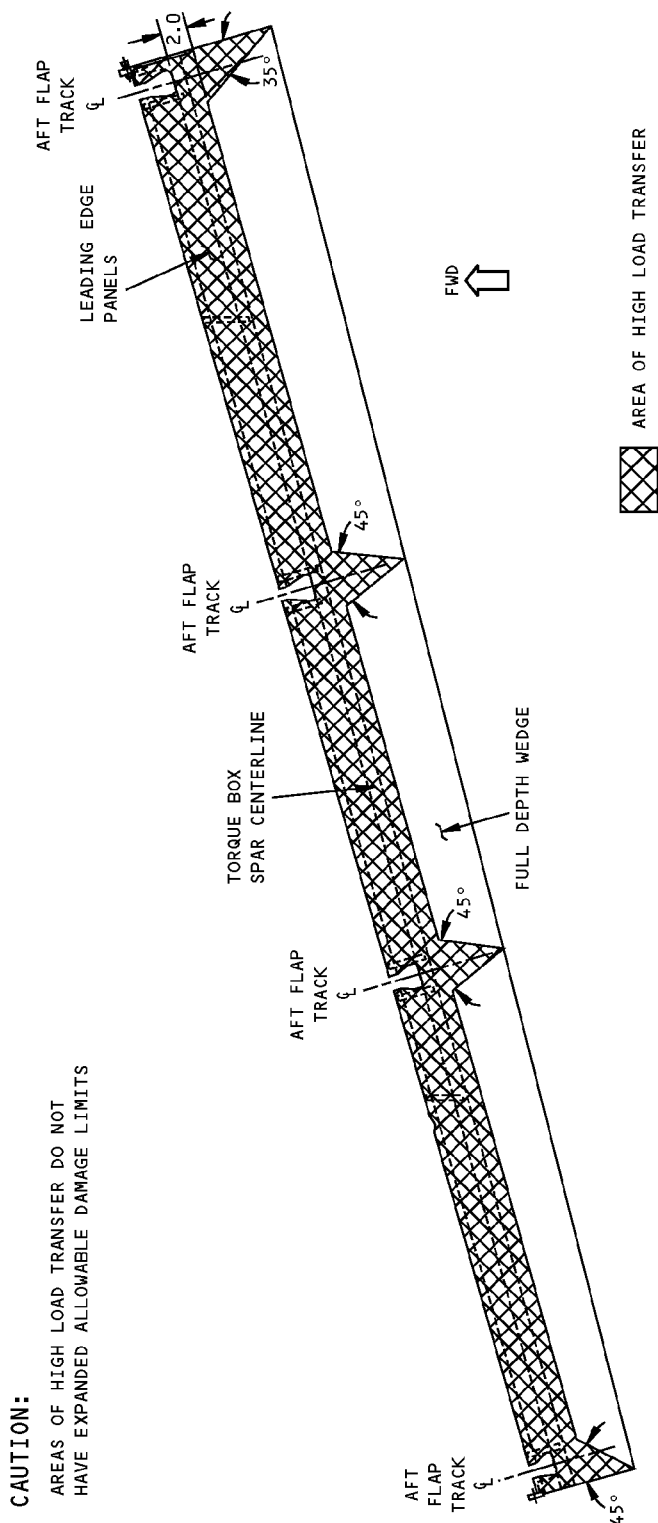
ALUMINUM SHEET (7075-T76, 7075-T73 OR CHEM-MILLED 2024-T3)

SRM 57-53-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MINIMUM DISTANCE BETWEEN HOLES OR TO EDGE OR FASTENER IS 1.0 INCH
- CLEAN UP DAMAGE WITH 0.25 INCH MAXIMUM HOLE AND FILL WITH RIVET. ALL OTHER HOLES TO BE REPAIRED.
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

Wing-Main Flap-Outboard Trailing Edge Flap
Figure 109


757-200 STRUCTURAL REPAIR MANUAL



NOTES

ALL DIMENSIONS ARE IN INCHES

MATERIAL:

 GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX
CORE-350°F (177°C) CURE

SRM 57-53-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE
- MAXIMUM HOLE, PUNCTURE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN ANY TWO DAMAGE SITES IS 3 TIMES THE DIAMETER OF LARGE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 113N3800

**Wing-Aft Flap-Outboard Trailing Edge Flap
Figure 110**

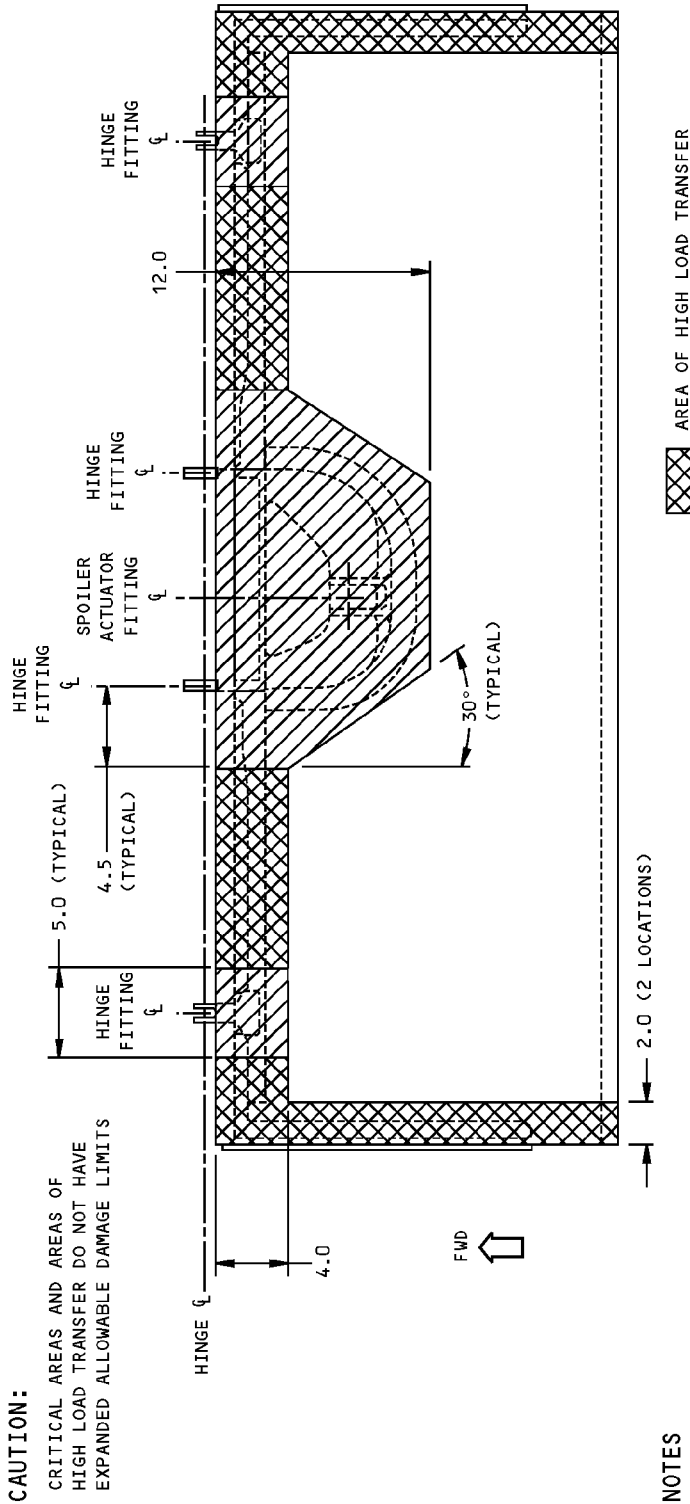
ALLOWABLE DAMAGE GENERAL

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STRUCTURAL REPAIR MANUAL



Wing-Spoiler (Typical)
Figure 111

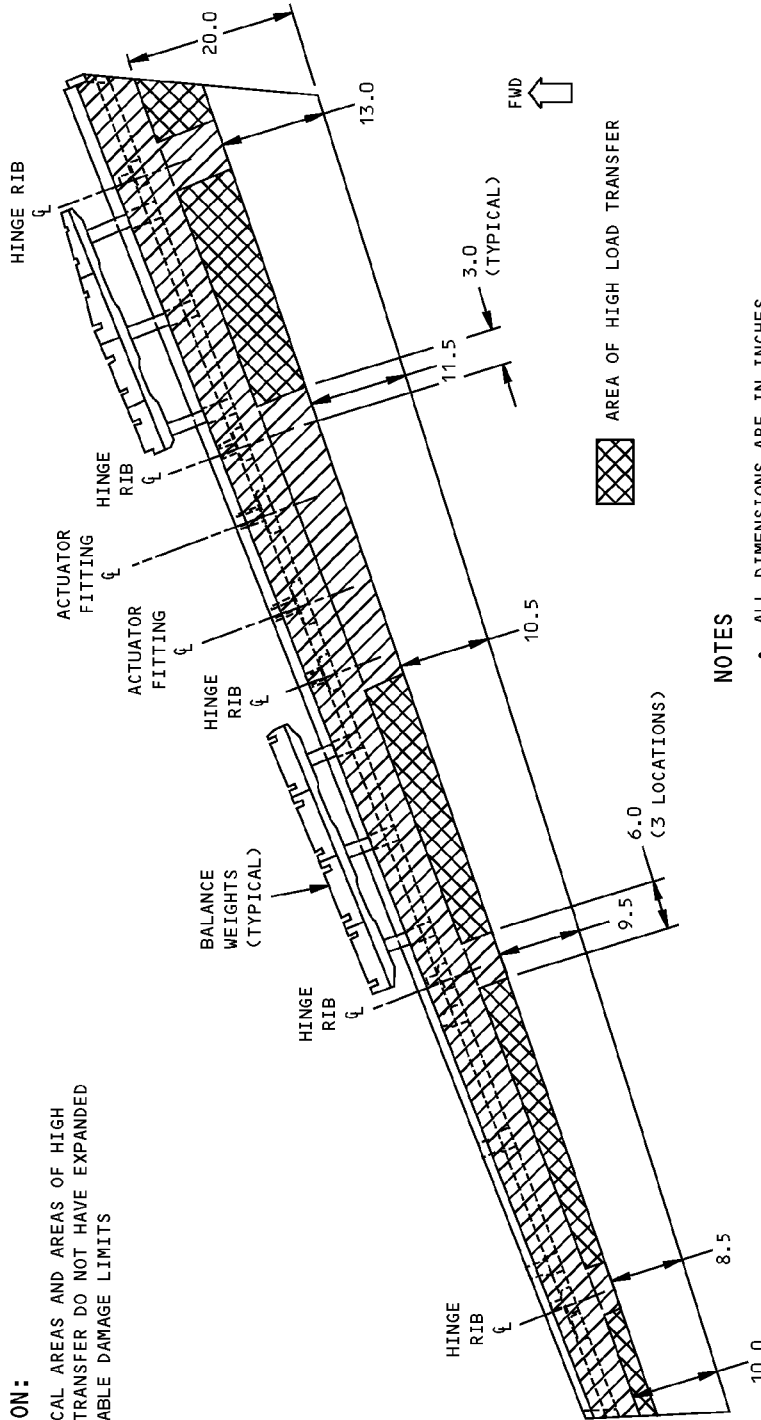
ALLOWABLE DAMAGE GENERAL

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757-200 STRUCTURAL REPAIR MANUAL



CAUTION:

CRITICAL AREAS AND AREAS OF HIGH LOAD TRANSFER DO NOT HAVE EXPANDED ALLOWABLE DAMAGE LIMITS

Wing-Aileron
Figure 112

NOTES

- ALL DIMENSIONS ARE IN INCHES

MATERIAL: NON-CRITICAL AREA

GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-350°F (177°C) CURE

SRM 57-60-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS HOLE OR PUNCTURE
- DENTS, DELAMINATIONS OR PUNCTURES NOT GREATER THAN 2.0 INCHES IN DIAMETER
- MAXIMUM 2.0 INCHES TOTAL LENGTH OF HOLES AND/OR DELAMINATION IN ANY ONE SQUARE FOOT OF PANEL AREA
- DISTANCE BETWEEN ANY TWO DAMAGE SITES MUST BE AT LEAST 3 TIMES THE DIAMETER OF THE LARGE DAMAGE
- MINIMUM DISTANCE FROM ANY DAMAGE TO EDGE OF PANEL OR FASTENER IS 3 TIMES THE DIAMETER OF THE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

MATERIAL: CRITICAL AREA

GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-350°F (177°C) CURE

SRM 57-60-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE OR PUNCTURE
- DENTS, DELAMINATIONS OR PUNCTURES NOT GREATER THAN 0.25 INCH IN DIAMETER
- MAXIMUM OF ONE HOLE PER ANY ONE SQUARE FOOT OF PANEL AREA
- DISTANCE BETWEEN ANY TWO DAMAGE SITES MUST BE AT LEAST 3 TIMES THE DIAMETER OF THE LARGE DAMAGE
- DISTANCE FROM EDGE OF DAMAGE SITE TO EDGE OF PART OR NEAREST FASTENER MUST BE AT LEAST 3 TIMES THE DIAMETER OF THE DAMAGE
- REPAIR THE AREA BY 300 FLIGHT HOURS
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 113N7100

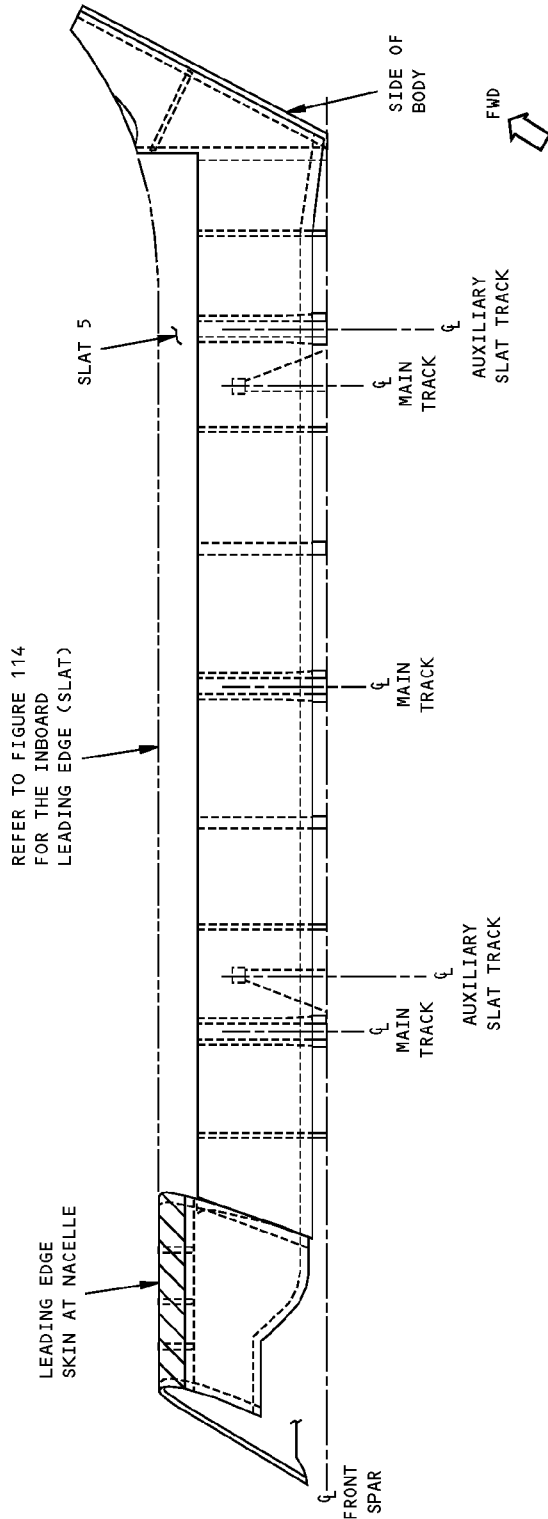
ALLOWABLE DAMAGE GENERAL

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STRUCTURAL REPAIR MANUAL



Wing-Inboard Fixed Leading Edge
Figure 113

MATERIAL:


 GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-350°F (177°C) CURE

SRM 57-41-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE OR PUNCTURE
- MAXIMUM ALLOWABLE PUNCTURE, HOLE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN ADJACENT HOLES, PUNCTURES OR DELAMINATIONS IS 3 TIMES DIAMETER OF THE LARGER DAMAGE
- MAXIMUM EDGE DAMAGE IS 10 PERCENT OF THE EDGE BAND LENGTH PER SIDE
- MAXIMUM ONE FASTENER HOLE IN SIX MAY BE DAMAGED
- REMOVE EDGE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 114N1601

MATERIAL:

 ALUMINUM SHEET (7075-T6)

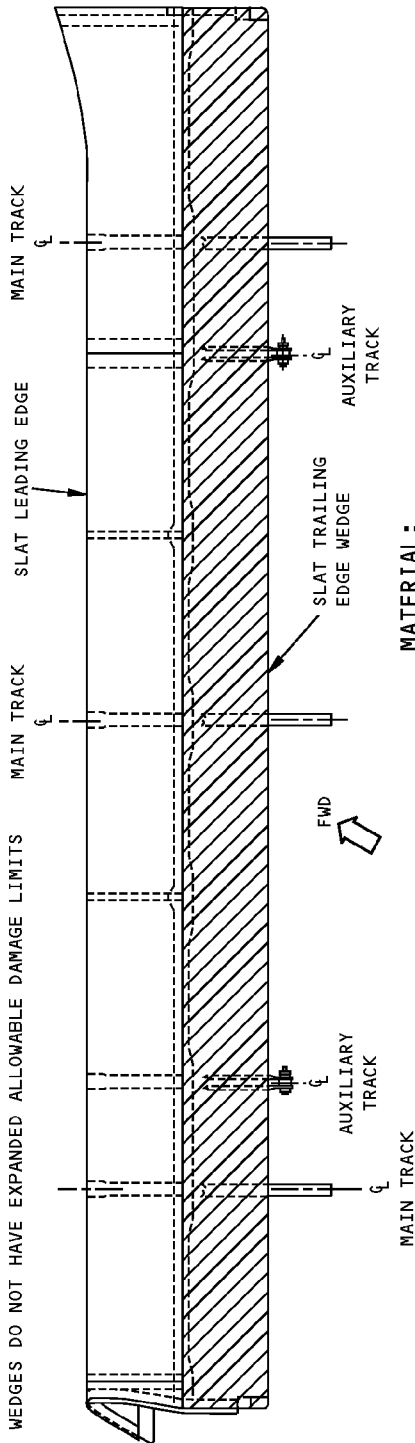
SRM 57-41-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MINIMUM DISTANCE BETWEEN HOLES OR TO EDGE OR FASTENER IS 1.0 INCH
- CLEAN UP DAMAGE WITH 0.25 INCH MAXIMUM HOLE AND FILL WITH RIVET. ALL OTHER HOLES TO BE REPAIRED.
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 114N1801

CAUTION:

THE LEADING EDGE (SLATS) AND SLAT TRAILING EDGE WEDGES DO NOT HAVE EXPANDED ALLOWABLE DAMAGE LIMITS


MATERIAL:


ALUMINUM HONEYCOMB SANDWICH (2024-T3) WITH ALUMINUM CORE

NOTES

- ALL DIMENSIONS ARE IN INCHES

MATERIAL:


ALUMINUM SHEET (7075-T6)

SRM 57-43-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM DENT DEPTH IS 0.06 INCH
- RATIO OF DENT DIAMETER TO DENT DEPTH MUST BE 30 OR GREATER
- MAXIMUM TOTAL OF 10 DENTS
- MINIMUM DISTANCE BETWEEN DENTS IS 0.5 TIMES LARGER DENT DIAMETER
- MINIMUM DISTANCE BETWEEN HOLES AND DISTANCE TO EDGE OR FASTENER IS 1.0 INCH
- ALL HOLES MUST BE CLEANED UP WITH 0.25 INCH DIAMETER HOLE AND FILL WITH RIVET. ALL OTHER HOLES TO BE REPAIRED
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

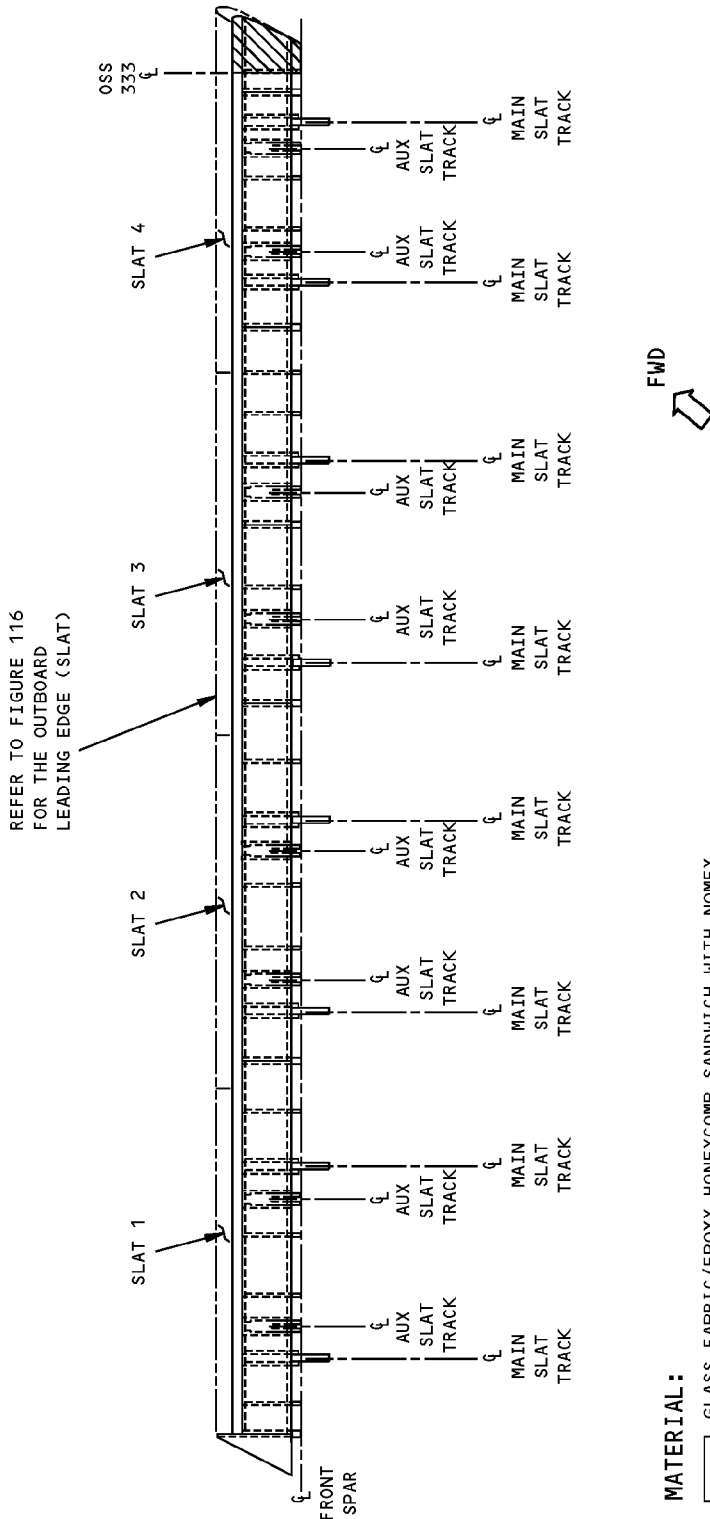
SRM 57-43-02 ALLOWABLE DAMAGE

- MAXIMUM DENT DIAMETER IS 2 INCHES
- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM 0.12 INCH DEEP DENT EXCEPT ONLY 0.04 INCH DEEP DENT ALLOWED IF LESS THAN 2.0 INCHES FROM EDGE OF PANEL
- DENT DIAMETER TO DEPTH RATIO MUST BE 10 OR GREATER
- DISTANCE BETWEEN DENTS MUST BE AT LEAST 1 TIMES THE DIAMETER OF THE LARGER DENT
- DENTS MORE THAN 0.12 INCH DEEP, BUT ALL OTHER LIMITS ARE NOT EXCEEDED, MUST BE FILLED WITH A POTTING COMPOUND AS SHOWN IN SRM 51-70-01
- MAXIMUM 0.25 INCH HOLE OR PUNCTURE DIAMETER AND ONLY ONE IN ANY 15 SQUARE INCHES OF PANEL AREA
- MINIMUM DISTANCE BETWEEN HOLES IS 1.0 INCH
- MINIMUM DISTANCE FROM HOLE TO EDGE OF PANEL OR FASTENER IS 1.0 INCH
- MAXIMUM 1.5 INCHES DELAMINATION DIAMETER
- MINIMUM EDGE TO EDGE DISTANCE FROM DELAMINATION TO EDGE OF PANEL OR FASTENER IS 1.0 INCH
- MINIMUM EDGE TO EDGE DISTANCE BETWEEN DELAMINATIONS IS 4 TIMES THE DIAMETER OF THE LARGER DELAMINATION
- EXCEPT FOR DENTS THAT ARE SATISFACTORY TO THE ALLOWABLE DENT LIMITS, REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 114N3002

Wing-Inboard Leading Edge (Slat)
Figure 114

757-200 STRUCTURAL REPAIR MANUAL



MATERIAL:

- GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE
- GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-350°F (177°C) CURE

SRM 57-41-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS AS A HOLE OR PUNCTURE
- MAXIMUM ALLOWABLE PUNCTURE, HOLE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN ADJACENT HOLES, PUNCTURES, OR DELAMINATIONS IS 3 TIMES THE DIAMETER OF THE LARGER DAMAGE
- MAXIMUM EDGE DAMAGE IS 10 PERCENT OF THE EDGE BAND LENGTH PER SIDE
- MAXIMUM ONE FASTENER HOLE IN SIX MAY BE DAMAGED
- REMOVE EDGE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 114N2035

Wing-Outboard Fixed Leading Edge
Figure 115

ALLOWABLE DAMAGE GENERAL

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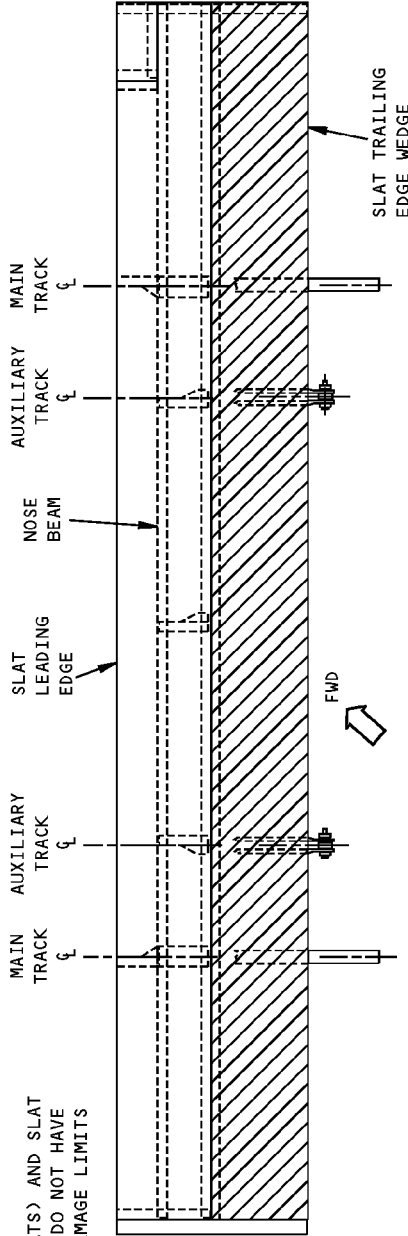
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STRUCTURAL REPAIR MANUAL

CAUTION:

THE LEADING EDGE (SLATS) AND SLAT TRAILING EDGE WEDGES DO NOT HAVE EXPANDED ALLOWABLE DAMAGE LIMITS



NOTES

- ALL DIMENSIONS ARE IN INCHES

MATERIAL:

ALUMINUM SHEET (7075-T6)

MATERIAL:



ALUMINUM HONEYCOMB SANDWICH (2024-T3) WITH ALUMINUM CORE

SRM 57-43-02 ALLOWABLE DAMAGE

- MAXIMUM DENT DIAMETER IS 2 INCHES
- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM 0.12 INCH DEEP DENT EXCEPT ONLY 0.04 INCH DEEP DENT ALLOWED IF LESS THAN 2.0 INCHES FROM EDGE OF PANEL
- DENT DIAMETER TO DEPTH RATIO MUST BE 10 OR GREATER
- DISTANCE BETWEEN DENTS MUST BE AT LEAST 1 TIMES THE DIAMETER OF THE LARGER DENT
- DENTS MORE THAN 0.12 INCH DEEP, BUT ALL OTHER LIMITS ARE NOT EXCEEDED, MUST BE FILLED WITH A POTTING COMPOUND AS SHOWN IN SRM 51-70-01
- MAXIMUM 0.25 INCH HOLE OR PUNCTURE DIAMETER AND ONLY ONE IN ANY 15 SQUARE INCHES OF PANEL AREA
- MINIMUM DISTANCE BETWEEN HOLES IS 1.0 INCH
- MINIMUM DISTANCE FROM HOLE TO EDGE OF PANEL OR FASTENER IS 1.0 INCH
- MAXIMUM 1.5 INCHES DELAMINATION DIAMETER
- MINIMUM DISTANCE FROM DELAMINATION TO EDGE OR FASTENER IS 1.0 INCH
- MINIMUM DISTANCE BETWEEN DELAMINATIONS IS 4 TIMES LARGER DELAMINATION DIAMETER
- EXCEPT FOR DENTS THAT ARE SATISFACTORY TO THE ALLOWABLE DENT LIMITS, REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

SRM 57-43-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM DENT DEPTH FORWARD OF NOSE BEAM IS 0.06 INCH
- MAXIMUM DENT DEPTH AFT OF NOSE BEAM IS 0.12 INCH
- RATIO OF DENT DIAMETER TO DENT DEPTH MUST BE 30 OR GREATER
- MAXIMUM TOTAL OF 10 DENTS FORWARD OF NOSE BEAM AND 10 DENTS AFT OF NOSE BEAM PER SLAT
- MINIMUM DISTANCE BETWEEN DENTS IS 0.5 TIMES LARGER DENT DIAMETER
- MINIMUM DISTANCE BETWEEN HOLES AND DISTANCE TO EDGE OR FASTENER IS 1.0 INCH
- ALL HOLES MUST BE CLEANED UP WITH 0.25 INCH DIAMETER HOLE AND FILLED WITH A RIVET. ALL OTHER HOLES TO BE REPAIRED
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 114N4002, 114N4003, 114N4004, 114N4005

Wing-Outboard Leading Edge (Slat)

Figure 116

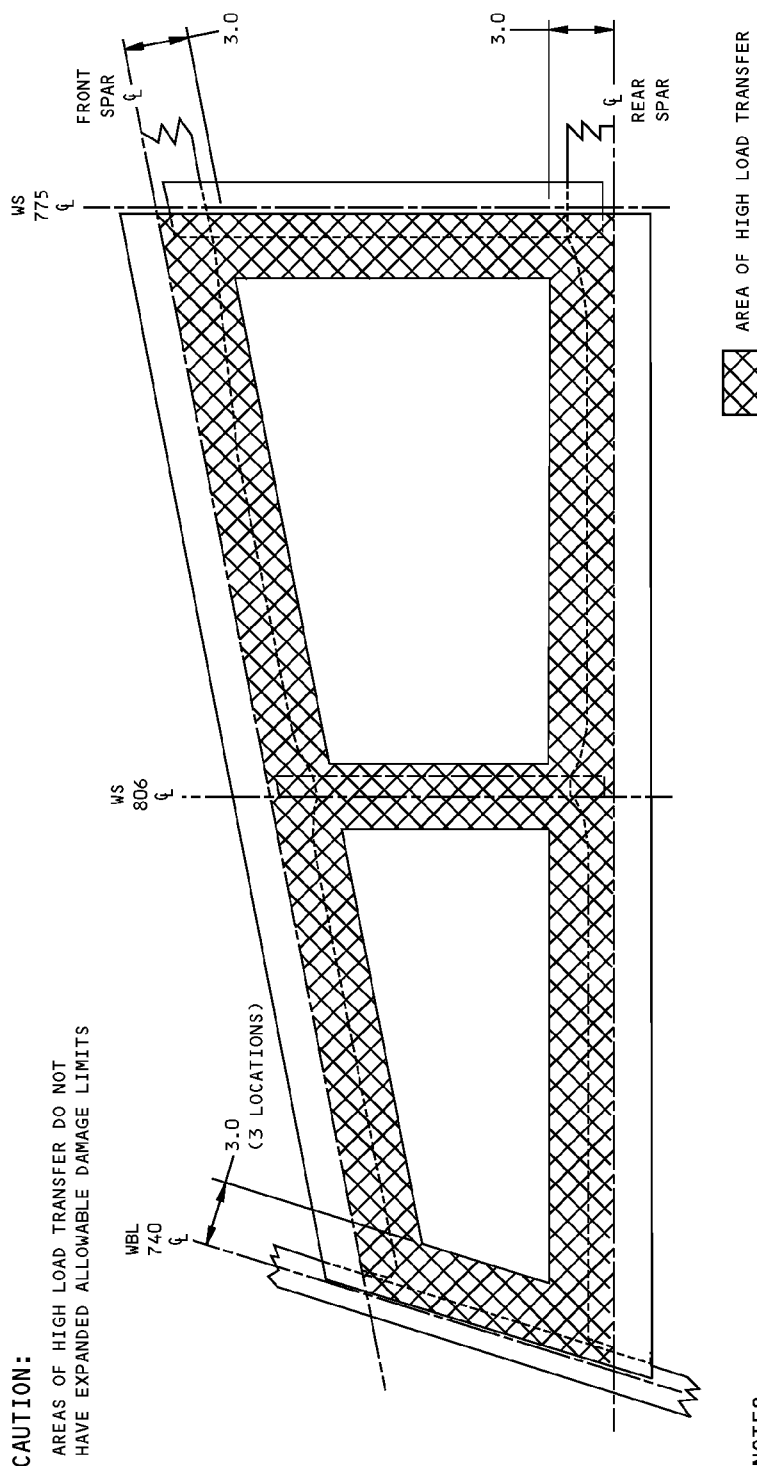
ALLOWABLE DAMAGE GENERAL

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757-200
STRUCTURAL REPAIR MANUAL



SRM 57-20-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE FROM ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM 1.5 SQUARE INCHES TOTAL DENT AREA PER 1.0 SQUARE FOOT OF PANEL AREA
- DENT DIAMETER TO DENT DEPTH MUST BE 30 OR GREATER
- MINIMUM DISTANCE FROM DENT TO EDGE OR FASTENER IS 4 TIMES DENT DIAMETER
- MINIMUM DISTANCE BETWEEN DENTS, HOLES OR EDGE IS 4 TIMES LARGER THAN THE DENT DIAMETER

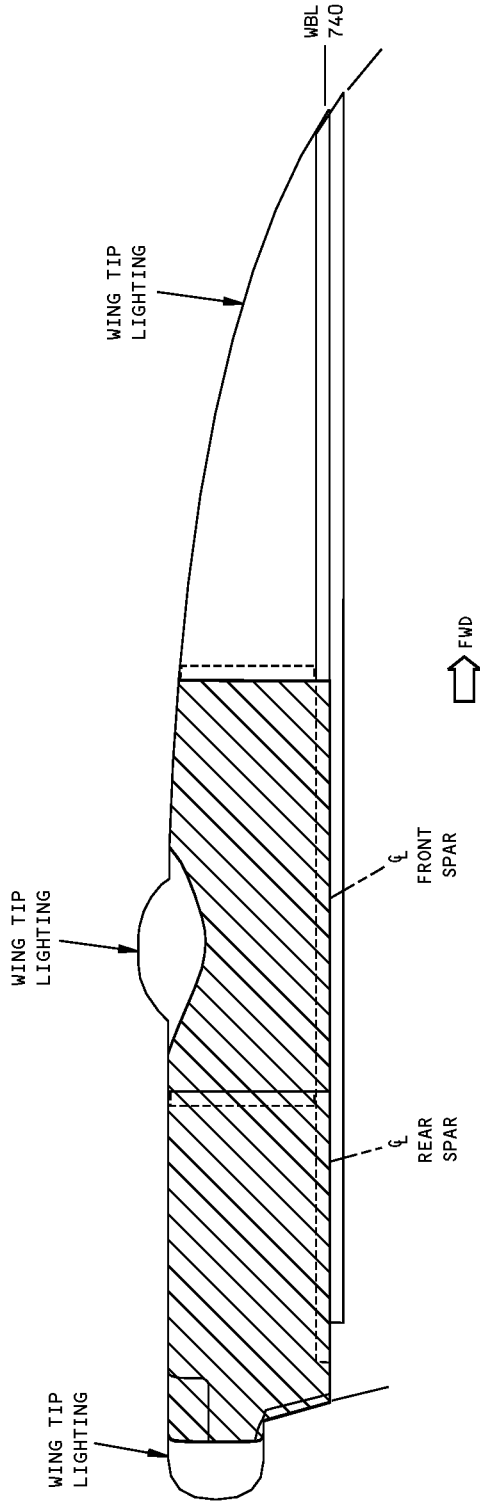
DRAWING NO. 112N3501

- HOLES IN THE EDGE BAND ARE NOT PERMITTED
- MAXIMUM HOLE OR PUNCTURE DIAMETER IS 0.25 INCH
- MAXIMUM 1 HOLE PER ANY 15 SQUARE INCHES OF PANEL AREA
- MINIMUM DISTANCE FROM HOLE TO EDGE OR FASTENER IS 1.0 INCH
- MINIMUM DISTANCE BETWEEN HOLES IS 1.0 INCH
- MAXIMUM DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN DELAMINATIONS IS 3 TIMES LARGER THAN THE DELAMINATION DIAMETER
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

Wing-Outboard Torque Box Panel

Figure 117

757-200 STRUCTURAL REPAIR MANUAL



**Wing-Wing Tip
Figure 118**

MATERIAL:

 ALUMINUM SHEET (CLAD 2024-T42)

SRM 57-30-01 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE FROM ALL SHARP CREASES, GOUGES OR CRACKS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MINIMUM DISTANCE BETWEEN HOLES OR PUNCTURES IS 1.0 INCH
- MINIMUM DISTANCE BETWEEN HOLES OR PUNCTURES AND ANY EDGE IS 1.0 INCH
- CLEAN UP HOLES AND PUNCTURES WITH 0.25 INCH DIAMETER HOLE. FILL THE HOLE WITH A 2117-T3 OR T4 ALUMINUM RIVET INSTALLED WET WITH BMS 5-95 SEALANT
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 119N0004

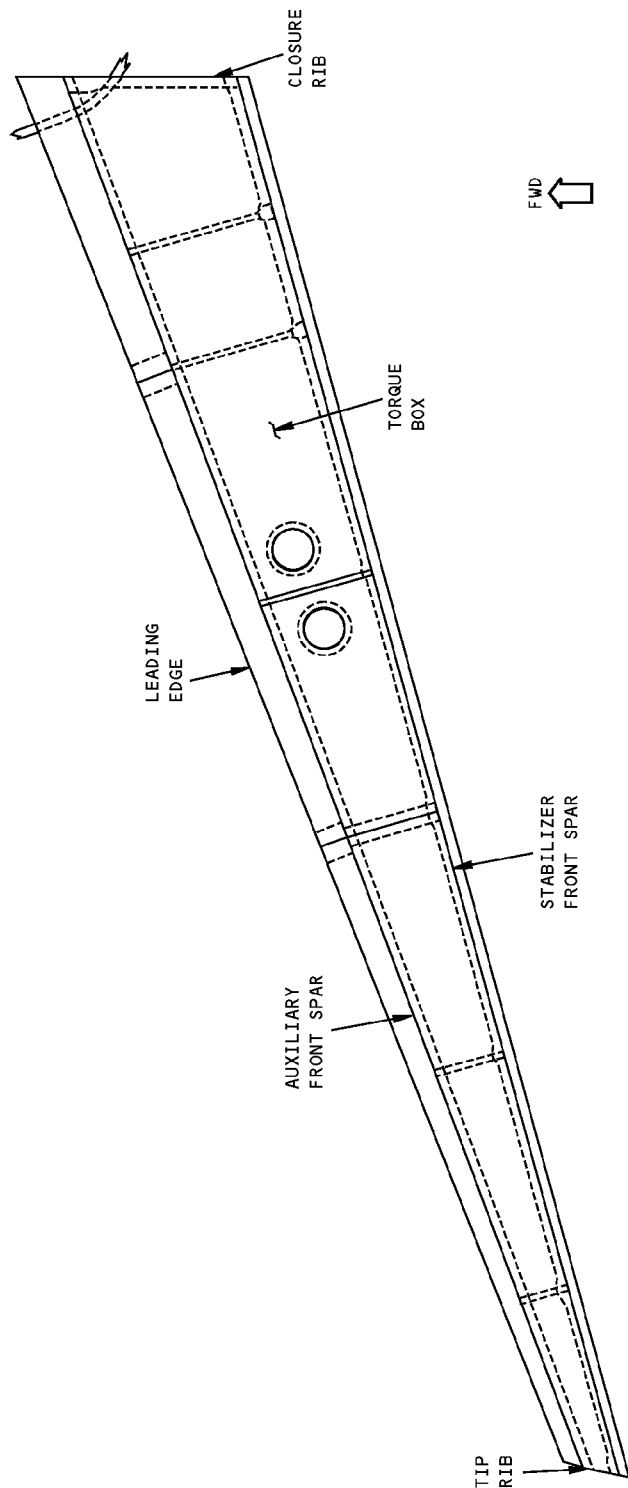
ALLOWABLE DAMAGE GENERAL

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757-200 STRUCTURAL REPAIR MANUAL



Horizontal Stabilizer-Leading Edge
Figure 119

MATERIAL:

ALUMINUM HONEYCOMB SANDWICH (CLAD 2024-T3 OR CLAD 7075-T6) WITH ALUMINUM CORE

SRM 55-10-01 ALLOWABLE DAMAGE

- ALL DENTS MUST BE SMOOTH AND FREE FROM ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM HOLE, CRACK OR PUNCTURE DIAMETER IS 0.25 INCH AND ONLY ONE ALLOWED PER ANY 15 SQUARE INCHES OF PANEL AREA
- MINIMUM DISTANCE BETWEEN HOLES OR DISTANCE FROM HOLE TO EDGE OF PART OR FASTENER IS 1.0 INCH
- MAXIMUM DENT DEPTH IS 0.125 INCH FOR WEBS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MINIMUM DISTANCE BETWEEN DENTS, EDGE OF PANEL OR FASTENER IS 4 TIMES THE DIAMETER OF LARGER DAMAGE
- MAXIMUM DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN DELAMINATIONS IS 3 TIMES LARGER THAN THE DELAMINATION DIAMETER
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 184N0001 AND 185N3001 (LEADING EDGE), 185N3002 (TORQUE BOX)

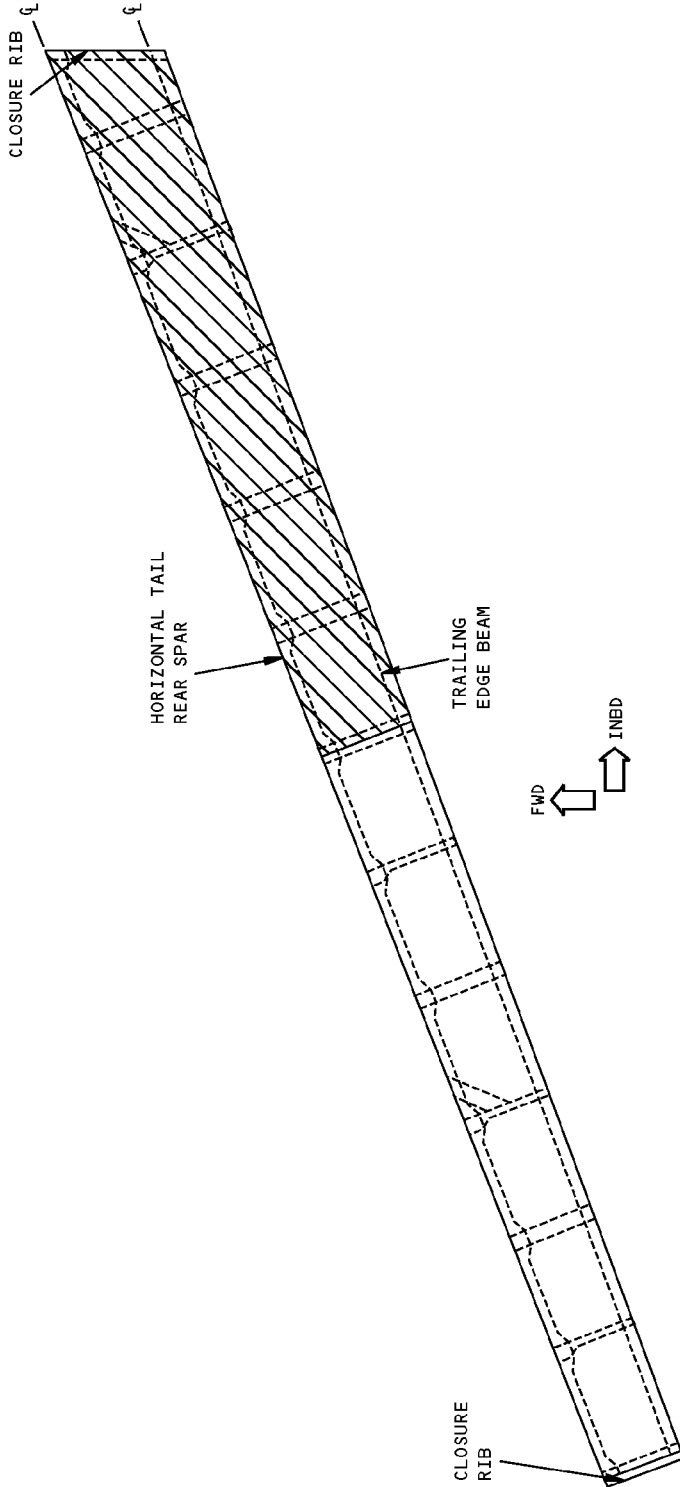
ALLOWABLE DAMAGE GENERAL

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STRUCTURAL REPAIR MANUAL



Horizontal Stabilizer-Fixed Trailing Edge
Figure 120

MATERIAL: (INBOARD)


 GLASS FABRIC/GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE

SRM 55-10-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS HOLE OR PUNCTURE
- MAXIMUM ALLOWABLE PUNCTURE, HOLE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM SPACING BETWEEN ADJACENT HOLES, PUNCTURES OR DELAMINATION IS 3 TIMES THE DIAMETER OF LARGER DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 183N1101

MATERIAL: (OUTBOARD)

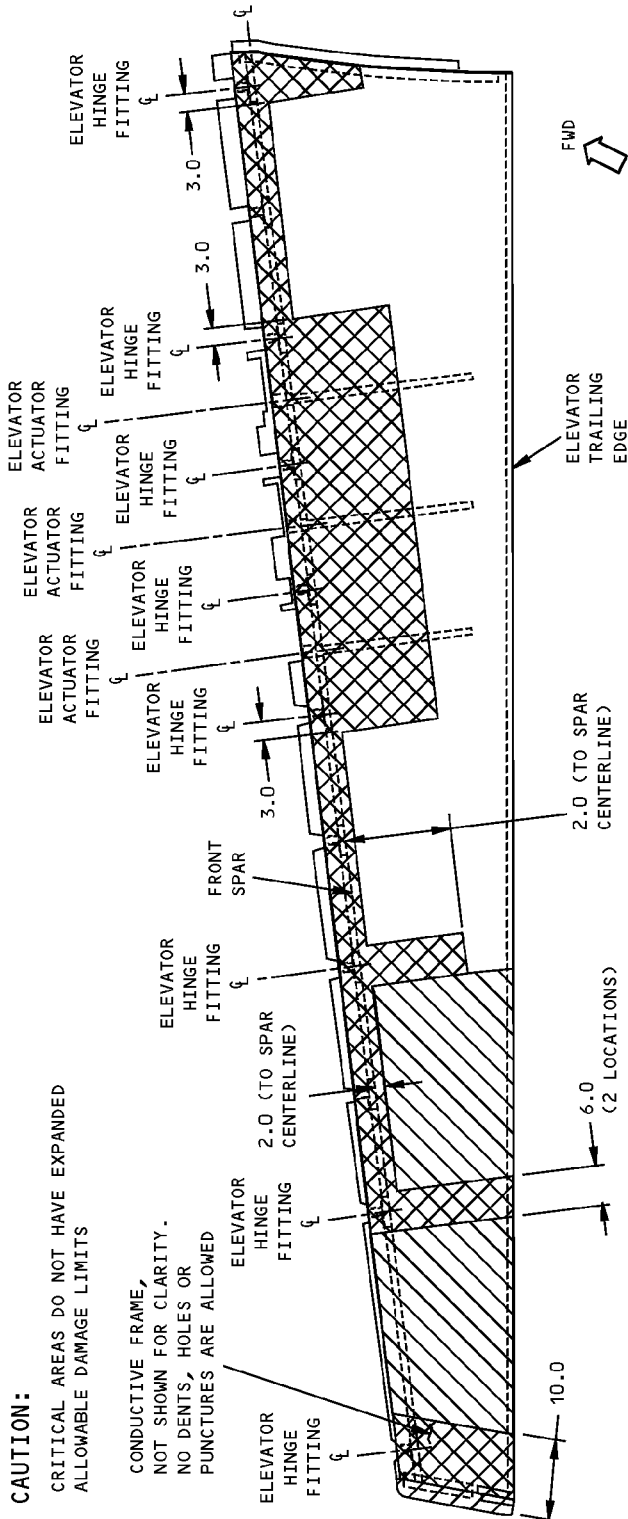
 GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE

SRM 55-10-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE OR PUNCTURE
- MAXIMUM ALLOWABLE PUNCTURE, HOLE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM SPACING BETWEEN ADJACENT HOLES, PUNCTURES OR DELAMINATION IS 3 TIMES THE DIAMETER OF LARGER DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 183N1102

STRUCTURAL REPAIR MANUAL



Horizontal Stabilizer-Elevator
Figure 121

CAUTION:

CRITICAL AREAS DO NOT HAVE EXPANDED ALLOWABLE DAMAGE LIMITS

CONDUCTIVE FRAME,
NOT SHOWN FOR CLARITY.
NO DENTS, HOLES OR
PUNCTURES ARE ALLOWED

MATERIAL: NON-CRITICAL AREA ZONE I

GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX
CORE-350°F (177°C) CURE

GLASS FABRIC/ARAMID/EPOXY OR GLASS FABRIC/EPOXY
LAMINATE

SRM 55-20-01 ALLOWABLE DAMAGE

SAME AS "CRITICAL AREA" EXCEPT

- MAXIMUM ALLOWABLE HOLE, PUNCTURE OR DELAMINATION DIAMETER IS 1.5 INCHES FOR EACH SQUARE FOOT OF AREA
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK

MATERIAL: NON-CRITICAL AREA ZONE II

GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX
CORE-350°F (177°C) CURE

SRM 55-20-01 ALLOWABLE DAMAGE

SAME AS "CRITICAL AREA" EXCEPT

- MAXIMUM ALLOWABLE HOLE, PUNCTURE OR DELAMINATION DIAMETER IS 2.0 INCHES FOR EACH SQUARE FOOT OF AREA
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK

NOTES

- ALL DIMENSIONS ARE IN INCHES

MATERIAL: CRITICAL AREA

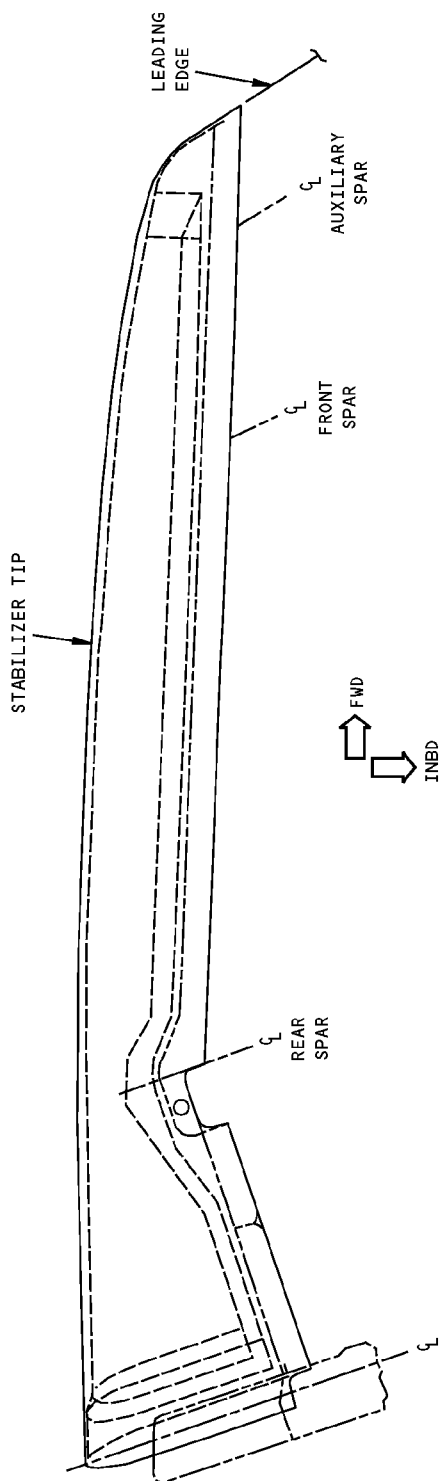
GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH NOMEX
CORE-350°F (177°C) CURE

SRM 55-20-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE OR PUNCTURE
- MAXIMUM ALLOWABLE HOLE, PUNCTURE OR DELAMINATION DIAMETER IS 0.25 INCH FOR EACH SQUARE FOOT AREA
- MINIMUM DISTANCE BETWEEN ADJACENT HOLES, PUNCTURES OR DELAMINATIONS IS 3 TIMES THE DIAMETER OF LARGER DAMAGE
- MINIMUM DISTANCE BETWEEN PUNCTURES, DELAMINATIONS OR HOLES AND EDGE OF PART OR FASTENER IS 3 TIMES THE DIAMETER OF LARGER DAMAGE
- REPAIR THE AREA BY 300 FLIGHT HOURS
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 183N2302

757-200 STRUCTURAL REPAIR MANUAL



MATERIAL:

- ARAMID/EPOXY OR GLASS FABRIC/EPOXY
- HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE

SRM 55-10-30 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE OR PUNCTURE
- MAXIMUM HOLE, CRACK OR PUNCTURE DIAMETER IS 2.0 INCHES AND ONLY ONE ALLOWED PER SQUARE FOOT OF AREA
- MINIMUM DISTANCE BETWEEN OTHER DAMAGE, FASTENER, HOLE OR PANEL EDGE IS 6 TIMES THE DIAMETER OF LARGER DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 189N0001

Horizontal Stabilizer-Horizontal Tail Tip
Figure 122

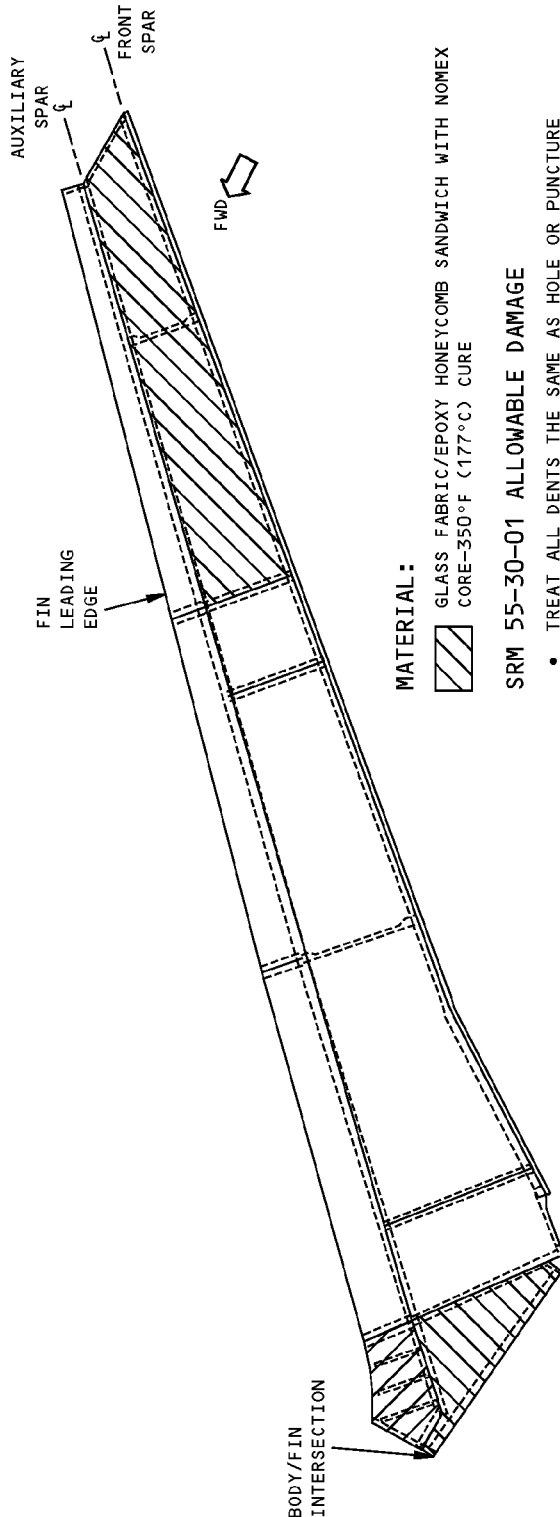
ALLOWABLE DAMAGE GENERAL

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STRUCTURAL REPAIR MANUAL



MATERIAL:



GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-350°F (177°C) CURE

SRM 55-30-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS HOLE OR PUNCTURE
- MAXIMUM ALLOWED HOLE, PUNCTURE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN DAMAGE IS 3 TIMES THE DIAMETER OF LARGER DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR THE TEMPORARY REPAIR OR SEAL OF DAMAGE

MATERIAL:



ALUMINUM HONEYCOMB SANDWICH (CLAD 7075-T6) WITH ALUMINUM CORE

SRM 55-30-01 ALLOWABLE DAMAGE

- ALL DENTS MUST BE SMOOTH AND FREE FROM ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM HOLE, CRACK OR PUNCTURE DIAMETER IS 0.25 INCH AND ONLY ONE ALLOWED PER ANY 15 SQUARE INCHES OF PANEL AREA
- MINIMUM DISTANCE BETWEEN HOLES OR DISTANCE FROM HOLE TO EDGE OF PART OR FASTENER IS 1.0 INCH
- MAXIMUM DENT DEPTH IS 0.125 INCH
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MAXIMUM DENT DAMAGE ALLOWED IS 1.5 INCHES PER ANY 12 SQUARE INCHES OF PANEL AREA
- MINIMUM DISTANCE BETWEEN DENTS AND/OR DELAMINATIONS AND DISTANCE BETWEEN DENT OR DELAMINATION AND EDGE OF PANEL OR FASTENER IS 4 TIMES DIAMETER OF LARGER DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR THE TEMPORARY REPAIR OR SEAL OF DAMAGE

MATERIAL:



ALUMINUM SHEET (CLAD 2024-T42)

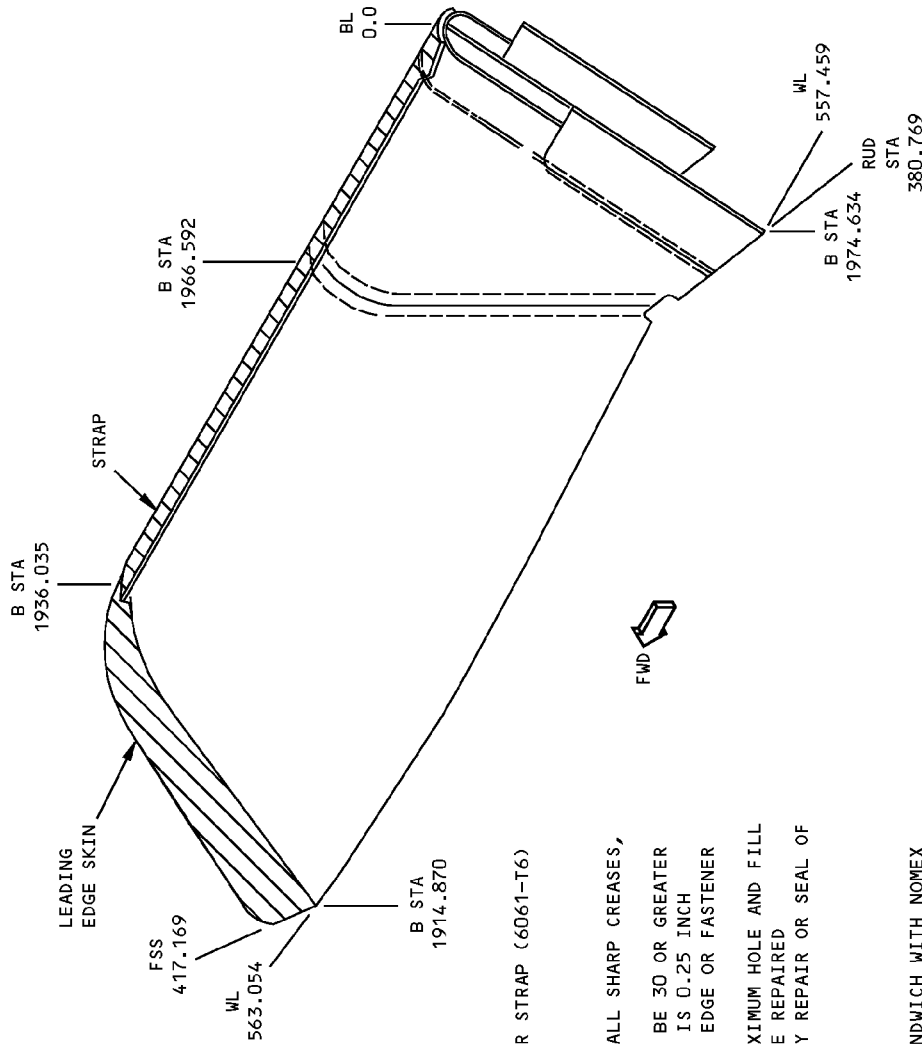
SRM 55-30-01 ALLOWABLE DAMAGE

- HOLES AND PUNCTURES ARE NOT ALLOWED
- ALL DENTS MUST BE SMOOTH AND FREE FROM ALL SHARP CREASES, GOUGES OR CRACKS
- MAXIMUM DENT DEPTH IS 0.125 INCH
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MAXIMUM DENT DAMAGE ALLOWED IS 1.5 INCHES PER ANY 12 SQUARE INCHES OF PANEL AREA
- MINIMUM DENT SPACING IS 4 TIMES LARGER DENT DIAMETER
- REFER TO PARAGRAPH 4 FOR THE TEMPORARY REPAIR OR SEAL OF DAMAGE


DRAWING NO. 175N2001 (LOWER AUXILIARY BOX SKIN), 175N2002 (UPPER AUXILIARY BOX SKIN), 175N2003 (MIDDLE AUXILIARY BOX SKIN), 175N1101 (LOWER LEADING EDGE), 175N1102 (MIDDLE LEADING EDGE), 175N1103 (UPPER LEADING EDGE)

Vertical Stabilizer-Leading Edge
Figure 123

757-200 STRUCTURAL REPAIR MANUAL



MATERIAL :

 ALUMINUM SHEET (CLAD 7075-T6) OR STRAP (6061-T6)

SRM 55-30-30 ALLOWABLE DAMAGE

- DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MAXIMUM HOLE OR PUNCTURE DIAMETER IS 0.25 INCH
- MINIMUM DISTANCE BETWEEN HOLES TO EDGE OR FASTENER IS 2.0 INCHES
- CLEAN UP DAMAGE WITH 0.25 INCH MAXIMUM HOLE AND FILL WITH RIVET. ALL OTHER HOLES TO BE REPAIRED
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

MATERIAL :

 GLASS FABRIC/EPOXY HONEYCOMB SANDWICH WITH NOMEX CORE-250°F (121°C) CURE

SRM 55-30-30 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS HOLE OR PUNCTURE
- MAXIMUM ALLOWED HOLE, PUNCTURE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN HOLES OR DELAMINATIONS IS 3 TIMES DIAMETER OF LARGE DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 179N1000

Vertical Stabilizer-Vertical Tail Tip
Figure 124

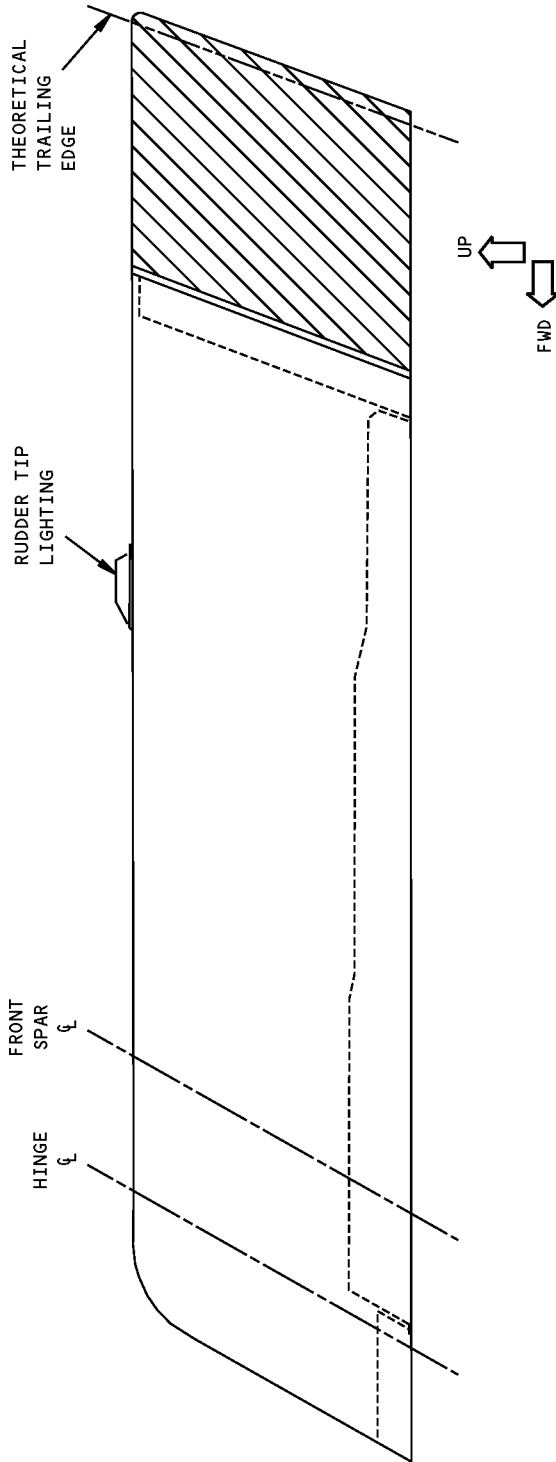
ALLOWABLE DAMAGE GENERAL

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STRUCTURAL REPAIR MANUAL



MATERIAL :

GLASS FABRIC/ARAMID/EPOXY OR GLASS FABRIC/EPOXY LAMINATE - 250°F (121°C) CURE



ALUMINUM CASTING 356-T51

SRM 55-40-30 ALLOWABLE DAMAGE

- HOLES AND PUNCTURES ARE NOT ALLOWED
- IF THERE IS NO FIBER DAMAGE OR DELAMINATION, DENTS UP TO 1.5 INCHES ARE ALLOWED
- ONE DENT PER SQUARE FOOT OF AREA AND A MINIMUM OF 6 INCHES FROM ANY OTHER DAMAGE, FASTENER, HOLE OR PANEL EDGE
- IF FIBER DAMAGE OR DELAMINATION, 1.0 SQUARE INCH ALLOWED WITHOUT REWORK
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

MATERIAL :



ALUMINUM CASTING 356-T51

SRM 55-40-30 ALLOWABLE DAMAGE

- HOLES AND PUNCTURES ARE NOT ALLOWED
- ALL DENTS MUST BE SMOOTH AND FREE OF ALL SHARP CREASES, GOUGES OR CRACKS
- DENT DIAMETER TO DEPTH RATIO MUST BE 30 OR GREATER
- MAXIMUM DENT DIAMETER IS 0.50 INCH

Vertical Stabilizer-Rudder Tip
Figure 125

DRAWING NO. 173N2601

ALLOWABLE DAMAGE GENERAL

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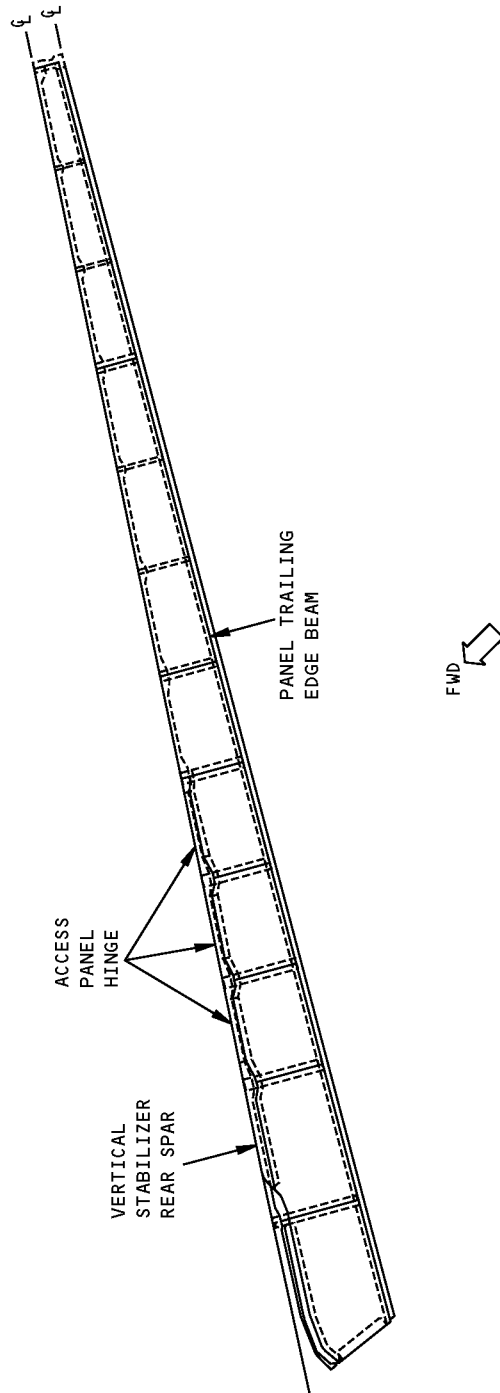
Vertical Stabilizer-Rudder

Figure 126

DRAWING NO. 173N2101

• SAME AS "CRITICAL ZONE" EXCEPT MAXIMUM ALLOWABLE HOLE, MAXIMUM ALLOWABLE HOLE, PUNCTURE, OR DELAMINATION DIAMETER IS 2.0 INCHES FOR EACH SQUARE FOOT OF AREA REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK

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MATERIAL:

ARAMID/GRAPHITE/EPOXY HONEYCOMB SANDWICH WITH
NOMEX CORE-250°F (121°C) CURE

SRM 55-30-01 ALLOWABLE DAMAGE

- TREAT ALL DENTS THE SAME AS A HOLE OR PUNCTURE
- MAXIMUM ALLOWED PUNCTURE, HOLE OR DELAMINATION DIAMETER IS 2.0 INCHES
- MINIMUM DISTANCE BETWEEN ADJACENT HOLES, PUNCTURES OR DELAMINATIONS IS 3 TIMES DIAMETER OF LARGER DAMAGE
- REINSPECT AT EVERY "A" CHECK, REPAIR AT NEXT "C" CHECK
- REFER TO PARAGRAPH 4 FOR TEMPORARY REPAIR OR SEAL OF DAMAGE

DRAWING NO. 173N1105 (LOWER), 173N1106 (LOWER-MIDDLE),
173N1107 (UPPER-MIDDLE), 173N1108 (UPPER)

Vertical Stabilizer-Fixed Trailing Edge
Figure 127

ALLOWABLE DAMAGE GENERAL

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GENERAL - INSTRUCTIONS TO MAKE IT POSSIBLE TO OPERATE AIRPLANES WITH MISSING FASTENERS IN SECONDARY STRUCTURE

1. Applicability

- A. Use this chapter-section-subject to see if it is possible to operate an airplane with missing fasteners in secondary structure.
- (1) Examples of secondary structure where missing fasteners are permitted are: fairings, trailing edge panels, and access panels.
Refer to 51-00-04, GENERAL.
 - (2) Missing fasteners must be of the types that are easy to remove, such as screws and bolts.
- B. The instructions in this chapter-section-subject do not apply to:
- (1) Fasteners that attach primary structure to the airplane.
 - (2) Fasteners in control surfaces such as: ailerons, trailing edge flaps, elevators, rudder, leading edge devices, and spoilers.
 - (3) Fasteners in leading edge panels of the wing, horizontal stabilizer, and vertical stabilizer.
 - (4) Fasteners in panels that are adjacent to side load ribs. See Figure 1/GENERAL for panels at side load rib locations.
 - (5) Fasteners in engine cowls and engine pylon fairings.
 - (6) Permanent type fasteners such as rivets and lockbolts.
 - (7) Hex drive bolts installed with permanent type BACC30 (or equivalent) collars.

2. General

- A. Paragraph 4./GENERAL will help you make a decision to see if an airplane is in a permitted dispatch condition. If the airplane is not in a permitted dispatch condition, then you must do one or more of the steps that follow:
- (1) Install a correct fastener in each missing fastener location until the airplane is in the permitted dispatch condition.
NOTE: You can remove a fastener from a different location, and then install the replacement fastener in a location that has a missing fastener.
 - Make sure that the fastener that is removed is the correct type, diameter, and length for the location that it will be installed at.
 - Make sure that the instructions in Paragraph 4./GENERAL let you have a missing fastener at the location where the fastener was removed.
 - Record the location of the initial missing fastener. Inspect that location as specified in Paragraph 4./GENERAL. Make sure that at each inspection interval, that the fastener is not missing again.
 - (2) Tell an engineer who has the authority to do an analysis and make a decision.
 - (3) Call Boeing and ask for an analysis.
- B. Do one of the steps that follow for a countersink that is damaged or has unsatisfactory wear:
- (1) Do a temporary repair. Install a flanged CRES washer under the bolthead (BACW10D* or BACW10CC, or equivalent). Refer to Paragraph 4.B./GENERAL for inspection intervals and when you must do a permanent repair.
 - (2) Count the fastener location as a missing fastener. Make sure that a missing fastener is permitted at that location. Refer to Paragraph 4.A./GENERAL

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3. References

Reference	Title
51-00-04, GENERAL	Structural Classification
51-20-05, GENERAL	Repair Sealing

4. Permitted Dispatch Conditions

CAUTION: THE INSTRUCTIONS IN PARAGRAPH 4./GENERAL CONTAIN INSPECTIONS AND FLIGHT LIMITATIONS. MISSING FASTENERS ARE PERMITTED ONLY IF THESE INSPECTIONS AND FLIGHT LIMITATIONS ARE OBEYED.

A. An airplane is in a permitted dispatch condition if all of the data that follows applies:

NOTE: If a part fails one or more of the conditions that follow, see if the Master Minimum Equipment List (MMEL) allows an airplane to operate without the part (for example: small access doors and panels). Do not operate an airplane with one of these parts on the airplane unless all of the data that follows applies.

- (1) All fasteners that were specified in Paragraph 1.B./GENERAL are installed in the structure.
- (2) Fasteners in panels that were specified in Paragraph 1.A./GENERAL can be missing if the panels are in the conditions that follow:
 - (a) All electrical grounding and bonding fasteners must be installed and functional.
 - (b) All fasteners must be installed in the leading edge, which is open to the airflow. See Figure 2/GENERAL, Detail I.
 - (c) All corner fasteners must be installed. See Figure 2/GENERAL, Detail I.
 - (d) All fasteners must be installed on sides with eight or less fasteners. See Figure 2/GENERAL, Detail I.
 - (e) One missing fastener in 10 is permitted on a side (but not on a leading edge open to the airflow).

NOTE: A side that has only nine fasteners can have the middle fastener missing. See Figure 2/GENERAL, Detail I.
 - (f) No more than two adjacent missing fasteners are permitted (but not on a leading edge open to the airflow). See Figure 2/GENERAL, Detail I.
 - (g) There must be three or more fasteners adjacent to a corner fastener. See Figure 2/GENERAL, Detail I.
 - (h) There must be five or more fasteners installed adjacent to an attached fitting or primary load point. See Figure 2/GENERAL, Detail II.

B. If the airplane has missing fasteners, and is in the permitted dispatch condition as shown in par. Paragraph 4.A./GENERAL, then do the steps that follow:

- (1) Make sure that the fasteners that remain have the correct torque as shown in one of the references given below.
 - (a) The Engineering drawing that shows the panel installation
 - (b) The Structural Repair Manual
 - (c) The Airplane Maintenance Manual



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- (2) Record the locations of missing fasteners and fasteners that are loose or will not keep the minimum torque value.

NOTE: It is permitted to apply an approved sealant on the fastener threads to increase the torque value of a fastener. Refer to 51-20-05, GENERAL for approved sealants and sealing procedures.

- (3) Record the locations of fastener holes and countersinks that show unsatisfactory damage or wear.
- (4) Put aluminum foil speed tape over all open fastener holes.
- (5) Do an inspection of the panels that had missing or loose fasteners.
- (a) After the missing or loose fasteners have been found, you must do an inspection of the panels before a maximum time period of 30 calendar days has occurred.
 - (b) Then you must do an inspection of the panels at each 10-calendar day interval until the missing or loose fasteners are replaced.
- (6) When you do an inspection of the panels that had missing or loose fasteners, make sure that you do the procedure that follows:
- (a) Make sure that there are no additional missing or loose fasteners.
 - (b) Make sure that all open fastener holes have aluminum foil speed tape over them. Replace any tape that shows deterioration.
 - (c) If there are additional missing or loose fasteners, then refer to Paragraph 4./GENERAL to see if the airplane is in the permitted dispatch condition. Then do the steps in Paragraph 4./GENERAL again.
- (7) Do the steps that follow at or before 60 days or 500-airplane flight hours:

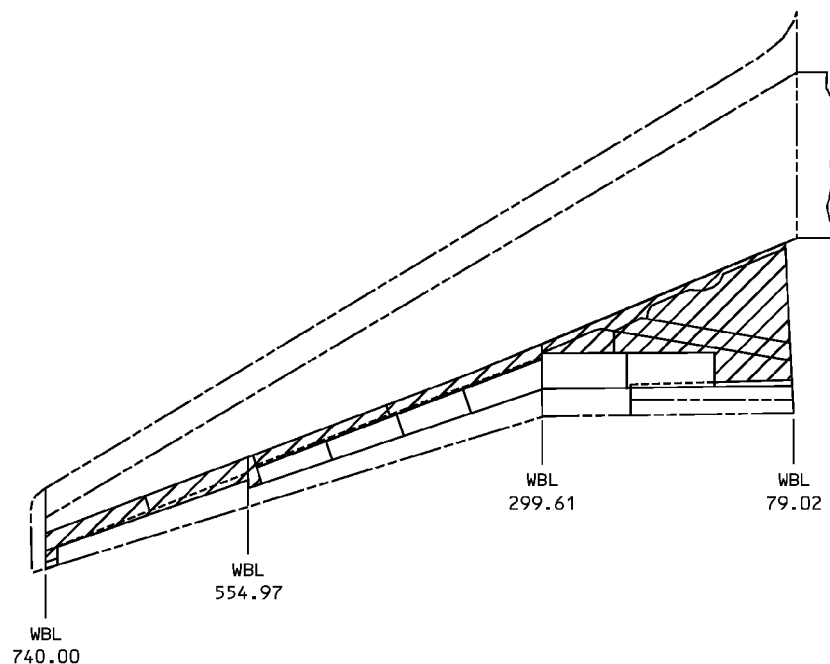
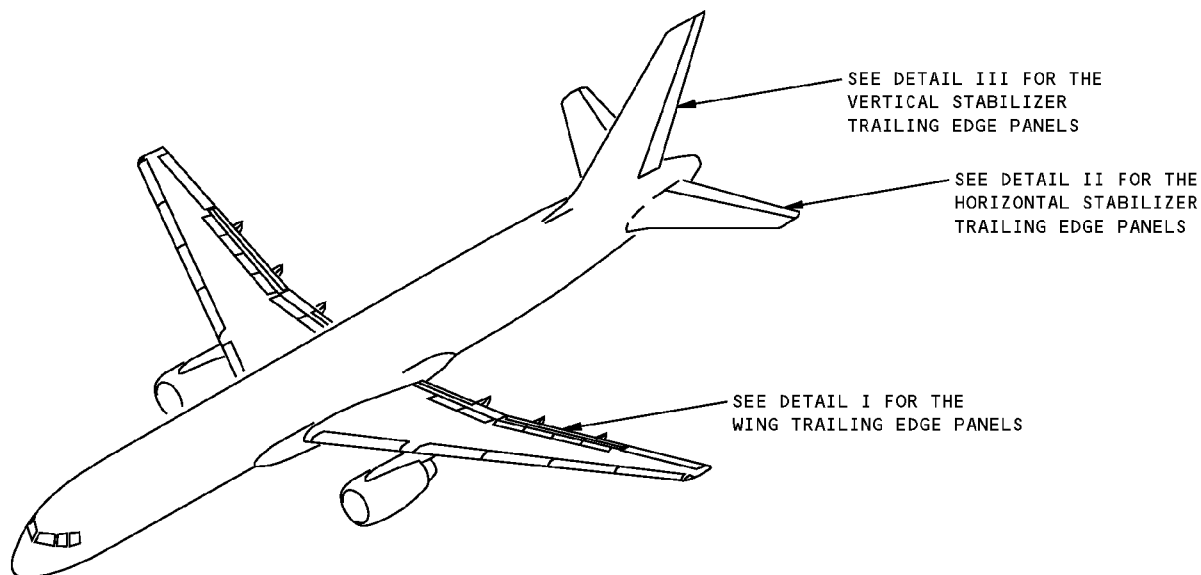
NOTE: Begin your time measurement of days, or airplane flight hours, from the time when missing or loose fasteners were first found.

- (a) Do a permanent repair for holes and countersinks that are damaged or have unsatisfactory wear.
- (b) Replace nutplates at all missing and loose fastener locations.

NOTE: Also, replace nutplates at initial fastener locations that were filled with another fastener in Paragraph 4.A.(1)/GENERAL or sealed as given in Paragraph 4.B.(2)/GENERAL.

- (c) Replace all missing or loose fasteners.

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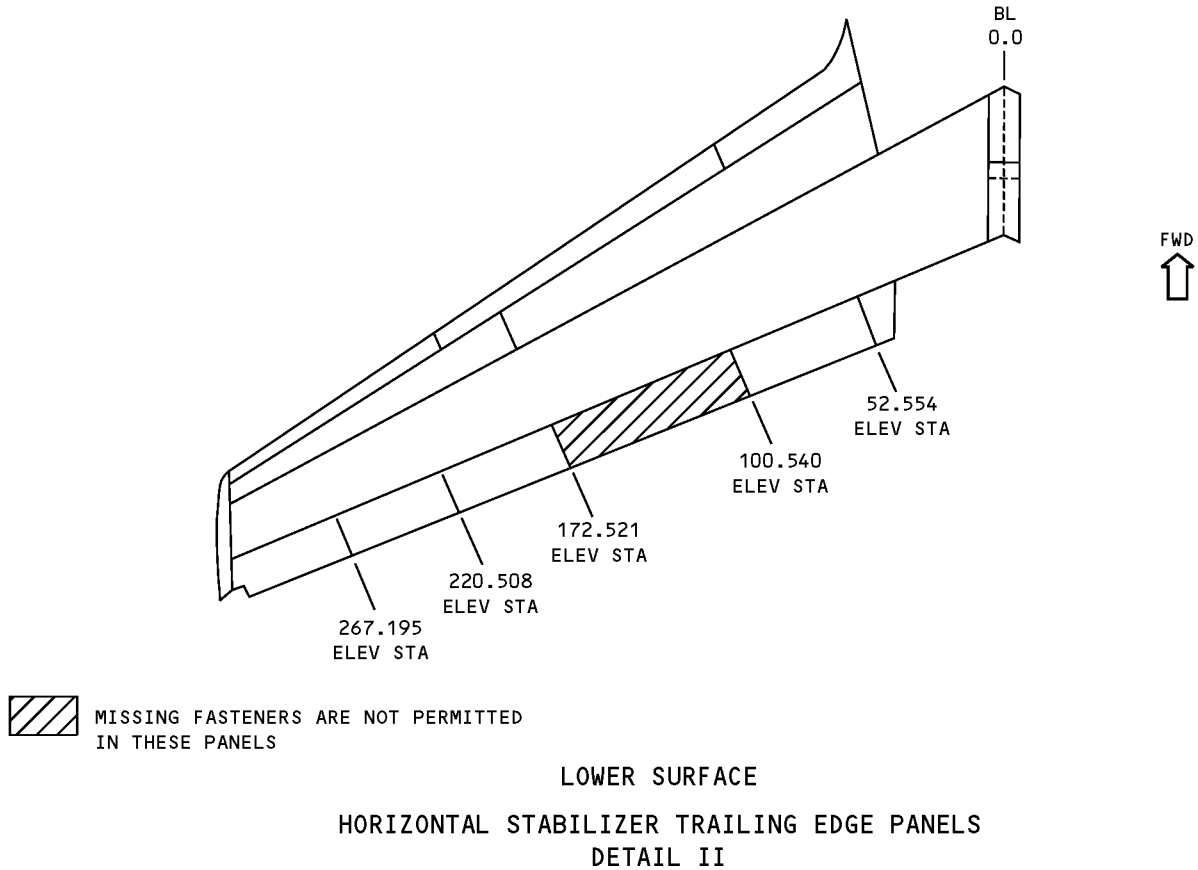


CALL BOEING FOR THE PERMITTED DISPATCH
CONDITION OF AN AIRPLANE WITH A
MISSING FASTENER IN ONE OR MORE OF
THESE PANELS. (BOTH UPPER AND LOWER
SURFACES)

WING TRAILING EDGE PANELS DETAIL I

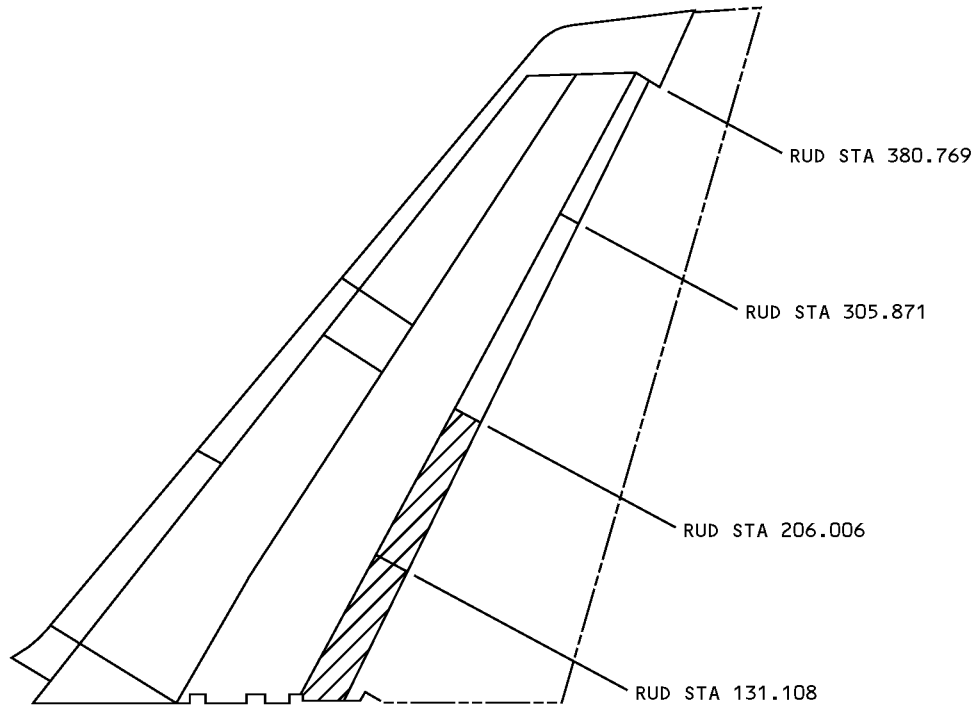
Panels Where Missing Fasteners are not Permitted
Figure 1 (Sheet 1 of 3)

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Panels Where Missing Fasteners are not Permitted
Figure 1 (Sheet 2 of 3)

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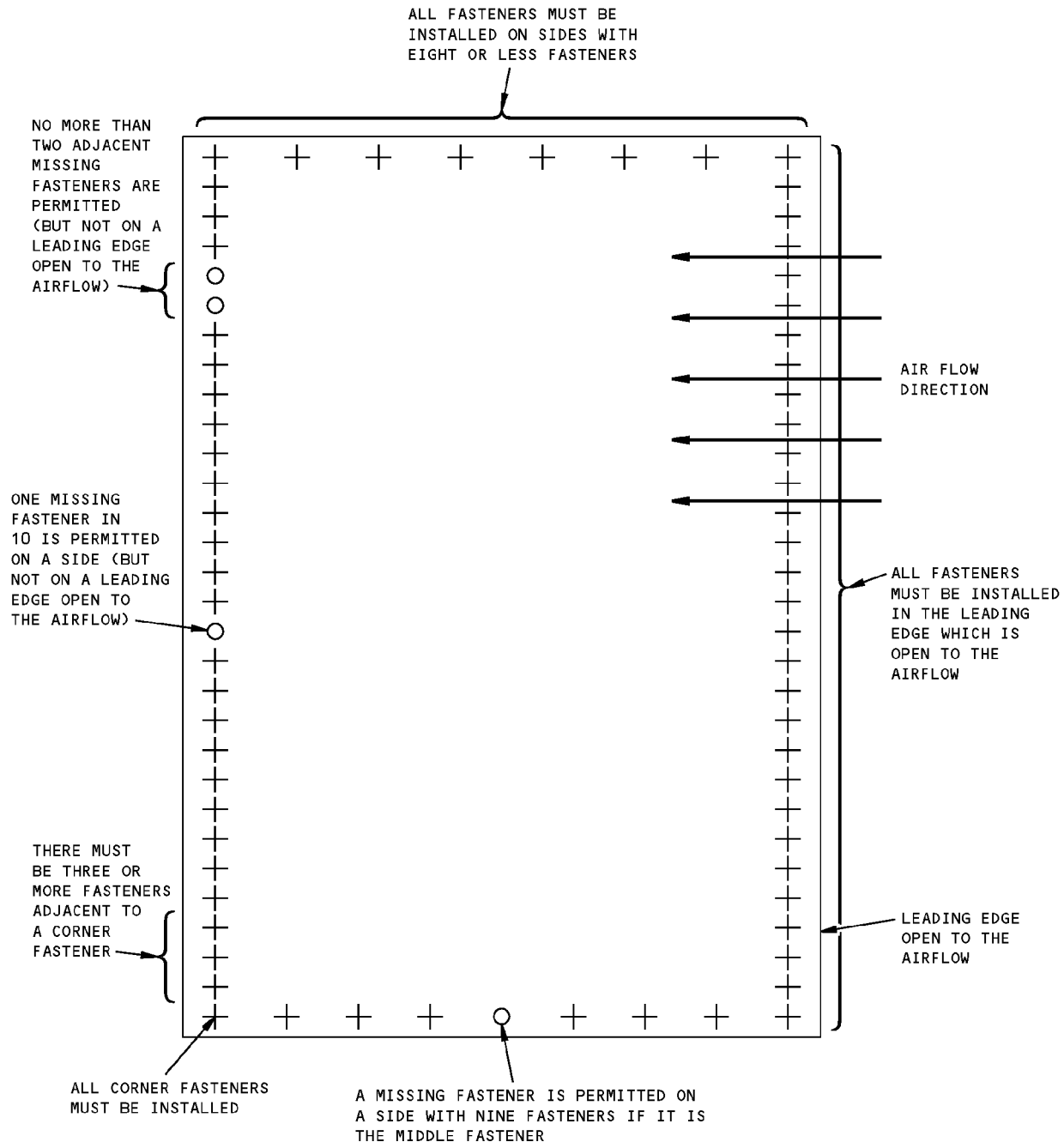


MISSING FASTENERS ARE NOT PERMITTED
IN THESE PANELS (BOTH SIDES)

LEFT SIDE IS SHOWN, RIGHT SIDE IS OPPOSITE
DETAIL III

**Panels Where Missing Fasteners are not Permitted
Figure 1 (Sheet 3 of 3)**

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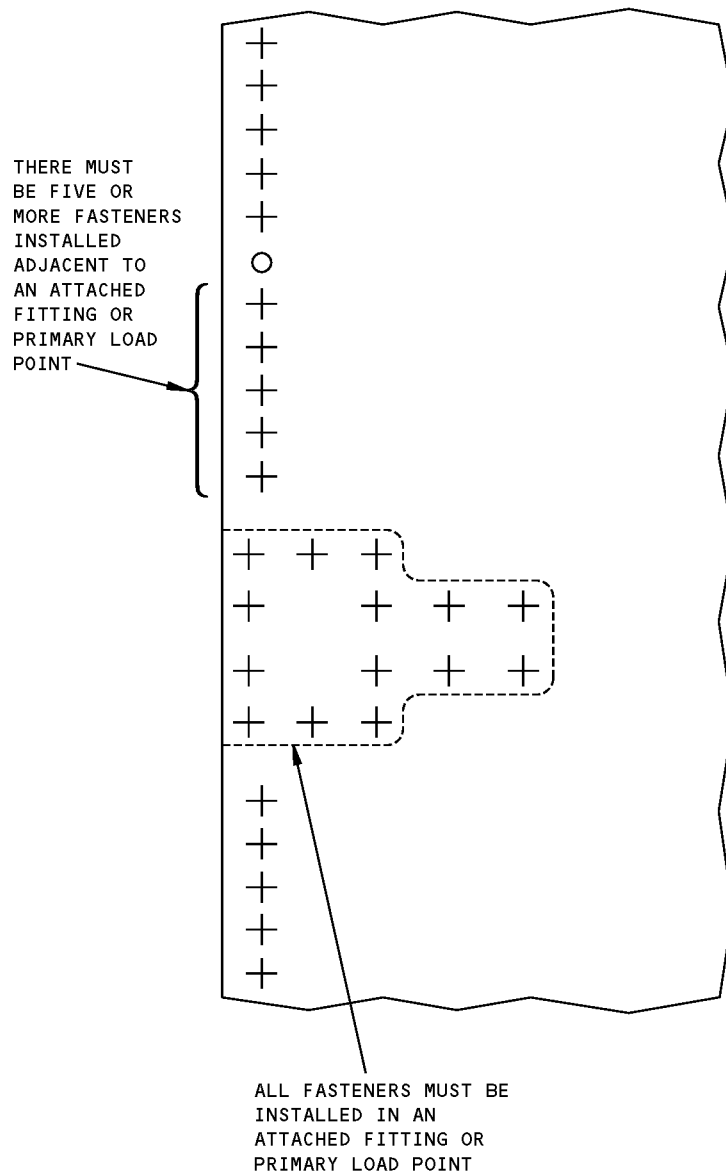
TYPICAL PANEL
DETAIL I

NOTES

- + FASTENER LOCATION
- MISSING FASTENER LOCATION

Missing Fastener Locations that are Permitted in Secondary Structure
Figure 2 (Sheet 1 of 3)

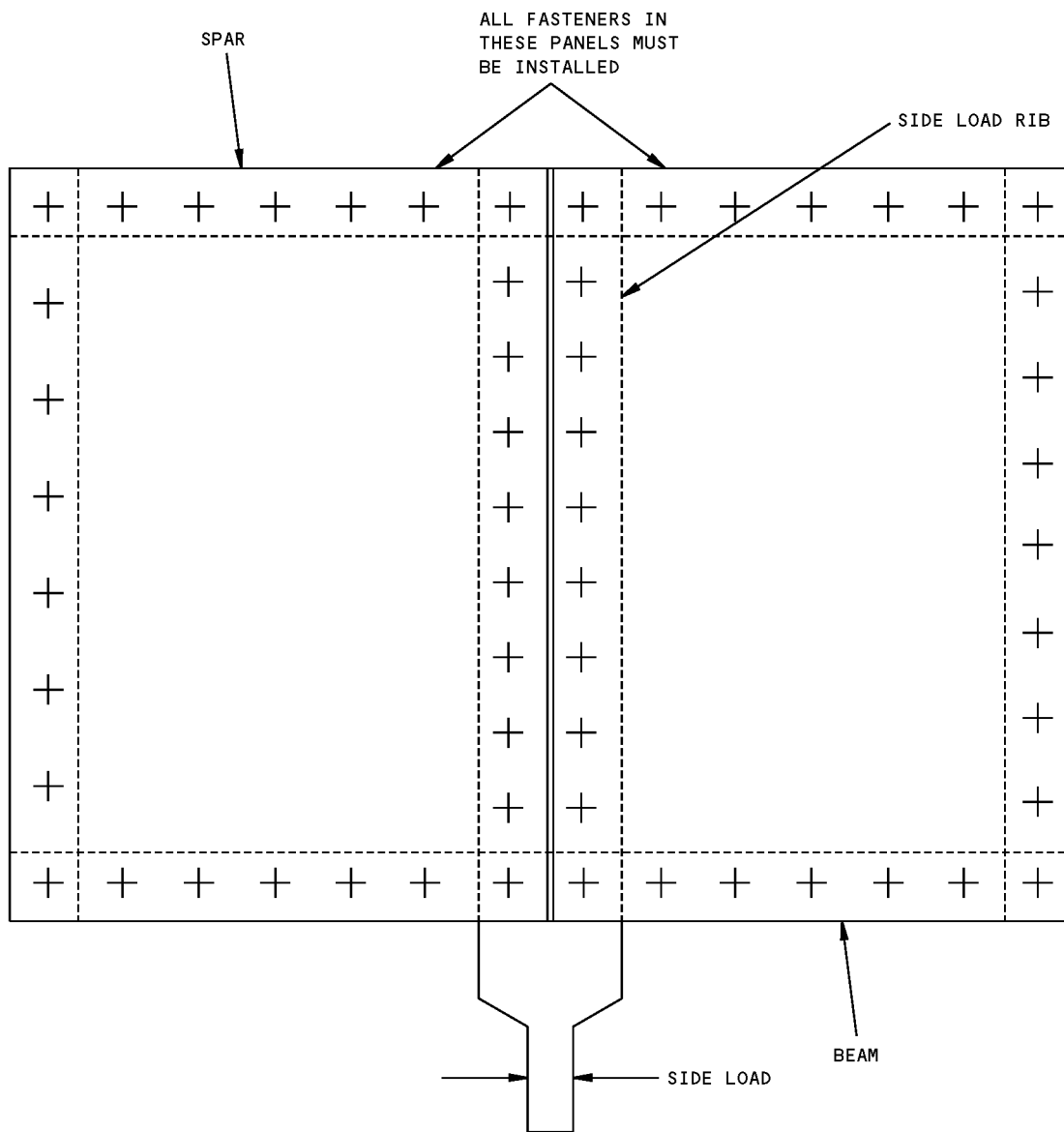
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PANEL WITH AN ATTACHED FITTING OR A PRIMARY LOAD POINT
DETAIL II

Missing Fastener Locations that are Permitted in Secondary Structure
Figure 2 (Sheet 2 of 3)

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PANEL NEXT TO A SIDE LOAD RIB
DETAIL III

Missing Fastener Locations that are Permitted in Secondary Structure
Figure 2 (Sheet 3 of 3)

STRUCTURAL REPAIR MANUAL**GENERAL - AERODYNAMIC SMOOTHNESS - RB211-535 ENGINE NACELLE****1. General**

- A. The RB211 nacelle is designed to give an aerodynamically clean shape and a smooth exterior for high performance. Unrepaired damage which changes the original shape or smoothness of the surface will reflect in reduced performance. Performance deterioration will also result when repairs are effected which themselves change the original shape, i.e., 'External Patch Repairs', for this reason such repairs should be replaced by 'Permanent Patch Repairs' whenever possible.
- B. This section covers the requirements for the aerodynamic smoothness of the external and internal portions of the nacelle which are exposed to airflow. The smoothness requirements are divided into three categories:
- (1) Mismatch at joints (including latches)
 - (2) Waviness of skins
 - (3) Protrusion of flush-type fasteners

2. Critical Areas

- A. The aerodynamic smoothness of the complete nacelle is classified in two categories, critical (Zone 1) and non-critical (Zone 2) (Figure 1/GENERAL). These categories are in relationship to those parts of the nacelle which are covered in this Structural Repair Manual, and are listed below:
- Nose Cowling
 - Cowling (Fan Cowl) Side Panels (RH and LH)
 - Thrust Reverser Translating Cowl "C" Duct
 - Thrust Reverser 'C' Ducts Hinge Access Doors (RH and LH)

3. Types of Deviations

- A. Contour deviation is the tolerances allowed above or below lofted contours using nominal profile as the datum.
- B. Waviness is defined as a smoothly varying surface from a flat continuously curved contour. The distance between adjacent high points in this variation is one wavelength. Slope is defined as the degree of inclination from the nominal surface at any point on a wave (Refer to Figure 3/GENERAL).
- C. Mismatch is defined as an abrupt interruption in a surface from a flat or continuously curved contour. Mismatch is PLUS (+) when the trailing edge projects into the airstream and is MINUS (-) when the trailing edge is below the airstream (Refer to Figure 4/GENERAL).

4. Contour Deviation

- A. Nose cowling
- (1) Intake skin inlet/engine interface (Figure 3/GENERAL).
 - (2) Outer skin (Refer to Figure 3/GENERAL).
- B. Cowling (Fan Cowl) side panels
- (1) Outer skin
 - (a) Contour deviation within +0.032 in. to -0.032 in. of nominal dimensions can be accepted.
 - (2) Thrust reverser 'C' ducts
 - (a) Contour deviation within +0.032 in. to -0.032 in. of nominal dimensions can be accepted.
 - (b) Contour deviation of rear edge of inner skin to be within +0.030 in. to -0.030 in. of nominal dimension when clamped to support ring.

STRUCTURAL REPAIR MANUAL**5. Skin Waviness**

A. Nose cowling (Refer to Figure 2/GENERAL).

- (1) Local dishing, up to 1.000 in. diameter and to a depth of 0.005 in., can be added to skin waviness standard.

B. Cowling (Fan Cowl) side panels and thrust reverser 'C' ducts (Refer to Figure 2/GENERAL.)

6. Gaps and Mismatches

NOTE: Small 'into wind' steps, due to tolerances at butt joints, are acceptable but corners of potential 'into wind' steps must be radiused or chamfered.

A. Permissible gaps and mismatches for thrust reverser 'C' ducts are defined in Figure 4/GENERAL.

B. Permissible gaps and mismatches for the cowling (Fan Cowl) side panels are defined in Figure 4/GENERAL.

C. Permissible gaps and mismatches for access doors and removable panels in the nose cowling and cowling (Fan Cowl) side panels are defined in Figure 4/GENERAL.

D. Permissible gaps and mismatches for nose cowls are defined in Figure 4/GENERAL.

E. Permissible mismatch for cowling (Fan Cowl) side panels and thrust reverser 'C' duct inner and outer skins.

- (1) Riveted, spotwelded or bolted joints.

(a) Sound suppression panels: ± 0.032 in.

(b) Remaining mismatch skins: $+0.025$ in. to -0.050 in.

- (2) Specific critical points

(a) Cowling (Fan Cowl) side panels and thrust reverser 'C' duct exposed latches: $+0.040$ in. to -0.050 in.

(b) Longitudinal joint (at bottom of nacelle) of cowling (Fan Cowl) side panels:

Gap: 0.010 in. minimum to 0.150 in. maximum

Mismatch: 0.000 in. minimum to 0.060 maximum

(c) Longitudinal joint (at bottom of nacelle) of thrust reverser 'C' duct halves: 0.060 in. maximum.

(d) Cowling (Fan Cowl) side panel edge joint to thrust reverser, 0.125 in. maximum and 0.045 in. average.

NOTE: Average is to be determined as follows:

(i) Treat forward and after edges separately when calculating average.

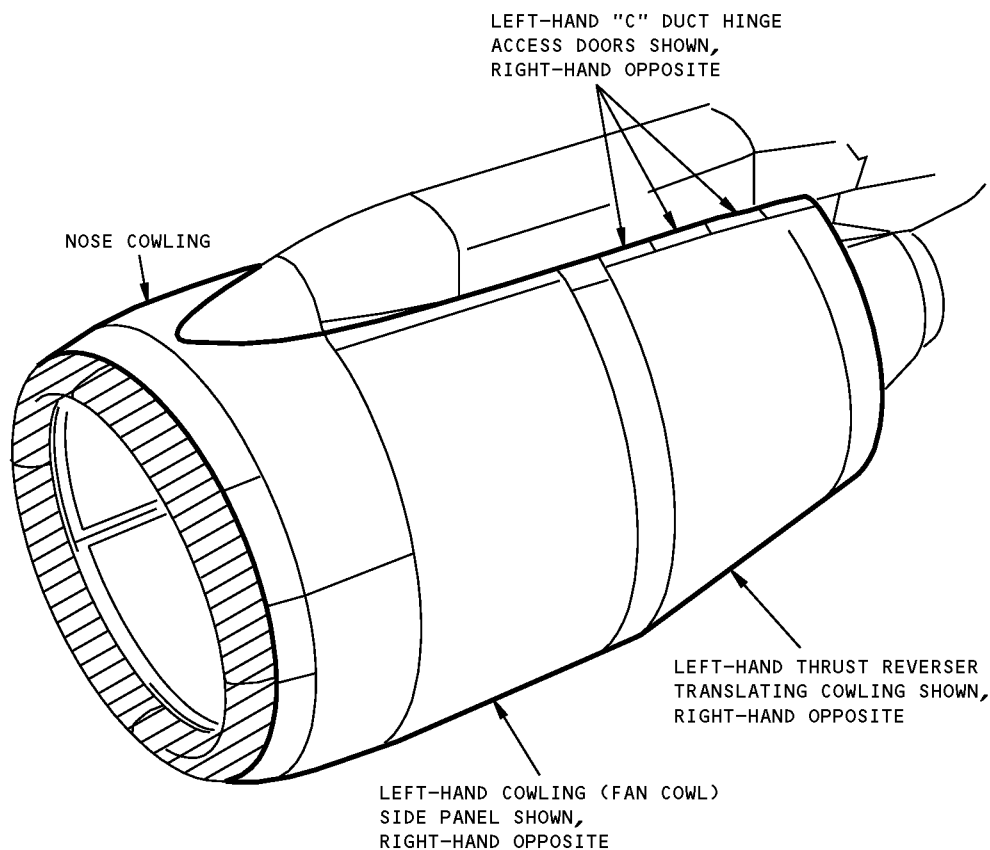
(ii) Measure mismatched every 18 in. commencing at top left-hand and top right-hand sides.

(iii) The average is the sum of mismatched measurements after dropping the PLUS (+) and MINUS (-) signs and including ZERO measurements divided by the number of measurements.

7. Fastener Flushness

A. The acceptance standards for rivet, screw/bolt and camlock fastener flushness are defined in Figure 5/GENERAL.

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STRUCTURAL REPAIR MANUAL

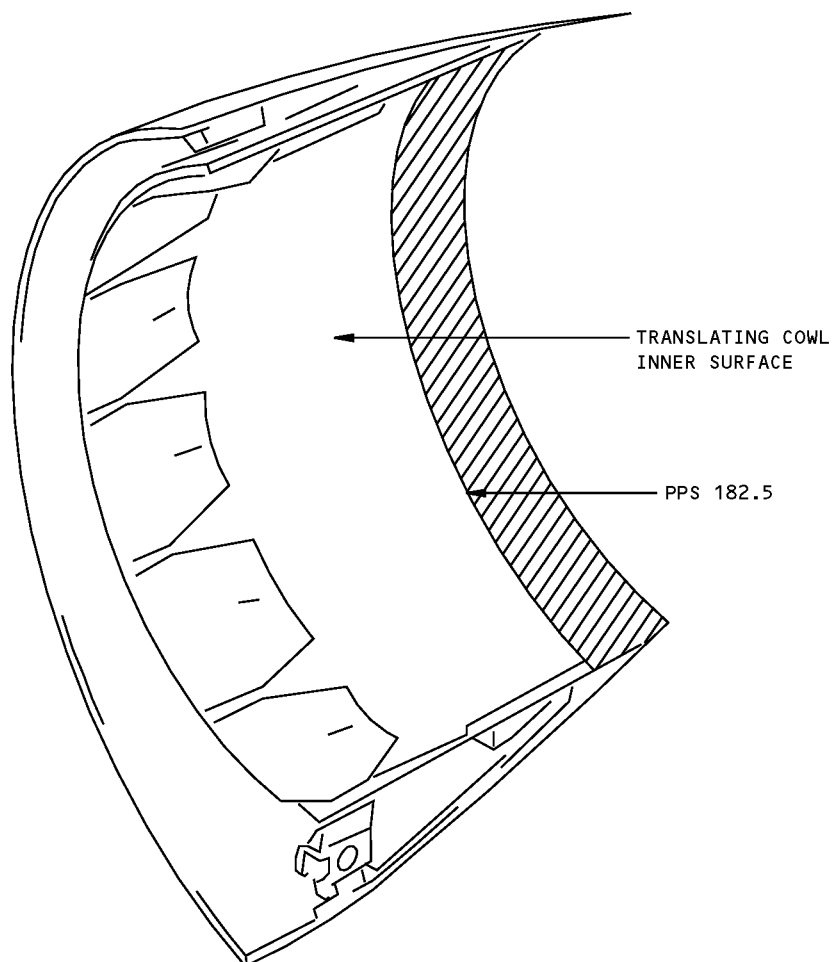


ZONE 1 (CRITICAL) - FIRST 9.5 IN. OF NOSE COWL INTERNAL AND EXTERNAL SURFACES



ZONE 2 (NONCRITICAL) - REMAINING SURFACES

Aerodynamic Smoothness - Critical Areas, All RB211-535 Engines
Figure 1 (Sheet 1 of 2)

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ZONE 1 (CRITICAL)

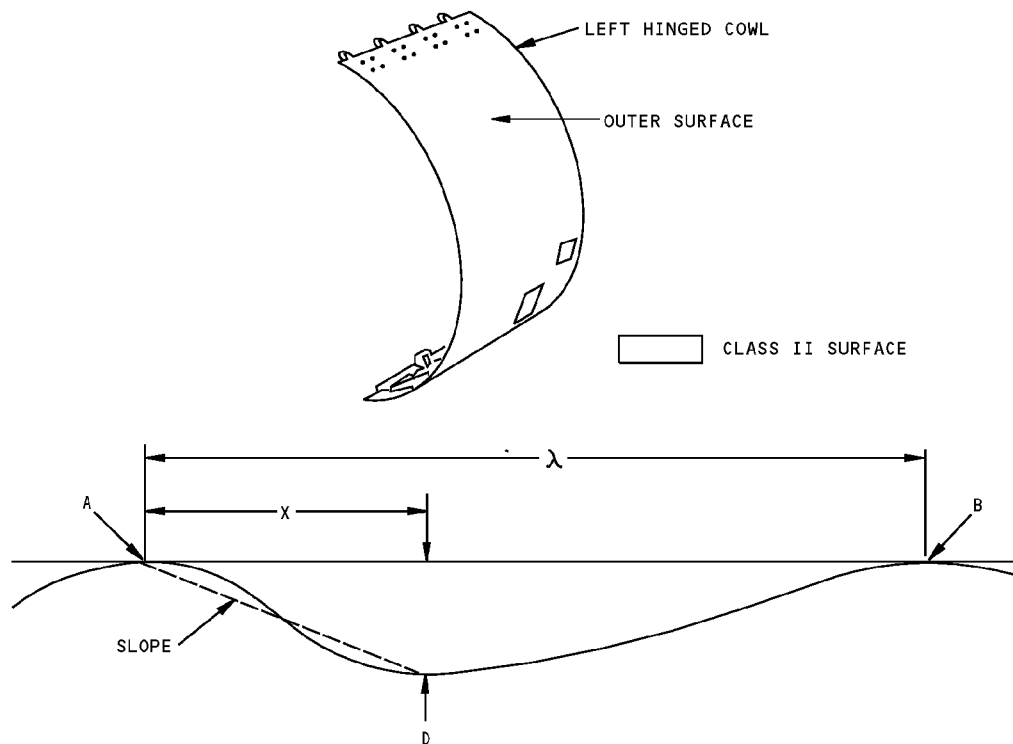


ZONE 2 (NON CRITICAL)

THRUST REVERSER TRANSLATING COWL INNER SURFACE
DETAIL I

Aerodynamic Smoothness - Critical Areas, All RB211-535 Engines
Figure 1 (Sheet 2 of 2)

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λ = WAVE LENGTH: DISTANCE BETWEEN ADJACENT HIGH POINTS, A AND B.

D = MAXIMUM DEPTH OF WAVE.

X = DISTANCE ALONG LINE AB FROM MAXIMUM DEPTH OF WAVE (D) TO A OR B, WHICHEVER IS CLOSER.

D/X = SLOPE.

WAVINESS LIMITATIONS - CLASS II SURFACES.

(1) DEPTH: 0.006 INCH PER INCH OF λ , NOT TO EXCEED 0.090 INCH

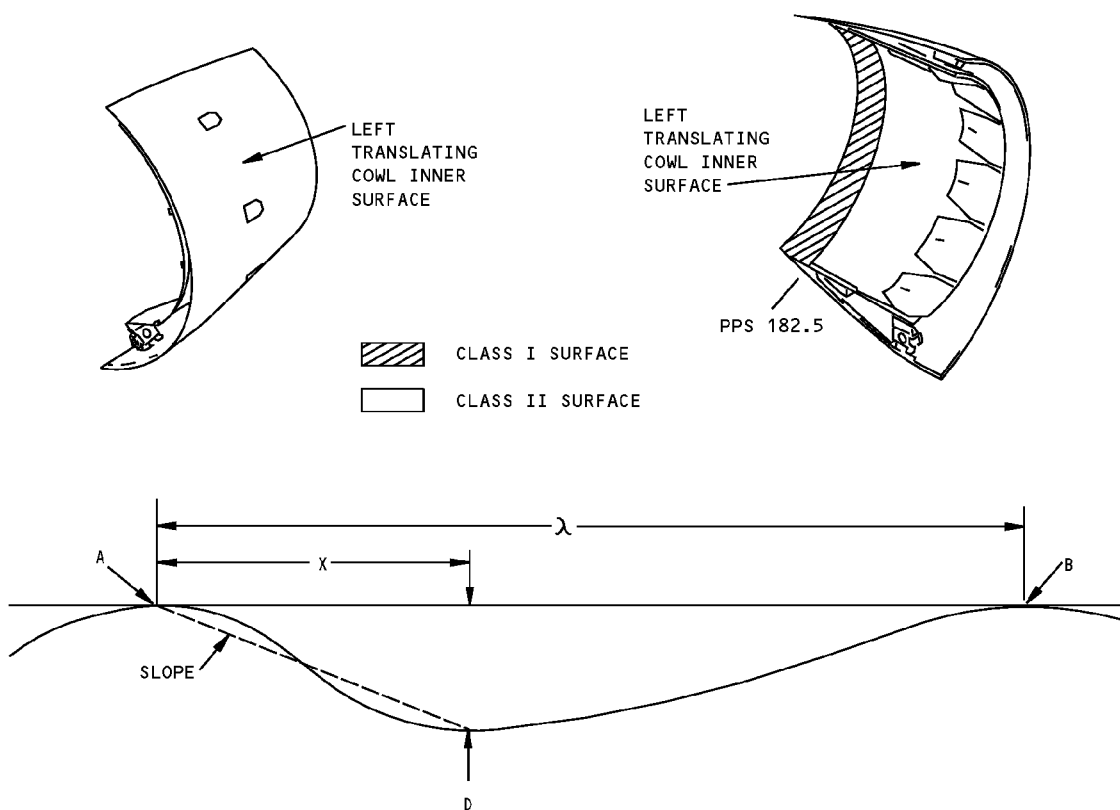
(2) SLOPE: D/X NOT TO EXCEED 0.024 INCH PER INCH

NOTE: WAVINESS IS DEFINED AS A SMOOTHLY VARYING INTERRUPTION IN A SURFACE FROM A FLAT OR CONTINUOUSLY CURVED CONTOUR. THE DISTANCE BETWEEN ADJACENT HIGH POINTS IN THIS VARIATION IS ONE WAVE LENGTH. SLOPE IS DEFINED AS THE DEGREE OF INCLINATION FROM THE NOMINAL SURFACE AT ANY POINT ON A WAVE.

FAN COWL SIDE PANELS DETAIL I

Aerodynamic Smoothness - Skin Waviness, All RB211-535 Engines Figure 2 (Sheet 1 of 3)

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λ = WAVE LENGTH: DISTANCE BETWEEN ADJACENT HIGH POINTS, A AND B.

D = MAXIMUM DEPTH OF WAVE.

X = DISTANCE ALONG LINE AB FROM MAXIMUM DEPTH OF WAVE (D) TO A OR B, WHICHEVER IS CLOSER.

D/X = SLOPE.

A. WAVINESS LIMITATIONS - CLASS I SURFACES.

(1) DEPTH: 0.003 INCH PER INCH OF λ , NOT TO EXCEED 0.064 INCH

(2) SLOPE: D/X NOT TO EXCEED 0.012 INCH PER INCH

B. WAVINESS LIMITATIONS - CLASS II SURFACES.

(1) DEPTH: 0.006 INCH PER INCH OF λ , NOT TO EXCEED 0.090 INCH

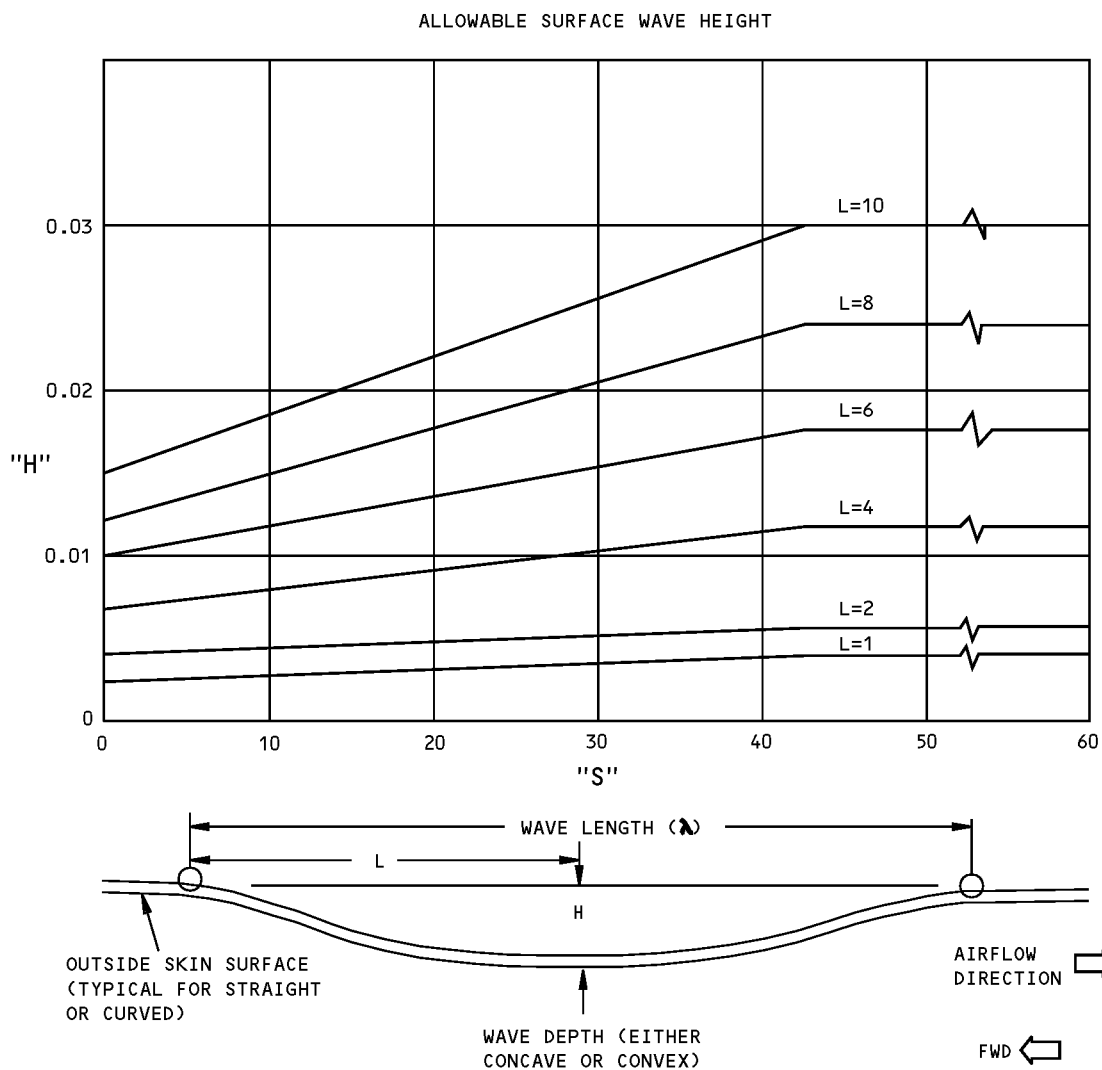
(2) SLOPE: D/X NOT TO EXCEED 0.024 INCH PER INCH

NOTE: WAVINESS IS DEFINED AS A SMOOTHLY VARYING INTERRUPTION IN A SURFACE FROM A FLAT OR CONTINUOUSLY CURVED CONTOUR. THE DISTANCE BETWEEN ADJACENT HIGH POINTS IN THIS VARIATION IS ONE WAVE LENGTH. SLOPE IS DEFINED AS THE DEGREE OF INCLINATION FROM THE NOMINAL SURFACE AT ANY POINT ON A WAVE.

THRUST REVERSER "C" DUCTS DETAIL II

Aerodynamic Smoothness - Skin Waviness, All RB211-535 Engines Figure 2 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



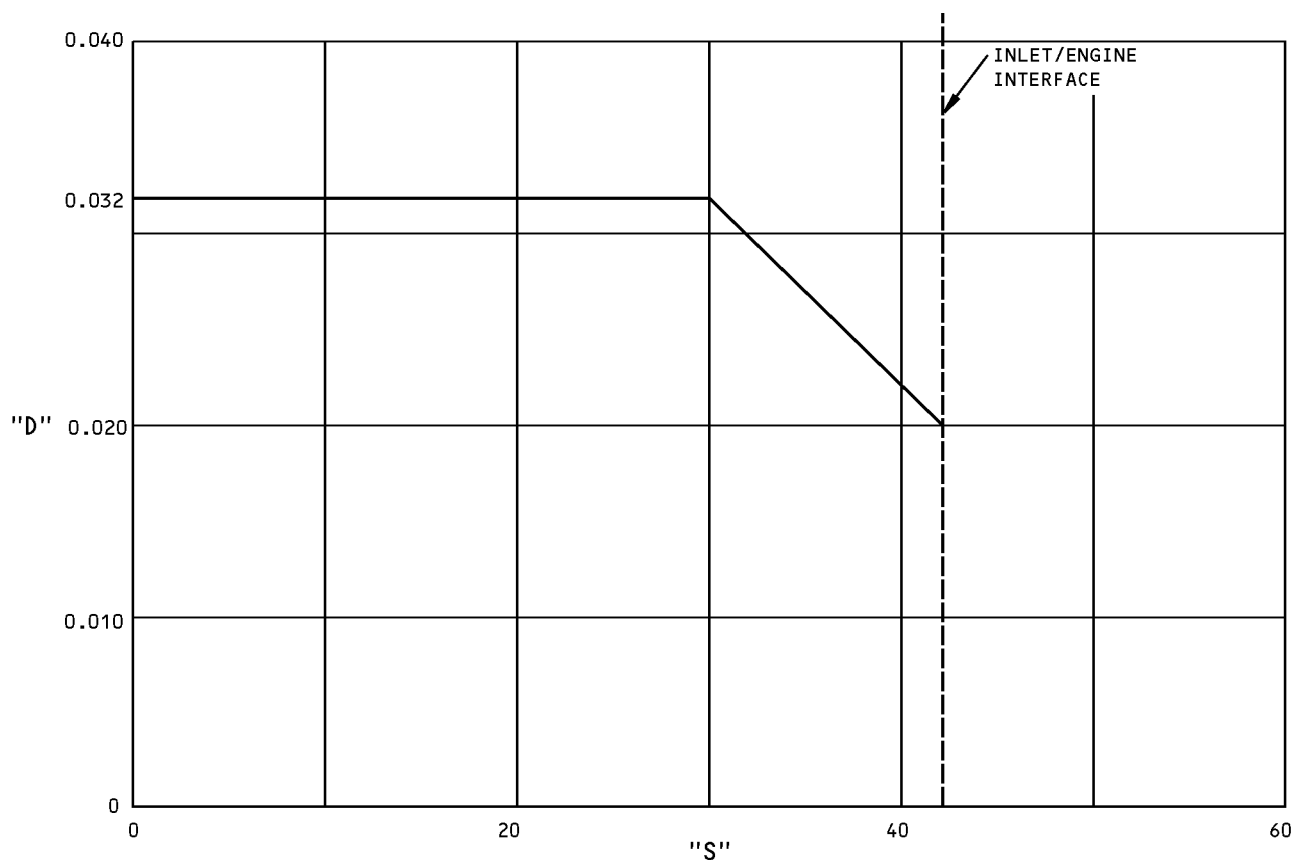
S =DISTANCE FROM LEADING EDGE IN INCHES
 H =WAVE HEIGHT INCHES
 λ =WAVE LENGTH IN INCHES

NOTE: H/L must not exceed 0.003 in/in (Nose cowl)
 H must not exceed 0.064 in (Nose cowl)

NOSE COWLING
DETAIL III

Aerodynamic Smoothness - Skin Waviness, All RB211-535 Engines
Figure 2 (Sheet 3 of 3)

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STRUCTURAL REPAIR MANUAL



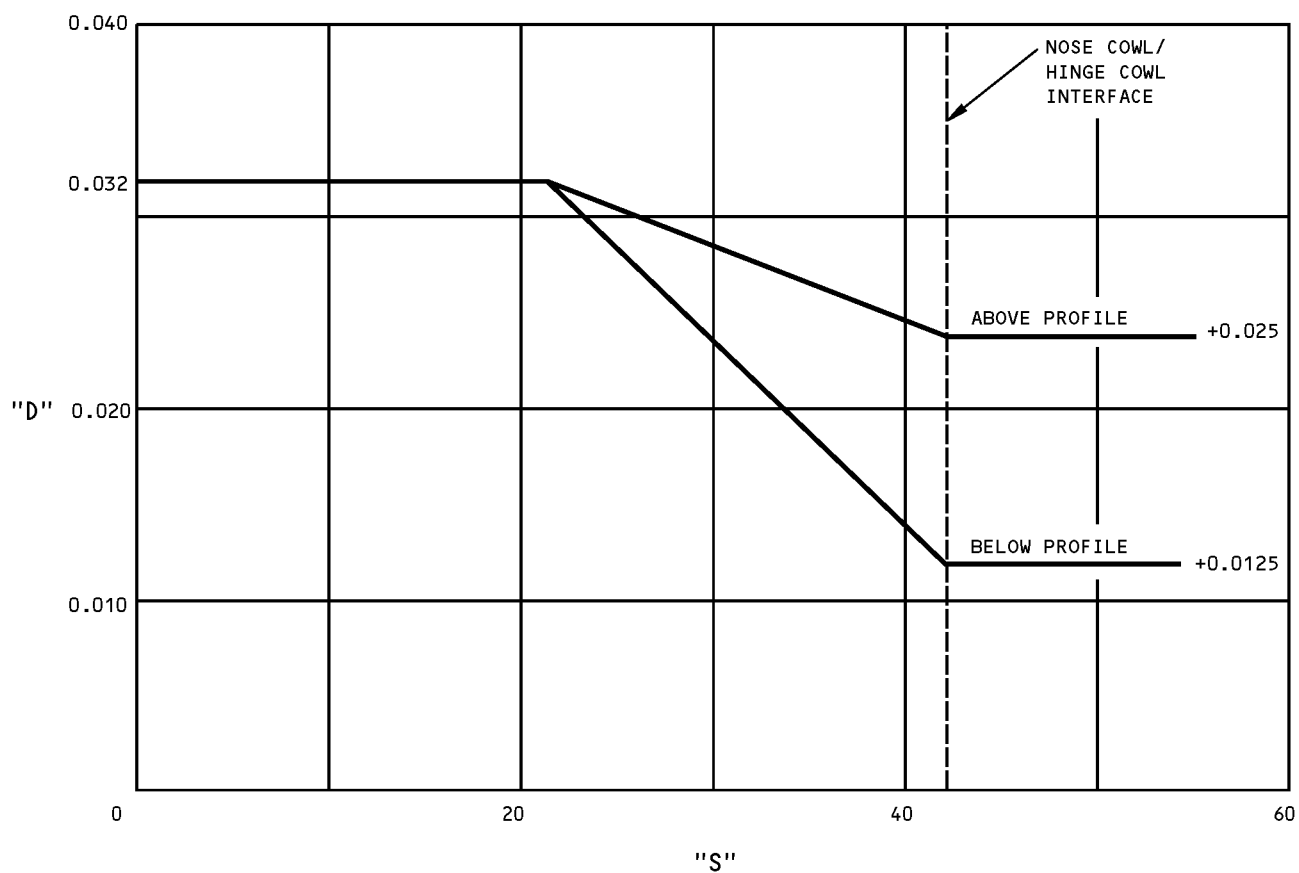
D = MAXIMUM DIMENSION ALLOWABLE FROM NOMINAL PROFILE IN INCHES

S = DISTANCE FROM LEADING EDGE IN INCHES

NOSE COWLING
DETAIL I

Aerodynamic Smoothness - Contour Deviation, RB211-535E4 Engine
Figure 3 (Sheet 1 of 2)

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STRUCTURAL REPAIR MANUAL



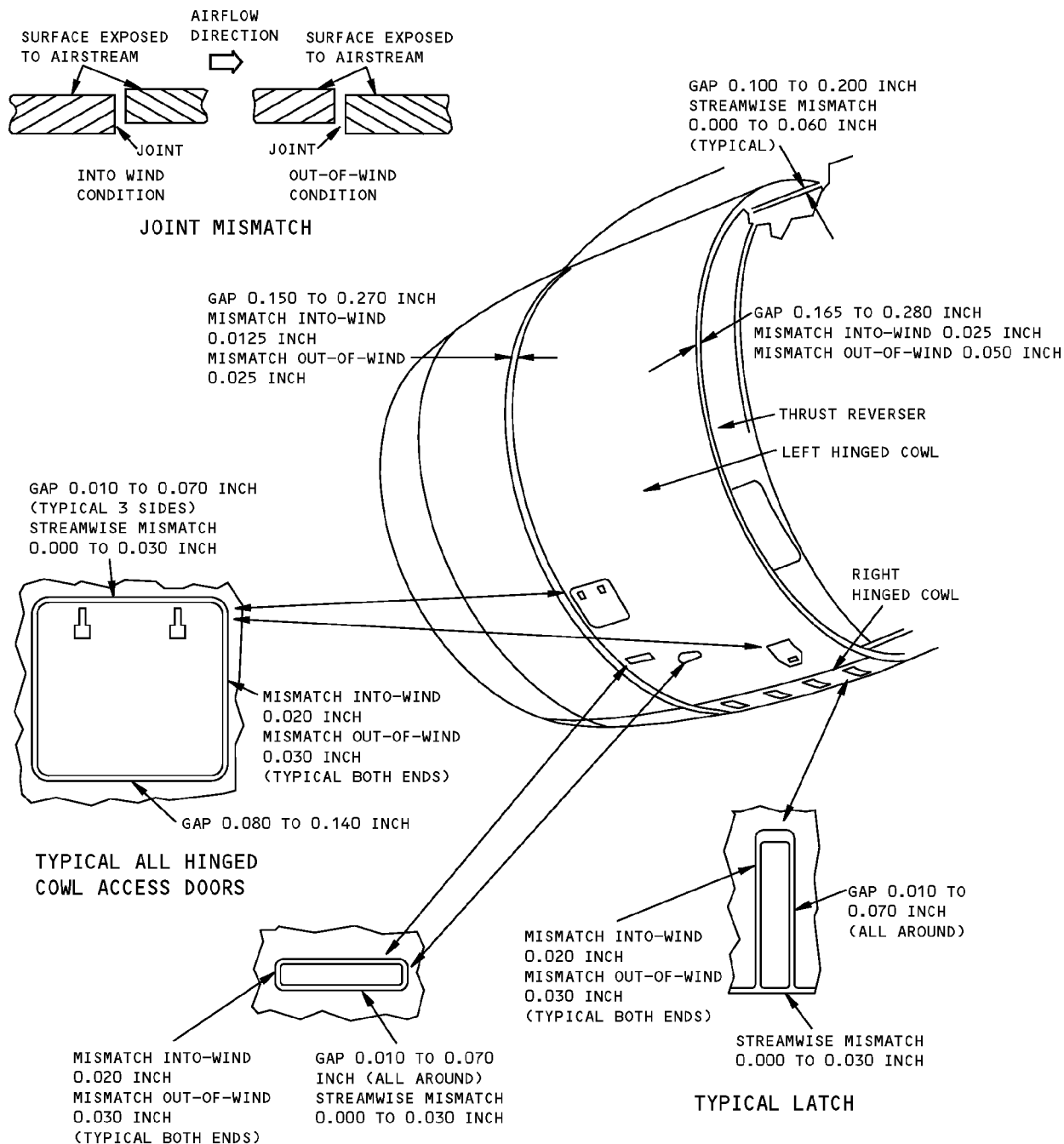
D = MAXIMUM ALLOWABLE DIMENSION FROM PROFILE IN INCHES

S = DISTANCE FROM LEADING EDGE IN INCHES

NOSE COWLING OUTER SKIN
DETAIL II

Aerodynamic Smoothness - Contour Deviation, RB211-535E4 Engine
Figure 3 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

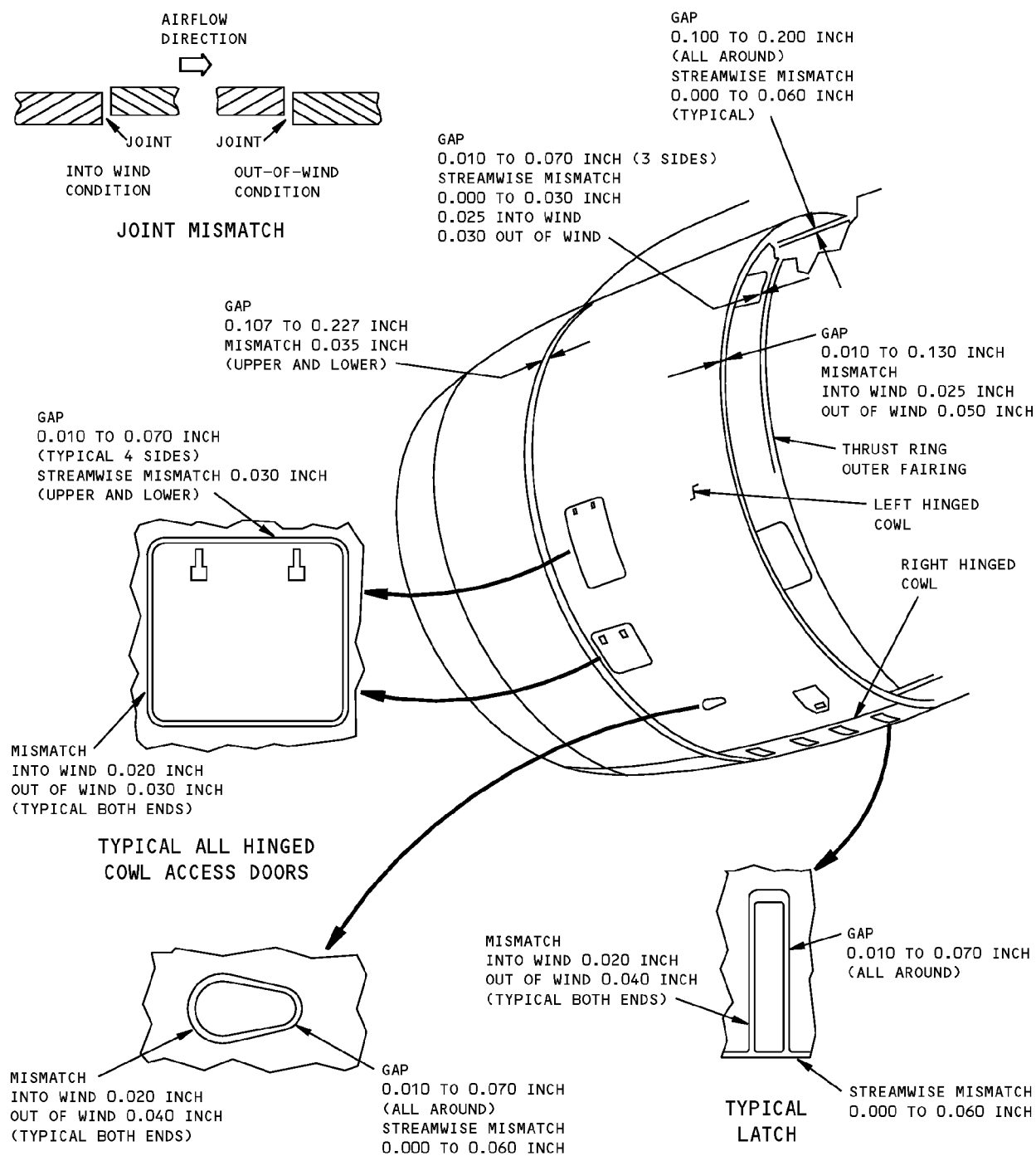


FAN COWL SIDE PANELS - RB211-535C37
LEFT SIDE SHOWN, RIGHT SIDE OPPOSITE

DETAIL I

Aerodynamic Smoothness - Permissible Gaps and Mismatch, RB211-535E4 Engine
Figure 4 (Sheet 1 of 7)

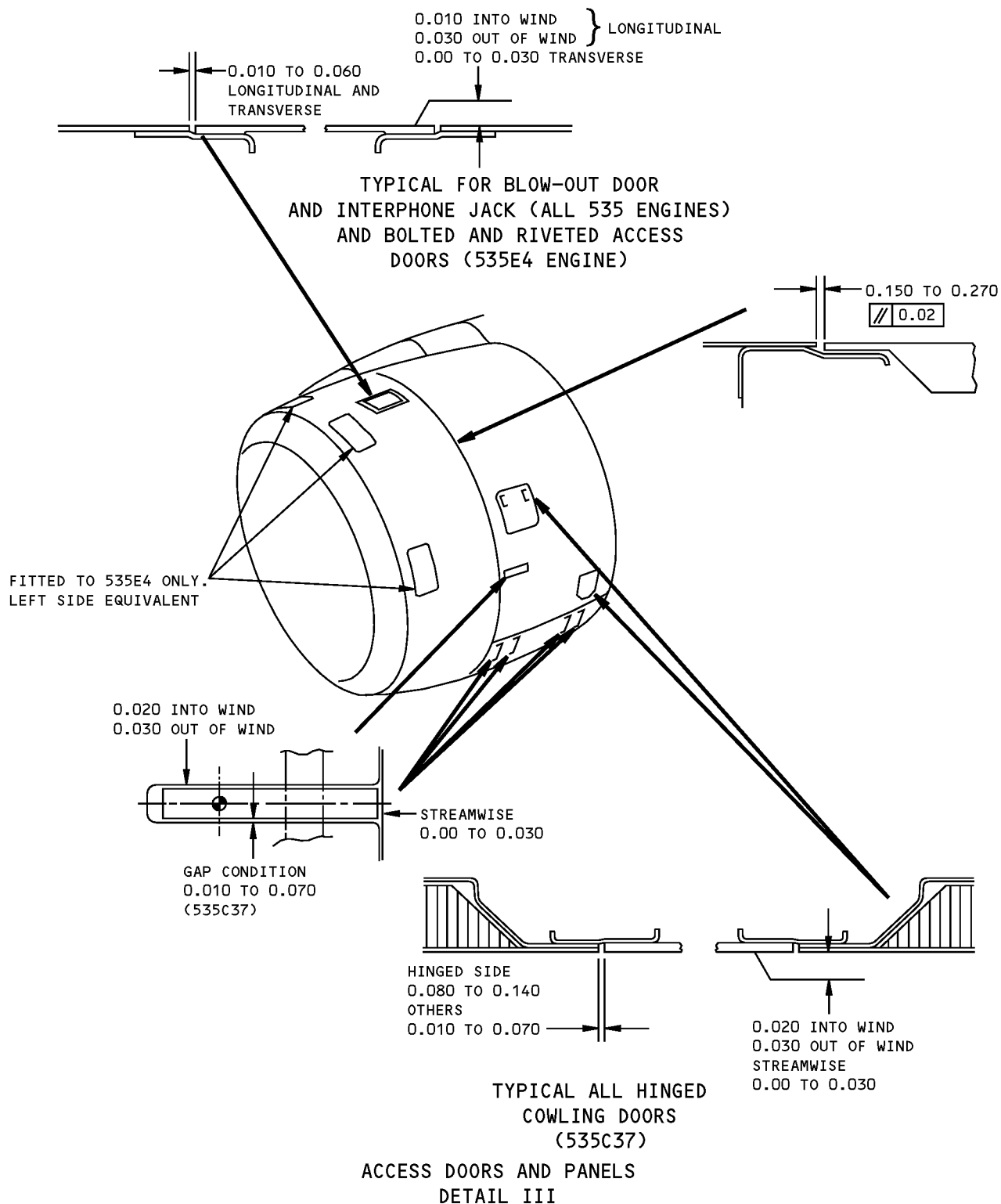
STRUCTURAL REPAIR MANUAL



FAN COWL SIDE PANELS - RB211-535E4
 LEFT SIDE SHOWN, RIGHT SIDE OPPOSITE
 DETAIL II

Aerodynamic Smoothness - Permissible Gaps and Mismatch, RB211-535E4 Engine
 Figure 4 (Sheet 2 of 7)

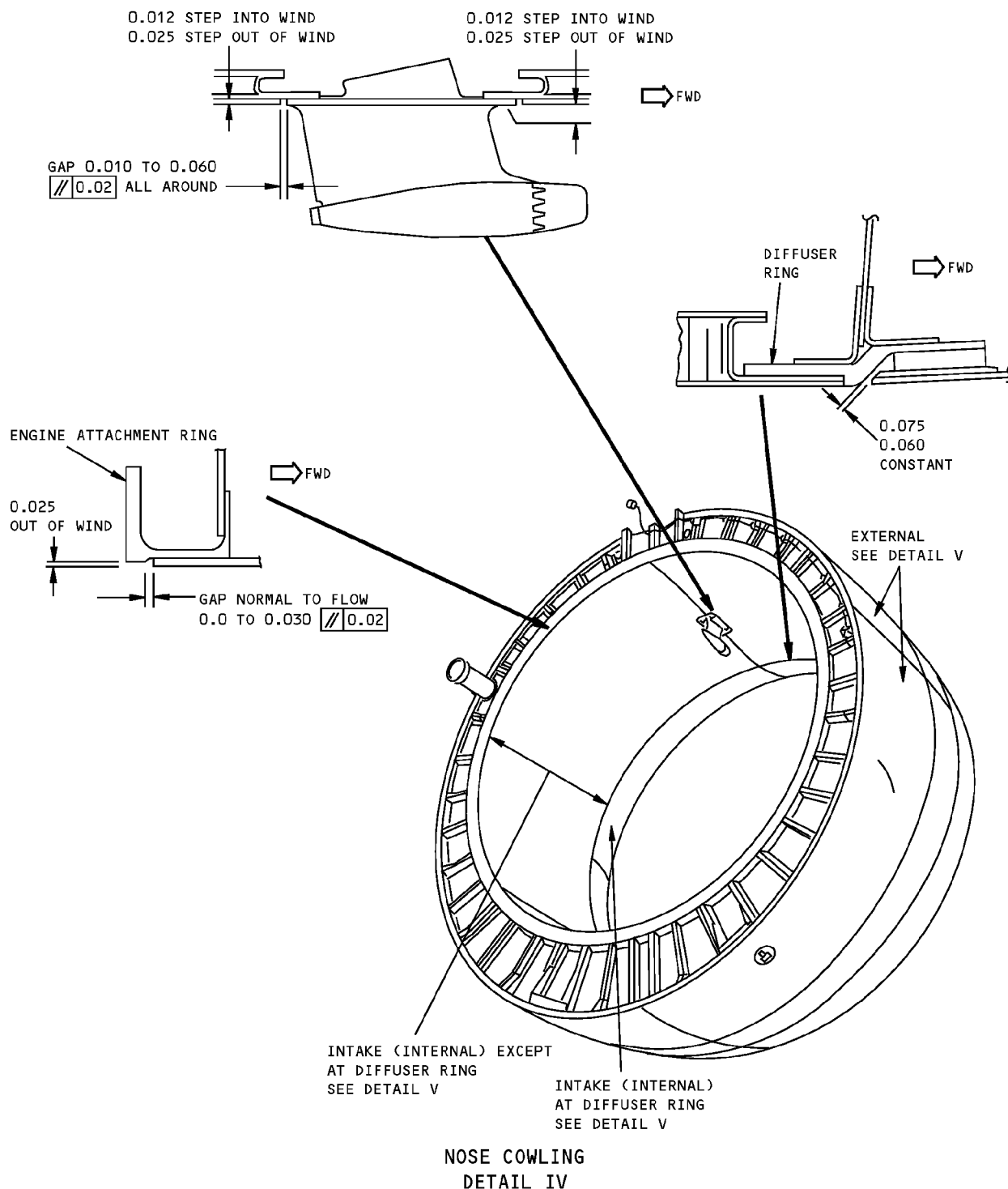
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**Aerodynamic Smoothness - Permissible Gaps and Mismatch, RB211-535E4 Engine
Figure 4 (Sheet 3 of 7)**

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STRUCTURAL REPAIR MANUAL



Aerodynamic Smoothness - Permissible Gaps and Mismatch, RB211-535E4 Engine
Figure 4 (Sheet 4 of 7)

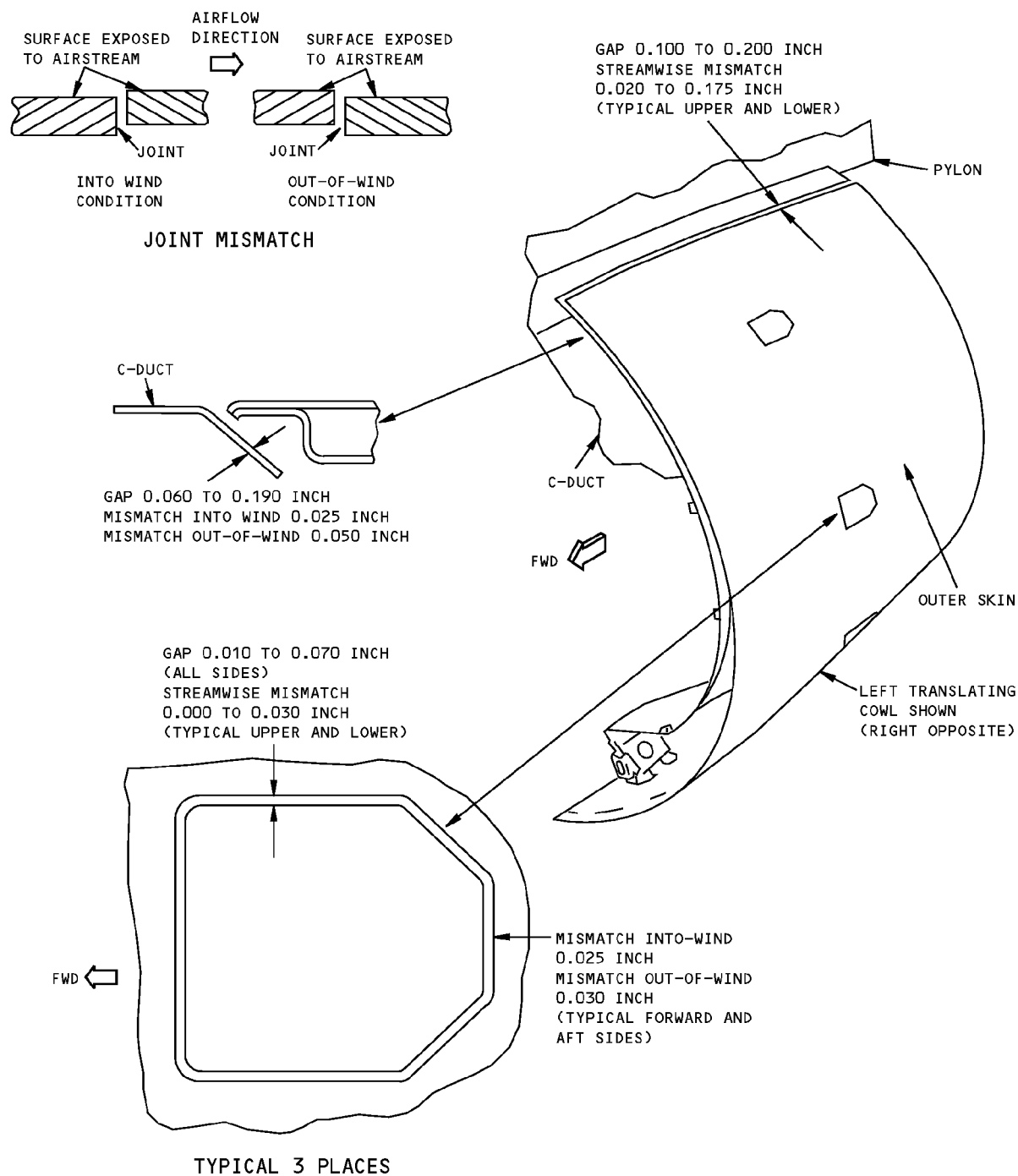
757-200
STRUCTURAL REPAIR MANUAL

	GAPS PARALLEL TO FLOW	GAPS NORMAL TO FLOW	STEPS PARALLEL TO FLOW	STEPS INTO WIND	STEPS OUT OF WIND
ACCESS DOORS	0.010 TO 0.060 // 0.02	0.010 TO 0.060 // 0.02	ZERO TO 0.030	0.010	0.030
INTAKE (INTERNAL) EXCEPT AT DIFFUSER RING	ZERO TO 0.040 // 0.02	ZERO TO 0.030 // 0.02	ZERO TO 0.015	0.012	0.025
INTAKE (EXTERNAL)	ZERO TO 0.040 // 0.02	ZERO TO 0.030 // 0.02	ZERO TO 0.030	ZERO	0.020
NOSE COWL TO HINGE COWL PANEL INTERFACE	—	0.150 TO 0.270 // 0.02	—	0.025	0.050
P.1 PROBE/INTAKE SKIN	0.010 TO 0.060 // 0.02	0.010 TO 0.060 // 0.02	ZERO TO 0.015	0.012	0.025
INTAKE (INTERNAL) AT DIFFUSER RING	ZERO TO 0.040 // 0.02	ZERO TO 0.030 // 0.02	ZERO TO 0.015	0.007 (535C37) 0.000 (535E4)	0.012 (535C37) 0.019 (535E4)

NOSE COWLING
DETAIL V

Aerodynamic Smoothness - Permissible Gaps and Mismatch, RB211-535E4 Engine
Figure 4 (Sheet 5 of 7)

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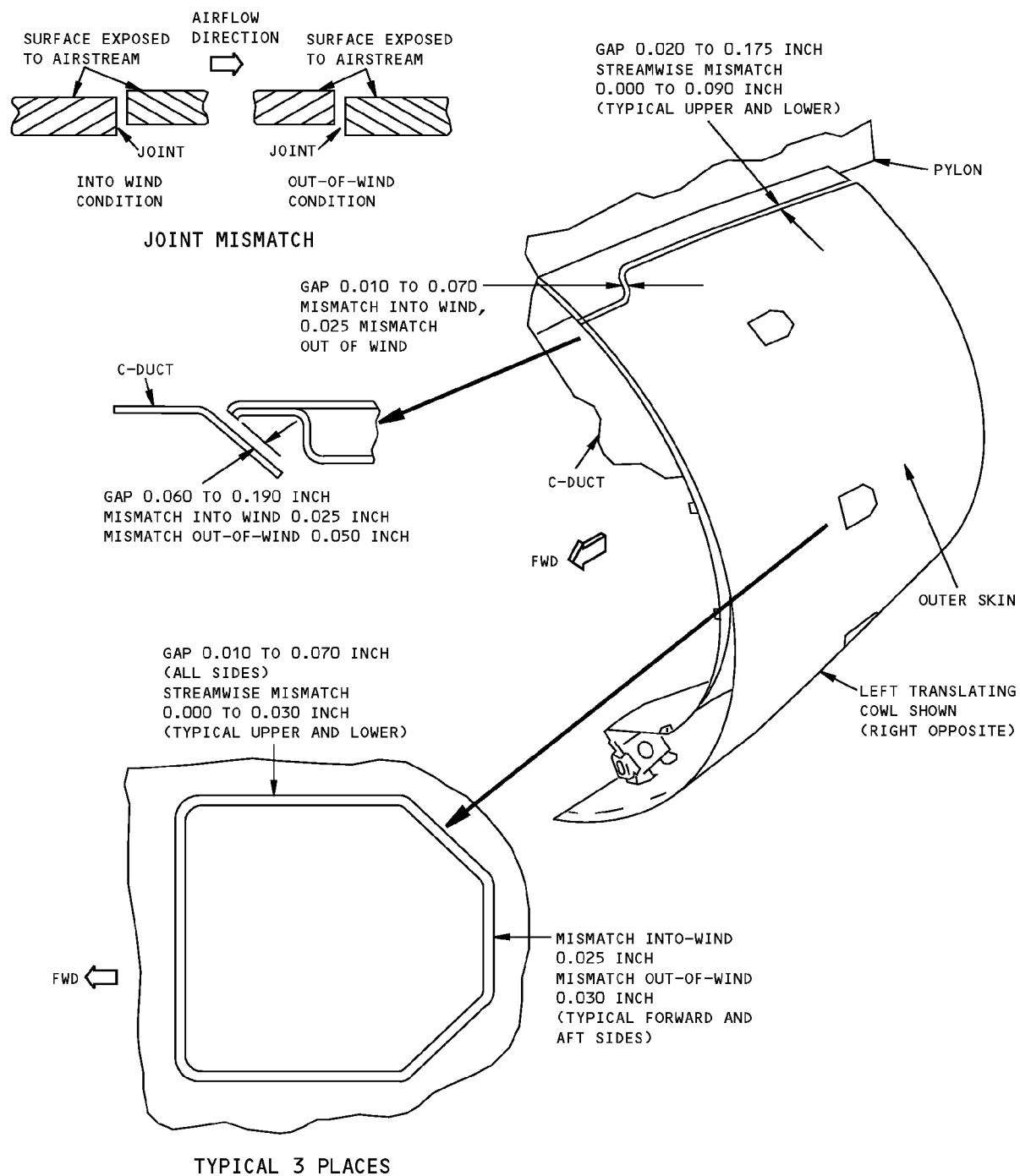
STRUCTURAL REPAIR MANUAL

THRUST REVERSER TRANSLATING COWL - RB211-535C37

DETAIL VI

Aerodynamic Smoothness - Permissible Gaps and Mismatch, RB211-535E4 Engine
Figure 4 (Sheet 6 of 7)

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STRUCTURAL REPAIR MANUAL

THRUST REVERSER TRANSLATING COWL - RB211-535E4

DETAIL VII

Aerodynamic Smoothness - Permissible Gaps and Mismatch, RB211-535E4 Engine
Figure 4 (Sheet 7 of 7)

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PERCENTAGE		90	85	15	10
RIVETS	ZONE 1 EXTERNAL	+0.003 -0.001			A $\begin{matrix} (+0.006 \\ -0.000 \end{matrix}$
	ZONE 2 EXTERNAL		+0.004 -0.000	A $\begin{matrix} (+0.006 \\ -0.000 \end{matrix}$	
	ZONE 1 INTERNAL	+0.004 -0.000			A $\begin{matrix} (+0.006 \\ -0.000 \end{matrix}$
	ZONE 2 INTERNAL	+0.004 -0.000			+0.006 -0.000
SCREWS AND BOLTS	ZONE 2 EXTERNAL	+0.003 -0.003			+0.003 -0.005
FASTENERS (OTHER THAN LATCHES)	ZONE 2 EXTERNAL	+0.003 -0.000			+0.003 -0.005

NOTES

- FOR ZONE DEFINITION, REFER FIG. 1

A RIVETS WITHIN THIS TOLERANCE BAND MUST BE
EVENLY DISTRIBUTED

NOSE COWLING DETAIL I

Aerodynamic Smoothness - Fastener Flushness, All RB211-535 Engines
Figure 5 (Sheet 1 of 2)

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STRUCTURAL REPAIR MANUAL

PERCENTAGE		100 UPSTREAM OF PPS 185	90	85 DOWNSTREAM OF PPS 185	15	10
RIVETS	EXTERNAL			+ 0.004 - 0.000		
	EXTERNAL				0.006	
	EXTERNAL	+ 0.008 - 0.002				
SCREWS AND BOLTS		TO BE ISSUED LATER				
FASTENERS OTHER THAN LATCHES	EXTERNAL		+ 0.003 - 0.003			
	EXTERNAL					- 0.003 - 0.005

FAN COWL SIDE PANELS AND THRUST REVERSER "C" DUCTS
DETAIL II

Aerodynamic Smoothness - Fastener Flushness, All RB211-535 Engines
Figure 5 (Sheet 2 of 2)



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - PROTECTIVE TREATMENT OF METALLIC AND NONMETALLIC MATERIALS

1. Applicability

- A. Use this chapter-section-subject for the protection of metal and nonmetallic structure and materials.

2. General Information about Protective Treatments

- A. When you do a repair or rework procedure that breaks the surface of an initial structure, you must apply a protective treatment to the surface.
- The treatment makes a base for the paint and inhibits corrosion when you apply it before the installation of the repair parts.
- B. Bare aluminum and magnesium alloys in initial structure need a subsequent chemical conversion coating if you use a repair process that will cause the area to corrode.
- C. Bare aluminum alloy and the chamfered edges of clad aluminum alloy repair parts need a protective treatment before you apply a primer.
- D. All steel parts need cadmium plating.
- E. If you use BMS 10-20 primer, then prepare the surface with the Alodine 600 chemical conversion coating. Do not use Alodine 1000 or Alodine 1200S in areas where you use BMS 10-20 primer material.
- F. If corrosion occurs on a structural component surface, the surface must be refinished. This is true even when the damage is not more than the applicable allowable damage limits. Refer to 20-40-00 of the Corrosion Prevention Manual. Apply the decorative finish if applicable, as given in the Airplane Maintenance Manual (AMM).
- G. Refer to 51-10-02, GENERAL for the mechanical cleanup procedure used to remove burrs or sharp edges.
- H. Table 1/GENERAL gives the maximum allowable temperatures of the following coatings, sealants, adhesives, primers, and paints.

Table 1: Maximum Permitted Temperatures for Coatings, Sealants, Adhesives and Paints

COATINGS, SEALANTS, ADHESIVES, PRIMERS AND PAINTS	MAXIMUM TEMPERATURE ALLOWABLE °F (°C)
BMS 10-11, Type I Primer & Type II Enamel	300°F (149°C) 300°F (149°C)
BMS 10-60, Type I & II Paint	300°F (149°C)
BMS 10-20, Type II Primer	300°F (149°C)
BMS 3-27 Coating	160°F (71°C)
BMS 10-79, Type II & III Primer	300°F (149°C)
BMS 10-21, Type III Antistatic Coating	300°F (149°C)
BMS 10-86 (BAC 5710 Type 27) Teflon Coating	300°F (149°C)
BMS 5-89 Primer	300°F (149°C)
BMS 10-100, BAC 5797 Coating	200°F (93°C)
BAC 5710, Type 47 PTFE Coating	700°F (371°C) Peak 425°F (218°C) Continuous
BMS 5-92 Adhesive	160°F (71°C)
BMS 10-103 Primer	300°F (149°C)



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Table 1: Maximum Permitted Temperatures for Coatings, Sealants, Adhesives and Paints (Continued)

COATINGS, SEALANTS, ADHESIVES, PRIMERS AND PAINTS	MAXIMUM TEMPERATURE ALLOWABLE °F (°C)
BMS 5-28 Potting Compound Type 3, 4, 15, 17, 19, 24, 28 Type 11 Type 6, 7, 12 class 1, 13, 14 class 2, 27	160°F (71°C) 450°F (232°C) 350°F (177°C)
BMS 5-95 Sealant	200°F (93°C)
BMS 5-126, Type II, III Potting Compound	160°F (71°C)
BMS 5-26 Sealant	200°F (93°C)
BMS 5-63 Sealant	450°F (232°C)
DC93-006	450°F (232°C)
BAC 5755 Aluminized Primer	450°F (232°C)
BMS 14-4, Type IV Coating	550°F (288°C)
Chemical Conversion Coating on Aluminum (Unpainted)	140°F (60°C)
Chemical Conversion Coating on Aluminum (Painted)	200°F (93°C)
Chemical Conversion Coating on Steel	200°F (93°C)
Anodized or Hardcoat on Aluminum (Unpainted)	300°F (149°C)
Anodized or Hardcoat on Aluminum (Painted)	400°F (204°C)

3. References

Reference	Title
51-10-02, GENERAL	Inspection and Removal of Damage
51-20-05	REPAIR SEALING
51-20-05, GENERAL	Repair Sealing
51-30-03, GENERAL	Nonmetallic Materials
51-70-03, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-06, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-17, GENERAL	Repairs to 250°F (121°C) and 350°F (177°C) Cured Graphite/Aramid/Fiberglass Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Structure - 200°F (93°C) to 230°F (110°C) Wet Layup Repair Method
AMM 20-30-00	Aircraft Maintenance Manual
AMM 20-41-01	Aircraft Maintenance Manual
AMM 28-11-00	Aircraft Maintenance Manual
AMM 51-20-00	Structures Finishes - Description and Operation
AMM 51-21-00	Aircraft Maintenance Manual
AMM 51-24-00	Corrosion Protection Finishes
BAC 5710	Application of Special Purpose Coatings
DOCUMENT D6-55564	Requirements for Alternative Paint Stripping Processes
SOPM 20-30-88	Solvents For Final Cleaning Metal Before Non-Structural Bonding (Series 88)
SOPM 20-41-01	Decoding Table For Boeing Finish Codes
SOPM 20-41-02	Application of Chemical and Solvent Resistant Finishes

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(Continued)

Reference	Title
SOPM 20-41-05	Application of Corrosion Inhibiting Compound
SOPM 20-42-01	Low Hydrogen Embrittlement Cadmium Plating
SOPM 20-42-05	Bright Cadmium Plating
SOPM 20-44-01	Application of Special Purpose Coatings and Finishes

4. Aluminum Alloy-Brush Chemical Conversion Coating Process

WARNING: USE EXTREME CAUTION WHEN YOU WORK WITH CORROSIVE CHEMICALS, CHEMICAL CONVERSION COATING POWDERS, OR SOLUTIONS. WHEN YOU WORK WITH POWDERS OR APPLY THE SOLUTION TO A SURFACE, YOU MUST USE A RESPIRATOR, AND WEAR GOGGLES, RUBBER OR NEOPRENE GLOVES, BOOTS AND APRONS THAT ARE MADE ACID-RESISTANT MATERIALS. IF YOU DO NOT OBEY, THE CORROSIVE CHEMICALS CAN CAUSE INJURY TO PERSONNEL.

DO NOT PERMIT THE SOLUTION OR POWDER TO TOUCH YOUR SKIN. IF YOU DO, WASH IT OFF IMMEDIATELY WITH WATER. IF THESE CHEMICALS TOUCH YOUR EYES, THEN WASH THEM WITH WATER FOLLOWED BY AN EYE WASH OR USE BORIC ACID. GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT SWABS OR THE PAPER THAT YOU USE TO APPLY OR REMOVE CHEMICAL CONVERSION COATING SOLUTIONS TO DRY OUT. IMMEDIATELY AFTER YOU USE THEM, SOAK THEM IN WATER BEFORE YOU DISCARD THEM. IF YOU DO NOT OBEY, AFTER THEY DRY THEY CAN BECOME A FIRE HAZARD.

A. The products that follow are approved for use to make a chemical film on aluminum alloys:

- (1) Alodine is a registered trade name for a proprietary procedure owned by Parker-Amchem, Henkel Corp.
- (2) Iridite is a registered trade name for a proprietary procedure owned by Allied-Kelite Products, a division of the Richardson Co.
- (3) Turcoat Alumigold is a registered trade name for a proprietary procedure owned by Turco Products Division, Atochem, Inc.

NOTE: These film layers are softer than the anodic treatment. However, they give a satisfactory protective layer and paint base. Treat repair parts and initial structure that have been cut or filled with one of these chemical conversion coatings.

B. Materials and Equipment Needed:

- (1) One of the following:
 - (a) Alodine 1200S powder, or
 - (b) Iridite 14-2 powder, or
 - (c) Turcoat Alumigold B powder, or
 - (d) Alodine 600 powder.
- (2) Tyco Wheels - Type 3A, very fine aluminum oxide wheels, Scotch-Brite pad, Type A, very fine aluminum oxide pads or 400-grit aluminum oxide paper.
- (3) Cheesecloth or new rags that contain less than 0.75 percent oil (Flintex-Buffalo Sanitary Wipes Co., or equivalent).



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- (4) Solvent - General cleaning of metal (Series 88) (refer to SOPM 20-30-88).

C. Alodine 1200S Solution Preparation

WARNING: DO NOT BREATHE THE VAPORS WHEN YOU WORK WITH NITRIC ACID. ALWAYS USE RESPIRATORY PROTECTION. DO NOT LET THE ACID TOUCH YOUR SKIN, EYES OR CLOTHING. ALWAYS WEAR A FACE SHIELD, AND USE GLOVES, BOOTS AND PROTECTIVE CLOTHING THAT ARE MADE OF ACID-PROOF MATERIALS. IF YOU DO NOT OBEY, THEN AN INJURY TO PERSONNEL CAN OCCUR.

KEEP NITRIC ACID AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS. DO NOT PERMIT NITRIC ACID TO COME IN CONTACT WITH OTHER MATERIALS.

DO NOT BREATHE NITRIC ACID. IF THE ACID FUMES ARE INHALED OR ONLY THOUGHT TO BE INHALED, GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT NITRIC ACID TO TOUCH YOUR SKIN. IF THE ACID DOES TOUCH YOUR SKIN, THEN WASH THE AREA WITH LARGE AMOUNTS OF WATER AND GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT NITRIC ACID TO TOUCH YOUR EYES. IF THE ACID DOES TOUCH YOUR EYES, THEN DO NOT RUB THEM. FLUSH YOUR EYES WITH WATER FOR 15 MINUTES AND GET MEDICAL AID IMMEDIATELY.

- (1) Prepare the brush chemical conversion coating solution.

NOTE: Prepare the solution in small quantities. A solution that is not used in 24 hours is not usable and should be thrown away. A dirty solution is unsatisfactory.

- (2) Mix 3 ounces of Alodine 1200S powder and 1 gallon of deionized or distilled water in a polyethylene, stainless steel or equivalent container.
- (3) Mix until powder is dissolved.
- (4) Let solution stand at least 1 hour before it is used.

NOTE: If you mix with nondistilled water, add nitric acid to control the pH. Use pHdriion papers to find the pH level.

- For the Alodine products, the pH must be 1.50 to 2.00.

D. Iridite 14-2 Solution Preparation

WARNING: DO NOT BREATHE THE VAPORS WHEN YOU WORK WITH NITRIC ACID. ALWAYS USE RESPIRATORY PROTECTION. DO NOT LET THE ACID TOUCH YOUR SKIN, EYES OR CLOTHING. ALWAYS WEAR A FACE SHIELD, AND USE GLOVES, BOOTS AND PROTECTIVE CLOTHING THAT ARE MADE OF ACID-PROOF MATERIALS. IF YOU DO NOT OBEY, THEN AN INJURY TO PERSONNEL CAN OCCUR.

GENERAL

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(WARNING PRECEDES)

KEEP NITRIC ACID AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS. DO NOT PERMIT NITRIC ACID TO COME IN CONTACT WITH OTHER MATERIALS.

DO NOT BREATHE NITRIC ACID. IF THE ACID FUMES ARE INHALED OR ONLY THOUGHT TO BE INHALED, GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT NITRIC ACID TO TOUCH YOUR SKIN. IF THE ACID DOES TOUCH YOUR SKIN, THEN WASH THE AREA WITH LARGE AMOUNTS OF WATER AND GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT NITRIC ACID TO TOUCH YOUR EYES. IF THE ACID DOES TOUCH YOUR EYES, THEN DO NOT RUB THEM. FLUSH YOUR EYES WITH WATER FOR 15 MINUTES AND GET MEDICAL AID IMMEDIATELY.

- (1) Prepare the brush chemical conversion coating solution.

NOTE: Prepare the solution in small quantities. A solution that is not used in 24 hours is not usable and should be thrown away. A dirty solution is unsatisfactory.

- (2) Mix 3 ounces of Iridite 14-2 powder and 1 gallon of deionized or distilled water in a polyethylene, stainless steel or equivalent container.
- (3) Mix until the powder is dissolved.
- (4) Let the solution stand at least 1 hour before it is used.

NOTE: If you mix with nondistilled water, add nitric acid to control the pH. Use pHydration papers to find the pH level.

- For the Iridite 14-2, the pH must be 1.10 to 1.60.

E. Turcoat Alumigold Solution Preparation

WARNING: DO NOT BREATHE THE VAPORS WHEN YOU WORK WITH NITRIC ACID. ALWAYS USE RESPIRATORY PROTECTION. DO NOT LET THE ACID TOUCH YOUR SKIN, EYES OR CLOTHING. ALWAYS WEAR A FACE SHIELD, AND USE GLOVES, BOOTS AND PROTECTIVE CLOTHING THAT ARE MADE OF ACID-PROOF MATERIALS. IF YOU DO NOT OBEY, THEN AN INJURY TO PERSONNEL CAN OCCUR.



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(WARNING PRECEDES)

KEEP NITRIC ACID AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS. DO NOT PERMIT NITRIC ACID TO COME IN CONTACT WITH OTHER MATERIALS.

DO NOT BREATHE NITRIC ACID. IF THE ACID FUMES ARE INHALED OR ONLY THOUGHT TO BE INHALED, GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT NITRIC ACID TO TOUCH YOUR SKIN. IF THE ACID DOES TOUCH YOUR SKIN, THEN WASH THE AREA WITH LARGE AMOUNTS OF WATER AND GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT NITRIC ACID TO TOUCH YOUR EYES. IF THE ACID DOES TOUCH YOUR EYES, THEN DO NOT RUB THEM. FLUSH YOUR EYES WITH WATER FOR 15 MINUTES AND GET MEDICAL AID IMMEDIATELY.

- (1) Prepare the brush chemical conversion coating solution.

NOTE: Prepare the solution in small quantities. A solution that is not used in 24 hours is not usable and should be thrown away. A dirty solution is unsatisfactory.

- (2) Mix 3 ounces of Turcoat Alumigold powder and 1 gallon of deionized or distilled water in a polyethylene, stainless steel or equivalent container.
- (3) Mix until the powder is dissolved.
- (4) Let the solution stand at least 1 hour before it is used.

NOTE: If you mix with nondistilled water, add nitric acid to control the pH. Use pHyrion papers to find the pH level.

- For the Turcoat Alumigold B, the pH must be 1.60 to 1.90.

F. Prepare the surface for chemical conversion coating application.

- (1) Mask all of the surface areas that need protection from running, splashing or dripping of the solution.
 - (a) Seal or plug all possible entry points to assemblies with honeycomb or foam plastic components with an applicable sealing or caulking material or with rubber plugs.
 - (b) Painted, anodized or previously conversion-coated surfaces do not need to be masked.
- (2) Clean the area to be chemical conversion-coated with a solvent or degreaser and a clean brush or rags. Dry with warm air or wipe dry.
- (3) Remove all of the finish and protective coating from the repair area. Remove the anodized, chemical conversion coatings mechanically with:
 - (a) Tycol, Type 3A, very fine aluminum oxide wheels attached to a drill motor, or
 - (b) Scotch-Brite pad, Type A, or
 - (c) 400-grit aluminum oxide paper.
- (4) Clean until all signs of organic or inorganic coatings are gone and only a bright shiny aluminum surface shows. Wipe dry with a clean cheesecloth to remove loose particles and residue.
- (5) Wipe with a clean cheesecloth moist (not soaked) with solvent, Series 88 or an equivalent solvent. Do this step again and again until no visible residue shows on the cheesecloth after wiping.
- (6) Allow a minimum of 15 minutes for the surface to dry.

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- (7) Remove all corrosion that may have occurred as given in AMM 51-21-00.
- (8) Refer to 51-20-05, GENERAL and AMM 28-11-00 for instructions to clean the structure and the repair parts before the installation of sealant in the integral fuel tanks.

G. Alodine 1200S Solution Application

- (1) Apply the Alodine 1200S solution with a fiber or nylon brush or clean, cotton wiper.
- (2) Rub the wet surface until a gold color comes into view (after approximately 30 seconds).

CAUTION: THE COATING IS SOFT WHEN IT IS INITIALLY APPLIED. USE CARE WHEN THE SURFACE IS FLUSHED AND DRIED. IF YOU DO NOT USE CARE, YOU WILL SCRATCH, OR POSSIBLY REMOVE THE COATING.

- (3) Flush the surface with clean water and wipe it dry with clean, cotton wipers.
- (4) Let the surface dry for 1 to 3 hours.
- (5) Apply a finish or start an adhesive bond as soon as possible after the surface is dry.

H. Iridite 14-2 Solution Application

- (1) Apply the Iridite 14-2 solution with a fiber or nylon brush or clean, cotton wipers.
- (2) Rub the wet surface until a gold color comes into view (after approximately 30 seconds).

CAUTION: THE COATING IS SOFT WHEN IT IS INITIALLY APPLIED. USE CARE WHEN THE SURFACE IS FLUSHED AND DRIED. IF YOU DO NOT USE CARE, YOU WILL SCRATCH, OR POSSIBLY REMOVE THE COATING.

- (3) Flush the surface with clean water and wipe it dry with clean, cotton wipers.
- (4) Let the surface dry for 1 to 3 hours.
- (5) Apply a finish or start an adhesive bond as soon as possible after the surface is dry.

I. Turcoat Alumigold Solution Application

- (1) Apply the Turcoat Alumigold solution with a fiber or nylon brush or clean, cotton wiper.
- (2) Rub the wet surface until a gold color comes into view (after approximately 30 seconds).

CAUTION: THE COATING IS SOFT WHEN IT IS INITIALLY APPLIED. USE CARE WHEN THE SURFACE IS FLUSHED AND DRIED. IF YOU DO NOT USE CARE, YOU WILL SCRATCH, OR POSSIBLY REMOVE THE COATING.

- (3) Flush the surface with clean water and wipe it dry with clean, cotton wipers.
- (4) Let the surface dry for 1 to 3 hours.
- (5) Apply a finish or start an adhesive bond as soon as possible after the surface is dry.

5. Magnesium Alloys - Conversion Coating

- A. Magnesium alloys are highly susceptible to corrosion when the metal surface is exposed to the environment without a protective finish. An oxide-carbonate film will normally form on an exposed magnesium alloy surface but this film provides very little protection against corrosion.

A proper protective finish is therefore required.

- B. All magnesium alloy surfaces that have been reworked must be cleaned and treated with a conversion coating.

C. Materials Required:

- (1) Chromic Acid
- (2) Calcium Sulfate

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- (3) Cheesecloth
- (4) Solvent - General Cleaning of Metal (Series 88) (refer to SOPM 20-30-88)
- (5) Sodium Hydroxide
- (6) Sulfuric Acid

D. Prepare the Solution

NOTE: The solution must be prepared and stored in polyethylene or glass container.

- (1) Fill a clean polyethylene or glass container to the 9/10 level with distilled water.
- (2) Slowly add 1-1/3 fluid ounce (39.5 milliliters) of chromic acid per gallon of final solution.
- (3) Add 1 fluid ounce (29.6 milliliters) of calcium sulfate per gallon of final solution.
- (4) Fill to final solution level with distilled water.
- (5) Stir vigorously for 15 minutes to ensure that the solution is saturated with calcium sulfate.
- (6) Let solution stand for 15 minutes to allow undissolved calcium sulfate to settle to the bottom of the container.
- (7) Decant to another polyethylene or glass container without transferring undissolved calcium sulfate.
- (8) Adjust pH with additions of sodium hydroxide or sulfuric acid to bring within a range of 1.2 to 1.6.

E. Prepare the Surface for Conversion Coating

- (1) Mask all surfaces likely to be affected by running, dripping, or splashing of the solution.
- (2) Seal or plug all holes, gaps, and inlets to assemblies containing honeycomb or foam plastic with suitable sealing or caulking material or rubber plugs to prevent entry of any solution.
- (3) Wipe treatment area with dry clean cheesecloth to remove loose particles and residue.
- (4) Wipe with cheesecloth dampened (not saturated) with solvent, Series Series 88 (refer to AMM 20-30-00 and SOPM 20-30-88). Repeat using clean cheesecloth until no visible residue transfers to the cheesecloth.
- (5) Allow to dry to a minimum of 15 minutes.

F. Apply the Conversion Coating

CAUTION: SEVERE RUBBING OF WET SURFACE CAN CAUSE COATING DAMAGE.

- (1) Apply solution by swabbing with brush, swab, swatches, cellulose sponge, or white blotting paper. Maintain a continuous wet film until metal surface becomes dull golden or dark brown in color. Discard used solution.
- (2) Rinse with cold, clean water.

CAUTION: DO NOT DIRECT HIGH PRESSURE AIR TO SURFACE WHILE DRYING, AS COATING IS STILL SOFT.

- (3) Allow to dry at ambient temperature. If possible, use low pressure air to dry the surface.
- (4) Restore the original finish as soon as possible after drying. Handle parts with clean gloves and keep parts clean and dry to avoid surface contamination. Refer to AMM 51-20-00.

6. Steel - Cadmium Plating Procedures

- A. Noncorrosion-resistant steel parts that you use for repairs must be cadmium plated for maximum protection from corrosion.



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- B. Oxidation is not a problem with corrosion-resistant steel parts. But steel parts are cathodic when they touch dissimilar metals. Steel parts should be cadmium plated, because they can become a cathode and cause corrosion.
- C. To provide maximum protection from corrosion, you must cadmium plate and prime all steel repair parts.
- (1) For the procedures to apply cadmium plating, refer to SOPM 20-42-01 and SOPM 20-42-05. For procedures to prime the surface, refer to SOPM 20-41-02.

NOTE: As an option, you can use a cadmium-free plating procedure. This procedure uses zinc-nickel to plate the surface. Refer to SOPM 20-41-01, Decoding Table for Boeing Finish Codes. The correct finish codes for zinc-nickel plating are F-15.40 and F-15-401. You must not use the zinc-nickel plating procedure on the following groups of parts:

- Parts that are heat-treated to 220,000 psi (1,516,847 kPa).
- All types of gears
- All threaded parts
- Parts that require plating and a phosphate treatment of the surface

- (2) Refer to the paragraph that follows, for the correct data when to apply cadmium plating and priming to corrosion-resistant steel (CRES) repair parts.

- D. Corrosion-resistant steels (CRES) contain more than 14 percent by weight of chromium and less than 0.2 percent carbon. These types of alloy steels are very corrosion-resistant.

- (1) Corrosion-resistant steels usually do not require more protection by plating or a protective finish, other than a passivation treatment that removes surface contamination and will keep a thin stable oxide layer on the surface.
- (2) Galvanic corrosion will occur when corrosion-resistant steels touch a dissimilar metal surface. Thus, when you use corrosion-resistant steels with a dissimilar metal, the corrosion-resistant steel must receive a surface finish to provide protection from galvanic corrosion.
- (3) Always use corrosion-resistant steel parts that are cadmium-plated and primed in areas where galvanic corrosion will occur.

NOTE: As an option, you can use a cadmium-free plating procedure. This procedure uses zinc-nickel to plate the surface. Refer to SOPM 20-41-01, Decoding Table for Boeing Finish Codes. The correct finish codes for zinc-nickel plating are F-15.40 and F-15-401. You must not use the zinc-nickel plating procedure on the following groups of parts:

- Parts that are heat-treated to 220,000 psi (1,516,847 kPa)
- All types of gears
- All threaded parts
- Parts that require plating and a phosphate treatment of the surface

WARNING: DO NOT BREATHE THE VAPORS WHEN YOU WORK WITH ALCOHOLIC-PHOSPHORIC SOLUTIONS. ALWAYS USE MECHANICAL VENTILATION AND RESPIRATORY PROTECTION. DO NOT LET THESE SOLUTIONS TOUCH YOUR CLOTHING. ALWAYS WEAR A FACE SHIELD AND USE PROTECTIVE GLOVES, BOOTS AND CLOTHING. IF YOU DO NOT OBEY, THEN AN INJURY TO PERSONNEL CAN OCCUR.



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(WARNING PRECEDES)

DO NOT PERMIT THESE SOLUTIONS TO TOUCH YOUR SKIN. IF IT DOES, THEN WASH THE AREA WITH LARGE AMOUNTS OF WATER AND GET MEDICAL AID IMMEDIATELY.

DO NOT PERMIT THESE SOLUTIONS TO TOUCH YOUR EYES. IF IT DOES, THEN FLUSH YOUR EYES WITH WATER FOR 15 MINUTES AND GET MEDICAL AID IMMEDIATELY.

KEEP THESE SOLUTIONS AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

- E. Until the reworked surfaces of the steel parts can be cadmium plated, apply a protective coating to the surfaces that are heat-treated to less than 220,000 psi (1,516,900 kiloNewtons/m²). Do the steps that follow:

- (1) Wipe the surface clean with a cloth or brush dipped in one of these two alcoholic-phosphoric solutions:
 - (a) Turco prepaint alcoholic-phosphoric solution
 - (b) Kelite polycote
 - (c) An aqueous solution containing:
 - 1) 10 percent by volume - phosphoric acid
 - 2) 10 percent by volume - butyl cellulose
 - 3) 0.1 percent by volume - Triton X-100 wetting agent

NOTE: Do not allow solution to dry on the surface.

- (2) Rinse with a water-soaked rag and wipe dry.
- (3) Wipe the surface dry.
- (4) Apply two layers of BMS 10-11, Type I primer to the surface as given in AMM 51-24-00.

7. Protective Treatment of Mating Surfaces

- A. Each metal and metal alloy has an inherent electrical potential. When these materials touch other materials of a different or higher potential and an electrolyte is present, galvanic corrosion may be the result.

NOTE: Galvanic corrosion will cause pitting in the higher potential material.

- B. Metals that have different electrical potentials are classified into four groups.
- (1) The four groups are given in Figure 1/GENERAL.
 - (2) Each classification is taken from the surface metal or in more basic terminology, the base metal of a nonplated part, or the deposited metal of a plated or coated part.
- C. Even though the graphite material in Carbon Fiber Reinforced Plastic (CFRP) is classified as a non-metal, it is still an electrically conductive material.
- (1) This material has an electrolytic reaction with metals and metal alloys from other material groups where they have a mating surface, or with fasteners made from dissimilar metals or other dissimilar materials.

NOTE: You can use one ply of fiberglass fabric as an electrolytic barrier between the CFRP and from dissimilar metals of other type of dissimilar material.

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- D. See Figure 2/GENERAL for the protective finishes that you must use on the mating surface of two dissimilar metals before they are placed into contact and fastened or bonded together.
- E. The protective treatments given in Figure 3/GENERAL are satisfactory for field-type repairs where you need the procedure to be fast and simple. Refer to AMM 51-21-00 to apply the internal or external finish.

8. Protective Treatment for Fastener Installation

- A. See Figure 3/GENERAL to find the correct treatment for fasteners to protect them from galvanic corrosion.
- B. If a fastener needs a protective coating, then install the fastener wet with BMS 5-95 sealant material (the preferred method) or install the fastener wet with BMS 10-11, Type I primer. But, you are not permitted to use these two materials in the areas that follow:

WARNING: ZINC CHROMATE IS A TOXIC MATERIAL. DO NOT LET ZINC CHROMATE PRIMER TOUCH YOUR SKIN, EYES, OR CLOTHING. ALWAYS USE RESPIRATORY PROTECTION, WHEN YOU USE ZINC CHROMATE PRIMER.

ALWAYS WEAR A CHEMICAL-RESISTANT FACESHIELD. USE NEOPRENE GLOVES, RUBBER APRONS, AND PROTECTIVE COVERALLS TO APPLY ZINC CHROMATE PRIMER. IF YOU DO NOT OBEY, THEN AN INJURY TO PERSONNEL CAN OCCUR.

APPLY ZINC CHROMATE PRIMERS IN A VENTILATED AREA. DO NOT BREATHE ZINC CHROMATE VAPORS. IF THE PRIMER FUMES ARE INHALED, OR ONLY THOUGHT TO BE INHALED, GET MEDICAL AID IMMEDIATELY.

KEEP PRIMER AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS. DO NOT PERMIT THE PRIMER TO CONTACT SPARE PARTS, OTHER THAN THOSE PARTS THAT ARE TO BE PRIMED.

- (1) On unpainted exterior surfaces - Install fasteners wet with TT-P-1757, zinc chromate primer. Install removable fasteners wet with MIL-C-11796, Class 3 corrosion preventative compound.
- (2) Integral fuel tanks - Refer to 51-20-05, GENERAL and AMM 28-11-00.
- (3) Where you use removable close tolerance fasteners - Install these fasteners with MIL-C-11796, Class 3 corrosion-preventative compound.
- (4) Torqued fasteners located in areas where you do not use close tolerance holes - Coat holes with BMS 10-11, Type I primer and allow to dry before you install the fasteners.
- (5) 5056 aluminum fasteners and all non-aluminum fasteners that go through exterior primary structure - Install wet with BMS 5-95 sealant; refer to BAC 5000 for installation procedures.
- (6) Hand-driven 5056 aluminum rivets that are installed in 2024 aluminum alloy - Install wet with BMS 5-95 sealant; refer to BAC 5000 for installation procedures.
- (7) In areas where the dry installation of fasteners is necessary, or where it is necessary to install fasteners with BMS 5-26 and BMS 5-63 fastener sealant materials - Refer to 51-20-05, GENERAL and the specific component repair sections.
- (8) In fireshield areas - Install the fasteners wet with DeSoto Hi-Temp primer (BAC 5710, Type 51). Refer to SOPM 20-44-01.

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- C. Install permanent fasteners that are not made from aluminum alloys with one of the sealant materials that follow (specific examples are hex-drive bolts, lockbolts, CRES bolts and titanium bolts):

- (1) With BMS 5-95 sealant material (the preferred method), or
- (2) With BMS 10-11, Type I primer in the fastener holes and around the fastener heads if they are located in the external fuselage structure, the external skin of the landing gear doors, and all metal fairings which does not include wheel well structure.

NOTE: If you use BMS 10-11, Type I primer, then the fasteners must be installed before the 4-hour cure time has expired.

If you use BMS 5-95 sealant material, then install the fasteners before the pot life of the sealant has expired. Refer to 51-20-05, GENERAL 51-20-05.

- D. If you use aluminum rivets with shaved heads and are in an area with an unpainted anodized aluminum alloy surface, then you must manually apply a clear coating of Alodine 1000.

9. The Use of Solvent-Dispersed Corrosion-Inhibiting Compounds for Corrosion Protection**A. General Information about Solvent-Dispersed Corrosion-Inhibiting Compounds**

- (1) Use solvent-dispersed corrosion-inhibiting compounds to stop corrosion when the finish is damaged. These compounds can get into very small cavities and push the water out. Thus, this compound can get between mating surfaces, or between fasteners and the fastener holes where the finish is broken.
- (2) These compounds are volatile liquids which can be sprayed, swabbed or brushed on different surfaces. Corrosion inhibitors are durable materials that are not easily removed by normal use.
- (3) When you use these compounds on the external surfaces of the airplane, they can be resistant to surface cleaning for a short amount of time. But after a specified amount of time, given by your airplane maintenance schedule, it will be necessary to replace the layer of solvent-dispersed corrosion-inhibiting compound.

NOTE: Do an analysis of your airplane's flight-cycle environment. Write down where you use all of the solvent-dispersed corrosion-inhibiting compounds on the airplane, and the schedule with which they were applied. This will make sure that the airplane has sufficient corrosion protection during its service life.

- (4) The Boeing Company recommends that you use one of the following compounds.

- (a) BMS 3-23
- (b) BMS 3-29
- (c) A layer of BMS 3-26 above BMS 3-23

NOTE: Some other type of solvent-dispersed corrosion-inhibiting compounds may be satisfactory, but only if it is approved for use as a solvent-dispersed corrosion-inhibiting compound. The airline operator can approve the use of their own solvent-dispersed corrosion-inhibiting compounds, if they have experience in the use of these materials.

- (5) BMS 3-23, BMS 3-26 and BMS 3-29 are organic compounds. These compounds are nonvolatile base materials. They are mixed with a solvent to make the compound more liquid.

NOTE: These compounds do not contain silicones.

- (6) BMS 3-23, BMS 3-26, and BMS 3-29 can be applied with an airless paint spray pump, an aerosol can, or with a brush.

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(7) The three types of solvent-dispersed corrosion-inhibiting compounds are listed below.

(a) BMS 3-23

- 1) BMS 3-23 is a solvent-dispersed, water-displacing, corrosion-inhibiting compound. There are two types of BMS 3-23 compounds.
 - Type I leaves a transparent, colorless film, which can be seen by the use of an ultraviolet light.
 - Type II leaves a colored film, which can be seen under visible light by a visual inspection.
- 2) After BMS 3-23 dries, it leaves a thin layer of wax-like material on the surface.
- 3) Surfaces which have had certain types of BMS 3-23 products applied, will stay tacky, and will then collect unwanted material. Thus, those surfaces must be regularly cleaned, and then more of the BMS 3-23 must be applied.

NOTE: This does not include Dinitrol AV-8, LPS Hardcoat, or ZC023, which are not tacky after they dry.

- 4) The time interval to clean the surface, and then to apply more BMS 3-23 will change with its location on the airplane.
- 5) Refer to the Airline Maintenance Planning Document or the manufacturer's written instructions for specific application procedures.

(b) BMS 3-26

- 1) BMS 3-26 is a heavy-duty, solvent-dispersed, corrosion-inhibiting compound. There are two types of BMS 3-26 compounds.
 - Type I leaves a continuous, medium-thick, colored film which can be seen under visible light by a visual inspection.
 - Type II leaves a continuous, thick, colored film which can be seen under visible light by a visual inspection.
- 2) BMS 3-26 does not have the same ability to go into small cavities like BMS 3-23 or BMS 3-29.
- 3) Surfaces, which have had BMS 3-26 products applied, will become dry to the touch after approximately 6 hours.
- 4) After BMS 3-26 dries, it leaves a thick, translucent layer of wax-like material on the surface.
- 5) The layer of BMS 3-26 is not easily worn off. But it must be applied once again, if the surface has been cleaned.

(c) BMS 3-29

- 1) BMS 3-29 is an advanced, heavy duty, solvent-dispersed, water-displacing, corrosion-inhibiting compound. There is only one type of BMS 3-29 compound.
 - It leaves a continuous, thick, colored film, which can be seen under visible light by a visual inspection.
- 2) Surfaces which have had BMS 3-29 products applied, will become dry to the touch after approximately 4 hours.
- 3) After BMS 3-29 dries, it leaves a thick, translucent layer of wax-like material on the surface.



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- 4) The layer of BMS 3-29 is not easily worn off. But it must be applied once again, if the surface has been cleaned.
 - (8) Refer to 51-30-03, GENERAL, Figure 1/GENERAL, for the products and product suppliers that are qualified to BMS 3-23, BMS 3-26, and BMS 3-29.
 - (9) Solvent-dispersed corrosion-inhibiting compounds can be applied to those areas of the airplane structure, where corrosion has started or where it may occur at a later date.
 - (a) If corrosion is present, then apply the solvent-dispersed corrosion-inhibiting compound to the area.
 - (b) The application of these solvent-dispersed corrosion-inhibiting compounds is only a temporary measure, until the corrosion is removed from the area.
 - (10) Solvent-dispersed corrosion-inhibiting compounds will not decrease the initial torque on fasteners. But, their application should be limited to those approved areas of aluminum structure where corrosion is likely to occur. Some examples of these type of areas include:
 - (a) Surfaces that are exposed to the atmosphere during operation. Examples: the wing leading edge and trailing edge cavities, the spar chords, and the faying surface edges between the chords and the spars.
 - (b) Structure, where water might collect and not drain away. Example: Fuselage bilge area.
 - (c) Structure, which can corrode due to contact with corrosive liquids. Examples: the structures below the galleys and the lavatories.
 - (d) Rivets and bolts after their installation, when no other type of finish has been applied.
 - (e) All faying surface edges, where the paint, the primer or the sealant can in any way deteriorate.
 - (f) Areas where the decorative paint film has broken down around the fasteners. (This is to inhibit "filiform" corrosion.)
 - (g) All other locations on the airplane where corrosion has been detected.
 - (11) During the manufacture of certain airplanes, solvent-dispersed corrosion-inhibiting compounds were applied to specified locations of the airframe structure for added protection against corrosion.
 - (12) If you do rework or repair in these areas, you should apply the solvent-dispersed corrosion-inhibiting compounds again. See Figure 4/GENERAL for the locations of these areas.
 - (13) For additional procedures on the use of solvent-dispersed corrosion-inhibiting compounds to control and prevent corrosion, refer to the Boeing Corrosion Prevention Manual, D634N401.
- B. Precautions for the Use of solvent-dispersed corrosion-inhibiting Compounds

WARNING: SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS ARE APPROXIMATELY EQUAL TO KEROSENE OR ALIPHATIC NAPHTHA IN TOXICITY. TO PROTECT THE SKIN, USE THE SAME PRECAUTIONS AS FOR KEROSENE.



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(WARNING PRECEDES)

IF YOU USE THESE COMPOUNDS IN AN EXTREMELY CONFINED AREA, MECHANICAL VENTILATION IS MANDATORY. RESPIRATORY AND SKIN PROTECTION IS ALSO NECESSARY.

AS A FIRE SAFETY PRECAUTION, SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS SHOULD BE KEPT AWAY FROM ANY SURFACE THAT CAN GET TO TEMPERATURES HIGHER THAN RECOMMENDED BY THE MANUFACTURER FOR SAFETY.

SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS CONTAIN FLAMMABLE COMPONENT MATERIALS. DO NOT PERMIT THESE MATERIALS TO COME IN CONTACT WITH OPEN FLAMES, ACTIVE ELECTRICAL CIRCUITS, OR OTHER ELECTRICAL COMPONENTS. IF YOU DO NOT OBEY, A POSSIBLE FIRE AND AN EXPLOSION CAN OCCUR. THESE COMPOUNDS ALSO CONTAIN VOLATILE CARRIER MATERIALS THAT ARE VERY FLAMMABLE. THUS, YOU MUST USE THE CORRECT SAFETY PRECAUTIONS UNTIL THE COMPOUND HAS FULLY DRIED.

WHEN MIXED WITH OXYGEN, SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS ARE POTENTIALLY EXPLOSIVE. KEEP THEM CLEAR OF ALL TYPES OF OXYGEN-TYPE SYSTEM COMPONENTS.

REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS, OR SPEAK TO THE MANUFACTURER FOR THEIR HEALTH AND SAFETY INFORMATION PERTAINING TO THE USE OF THESE HAZARDOUS MATERIALS.

TO DISCARD HAZARDOUS WASTE MATERIALS, SPEAK TO THE RESPONSIBLE POLLUTION CONTROL MONITORING ORGANIZATION FOR THEIR APPLICABLE PROCEDURES.

- (1) Make sure that oxygen system components are shielded to protect them from any type of contamination.
- (2) Protect electrical connectors and electrical contacts from possible contamination.
- (3) Use a clean, dry rag to remove unwanted solvent-dispersed corrosion-inhibiting compounds from mechanisms, and their moving parts. A thin film is sufficient for corrosion protection while a buildup of these compounds can become hard at low temperatures. A large buildup can reduce the operating efficiency of the moving parts.
- (4) Protect control cables, pulleys, Teflon bearings and lubricated surfaces from the direct application of corrosion-inhibiting compounds.
 - (a) Some of the materials contain volatile hydrocarbons, which can act as a solvent on the lubricant.
 - (b) Destruction of the lubricants can result in higher than normal wear on the parts.
- (5) Use care when you apply solvent-dispersed corrosion-inhibiting compounds around seals or other areas that contain rubber materials.
 - (a) Some locations include; the door and emergency hatch seals, the grease seals in bearing assemblies, and the rubber-lined clamps for tubing and wiring.

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- (b) The solvent-dispersed corrosion-inhibiting compounds may cause the rubber seals to swell, and then cause the seals to fail.
- (c) Hydraulic fluid (Skydrol) seals can also be affected. Thus, solvent-dispersed corrosion-inhibiting compounds are not applicable for use on any type of actuator rod.
- (6) Do not apply these compounds near the engines, the engine cowling or other areas of high temperature, or where you use a firewall sealant. Solvent-dispersed corrosion-inhibiting compounds can cause deterioration to this type of sealant material.

CAUTION: REFER TO SOPM 20-41-05 IF THE INSULATION BLANKET HAS CONTAMINATION BY CORROSION-INHIBITING COMPOUNDS. THESE COMPOUNDS CAN CAUSE THE INSULATION BLANKET TO BE MORE FLAMMABLE.

- (7) Protect insulation blankets from the solvent dispersed corrosion-inhibiting compounds. Solvent-dispersed corrosion-inhibiting compounds can decrease the function of these blankets to repel water.

C. Equipment and Materials for Applying Solvent-Dispersed Corrosion-Inhibiting Compounds

- (1) Masking Tape
- (2) Solvent Materials - P-D-680 or an equivalent solvent material, refer to 51-30-03, GENERAL
- (3) Solvent Wipes - Cheesecloth, gauze, new or laundered rags, tissue paper, or any other type of absorbent material
- (4) Protective caps with an enclosure for the exposed oxygen system tubing

D. Surface Preparation

WARNING: IF THE AREA TO BE TREATED WITH SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS IS IN A VERY CONFINED AREA, THEN MECHANICAL VENTILATION IS MANDATORY. ALSO, RESPIRATORY AND SKIN PROTECTION IS NECESSARY.

CAUTION: DISCONNECT ALL SOURCES OF POWER WHEN YOU USE SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS. THESE POWER SOURCES CAN BE BATTERY-OPERATED OR ELECTRICAL EQUIPMENT.

THIS IS VERY IMPORTANT TO REMEMBER WHEN YOU ARE NEAR ANY FLAMMABLE MATERIALS, OR WHEN IT IS NECESSARY TO USE A LARGE AMOUNT OF WATER. FAILURE TO DO THIS CAN CAUSE A DANGEROUS FIRE OR A SEVERE ELECTRICAL SHOCK.

SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS, OR ANY TYPE OF HYDROCARBON, WHEN APPLIED TO A SILICONE OR ETHYLENE PROPYLENE RUBBER WILL CAUSE IT TO SWELL AND PREVENT IT FROM PERFORMING ITS FUNCTION CORRECTLY.

- (1) Remove all external power sources.
- (2) Statically ground the airplane. Refer to AMM 20-41-01 for Static Grounding Instructions.
- (3) Vacuum all necessary surfaces to remove any unwanted materials.

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- (4) Clean the surface area with an applicable solvent material.

NOTE: Clean areas that are to be treated to increase the entry of the solvent-dispersed corrosion-inhibiting compound into exposed surfaces of the structure and also into faying surfaces.

- (5) Isolate all areas that do not need to be treated with solvent-dispersed corrosion-inhibiting compounds. Use masking tape and paper, or a plastic film.
- (6) Isolate all electrical connectors to prevent any contamination of the electrical contacts.
- (7) Isolate oxygen system components from any direct or indirect contact when you apply the solvent-dispersed corrosion-inhibiting compound to the adjacent structure.
- (8) Build a protective barrier around control cables, pulleys, bearings and lubricated surfaces to protect them from solvent-dispersed corrosion-inhibiting compounds.
- (9) Allow new primer or paint to dry for a minimum of 8 hours before you apply a solvent-dispersed corrosion-inhibiting compound.
- (10) Make sure a sealant has fully cured on a surface before you can apply a solvent-dispersed corrosion-inhibiting compound.

E. How to Apply Solvent-Dispersed Corrosion-Inhibiting Compounds

NOTE: Solvent-dispersed corrosion-inhibiting compounds usually contain hydrocarbons; thus, you are permitted to apply a different compound over the old compound. This will not cause a problem because the two compounds have equivalent chemical properties.

- (1) Solvent-dispersed corrosion-inhibiting compounds contain a solvent carrier, with a low surface tension, which will help in displacing existing water from a metal surface.
- (2) As the solvent dries, a thin film is left behind, to act as a barrier to prevent a chemical reaction that causes corrosion between the metal and water, or other substances in the environment.
 - (a) Solvent-dispersed corrosion-inhibiting compound will go into cracks and crevices through capillary action. It is not necessary to use pressure spraying.
 - (b) Refer to 51-30-03, GENERAL for sources of solvent-dispersed corrosion-inhibiting compounds.
- (3) You can apply solvent-dispersed corrosion-inhibiting compounds to an area with only a general cleaning of the surface.
- (4) Solvent-dispersed corrosion-inhibiting compounds can be applied with an airless paint spray pump, or by an aerosol can or a brush.
 - (a) The location, and how well you can access an area, will show you the best method to apply a solvent-dispersed corrosion-inhibiting compound.
 - (b) Apply one coat on top of another coat, but if the initial coat is contaminated with dirt or other solids, it must be cleaned before you apply another coat over it.
 - (c) Refer to Paragraph 9.H.(3)/GENERAL for a list of solvents that you can use for cleaning solvent-dispersed corrosion-inhibiting compounds.
- (5) Subsequent layers of solvent-dispersed corrosion-inhibiting compounds can be added if the surface is still clean. If the surface is not clean, it must be cleaned before another layer is applied. Solvent-dispersed corrosion-inhibiting compounds can only be applied to areas specified by applicable engineering data.
- (6) When you apply additional finishes, such as paint, primer or sealant material, to a surface, it cannot be easily done. This is because of the penetrating properties of the solvent-dispersed corrosion-inhibiting compounds, and from possible bleed-out at the faying surfaces.

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- (7) Obey all the precautions given by the manufacturer, along with the precautions given in Paragraph 7.B./GENERAL, when you apply solvent-dispersed corrosion-inhibiting compounds.
 - (8) Apply BMS 3-23, Types I and II at a temperature range between 40 to 100°F (4 to 38°C).
 - (9) Apply BMS 3-26, Type I at a temperature range between 40 to 100°F (4 to 38°C).
 - (10) Apply BMS 3-26, Type II at a temperature range between 50 to 100°F (10 to 38°C).
 - (11) Apply BMS 3-29 at a temperature range between 40 to 100°F (4 to 38°C).
 - (12) Mechanical ventilation must be supplied when working in an enclosed area.
 - (13) Apply a continuous coat of solvent-dispersed corrosion-inhibiting compound so it will go into a jointed area by capillary action.
 - (14) Apply at a spray rate of 1 gallon per hour (3.79 liters per hour) to cover a surface at a rate of approximately 15 to 20 square feet per minute (1.4 to 1.9 square meters per minute).
 - (15) The 1 gallon per hour (3.79 liters per hour) spray rate will give a film thickness of:
 - (a) 0.002 to 0.006 inch (0.051 to 0.152 millimeter) for BMS 3-26, Type I
 - (b) 0.008 to 0.012 inch (0.203 to 0.305 millimeter) for BMS 3-26, Type II
 - (c) 0.006 to 0.010 inch (0.152 to 0.254 millimeter) for BMS 3-29
 - NOTE:** Minimum coating thicknesses for BMS 3-23 have not been established, but use a continuous coating to cover the entire surface.
 - (16) These compounds can also be brushed, or swabbed to the thicknesses shown above.
 - (17) The use of pressure equipment to apply these compounds directly to the joints is recommended.
 - (a) Allow the solvent-dispersed corrosion-inhibiting compound to remain on the surface for 60 minutes before any unwanted compound is removed.
 - (b) This will make sure that the maximum quantity of compound will go into the jointed area where the compound has been applied.
 - (c) Refer to Paragraph 9.F./GENERAL for spraying procedures and pressure equipment.
 - (18) Remove any excess solvent-dispersed corrosion-inhibiting compound from a treated surface using a clean wiper or clean gauze.
 - NOTE:** If you let more of the compound stay on the surface than is necessary, it will not give the area better corrosion protection.
 - (19) Remove all of the used masking tape, protective paper, or plastic film from the area.
 - (20) Give the area a good flow of air over the surface until the volatile solvents are removed.
 - (a) The cure time for BMS 3-23, Types I and II is approximately 1 hour.
 - (b) The cure time for BMS 3-26, Types I and II is approximately 6 hours.
 - (c) The cure time for BMS 3-29 is approximately 4 hours.
 - (21) Solvent-dispersed corrosion-inhibiting compounds contain wax compounds and are not to be applied to surfaces that have a temperature of more than 140°F (60°C).
- F. Procedures to Apply BMS 3-23, BMS 3-26 and BMS 3-29
- (1) The Spray Procedure



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- (a) The Boeing Company recommends that you apply this compound with an approved pressure pot system and an airless spray gun. The operating pressure should be approximately 45 pounds per square inch (310 KiloNewtons per square meter) or less.

NOTE: If necessary, you can use an aerosol can with a plastic nozzle extension, but The Boeing Company does not recommend this procedure to apply solvent-dispersed corrosion-inhibiting compounds. This is because of the cost and the amount of overspray supplied by the nozzle extension.

- (b) Spray equipment can be purchased from the following suppliers:

- 1) Nordson Corporation
555 Jackson St.
Amhearst, Ohio, 44001-2408
- 2) Binks Manufacturing Company
9201 West Belmont Ave
Franklin Park, Illinois, 60131-2807
- 3) Graco Incorporated
60 11th Ave, NE
PO Box 1441
Minneapolis, Minnesota, 55440
- 4) ITW DeVilbiss Industrial Spray Equipment
1724 Indian Wood Circle
Maumee, Ohio, 43537-4048

- (c) You will be able to get better access to an area if you use a spray gun extension kit and a swivel adapter so that you can change the position of the nozzle.

- (d) Use approved air atomizing equipment (a siphon or a pressure pot) when there is sufficient access to apply a wet coat of sealant. A spray with a nozzle-to-surface distance of no more than 12 inches (30.5 cm) is necessary for wet application, and can be done by the use of an applicable nozzle extension.

(2) The Brush Procedure

- (a) Apply the compound with a paint brush or a clean cloth. Use this procedure for smaller areas, or where extreme caution is necessary. Do not apply the solvent-dispersed corrosion-inhibiting compound to an unwanted area.
- (b) For larger areas, or where access is not a problem, the spray procedure is recommended.

G. Exterior Discoloration Caused by Solvent-Dispersed Corrosion-Inhibiting Compounds

- (1) When you use a large amount of solvent-dispersed corrosion-inhibiting compound on the internal surfaces of the airplane, some discoloration of the external surfaces of the airplane may occur. This is called "bleed-through", and can occur because these materials can easily go through the mechanically fastened structural joints to the external surface of the airplane.
- (2) A "bleed-through" situation can be expected at fastener locations that are not fluid-tight. This is normal and it is not necessary to replace the fasteners. The tiny passages will seal themselves in a short time.
- (3) Solvent-dispersed corrosion-inhibiting compounds can bleed-through and stain the decorative finish of the airplane. A difference in oxidation that you can see on the external surface can occur between those areas where you apply the compound, and those areas where you do not.

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- (4) It is recommended that you frequently clean the airplane in those areas where streaking of the solvent-dispersed corrosion-inhibiting compound occurs, or if it looks like it will leave a permanent stain on the surface of the airplane.

H. Removal of Solvent-Dispersed Corrosion-Inhibiting Compounds

NOTE: The complete removal of solvent-dispersed corrosion-inhibiting compound is necessary before you can try to paint or apply a sealant to a surface.

WARNING: SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUNDS ARE APPROXIMATELY EQUAL TO KEROSENE OR ALIPHATIC NAPHTHA IN TOXICITY. TO PROTECT THE SKIN, USE THE SAME PRECAUTIONS AS FOR KEROSENE.

IF YOU USE THESE COMPOUNDS IN AN EXTREMELY CONFINED AREA, MECHANICAL VENTILATION IS MANDATORY. RESPIRATORY AND SKIN PROTECTION IS ALSO NECESSARY.

REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS, OR SPEAK TO THE MANUFACTURER FOR THEIR HEALTH AND SAFETY INFORMATION PERTAINING TO THE USE OF THESE HAZARDOUS MATERIALS.

TO DISCARD HAZARDOUS WASTE MATERIALS, SPEAK TO THE RESPONSIBLE POLLUTION CONTROL MONITORING ORGANIZATION FOR THEIR APPLICABLE PROCEDURES.

- (1) A complete solvent cleaning is also necessary before you can do a penetrant inspection of the area.
- (2) Give the area a good flow of air until all of the solvent material is gone.
- (3) Use the following solvent materials to remove solvent-dispersed corrosion-inhibiting compounds:
 - (a) Aliphatic Naphtha
 - (b) Biogenic SE377C
 - (c) Citra-Safe

NOTE: Methyl Ethyl Ketone (MEK) or acetone is not recommended by The Boeing Company.

10. Repairs for Finish Cracks on Graphite Composite Parts

A. General

- (1) If you have finish cracks:
 - (a) Moisture can go into the cracks in the finish, which can cause the finish to come off.
 - (b) Sunlight can damage the bare composite surface at the locations where the finish has come off.
- (2) Cracks in the resin without fiber damage are not a flight safety problem.



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B. Interim Repair

NOTE: The aileron has operational balance limits. Measure the static balance moment after each interim repair. The static balance moment must not be larger than the operational balance limit. Refer to 51-60-01 for the balancing procedure.

If three interim repairs on a given component have been done one after the other, you must do a permanent repair, then measure the static balance moment.

- (1) Find the level of damage.

WARNING: WHEN YOU WORK WITH SOLVENTS AND COMPOSITE MATERIALS, USE APPROVED GLOVES, PROTECTIVE CLOTHING, AND MECHANICAL VENTILATION OR RESPIRATORY PROTECTION. USE EYE PROTECTION.

KEEP THE SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. AN EXPLOSION COULD OCCUR.

CAUTION: DO NOT USE PAINT STRIPPERS TO REMOVE FINISH. PAINT STRIPPERS WILL CAUSE DAMAGE TO THE RESIN SYSTEM. WHEN THE SURFACE IS SANDED, FIBERS IN THE COMPOSITE OR THE SURFACE BELOW THE BARE COMPOSITE MUST NOT BE DAMAGED OR PERMITTED TO BE OPEN TO THE AIR. A DECREASE IN THE STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. FIBERS WHICH HAVE NO PROTECTION OR ARE DAMAGED MUST BE REPAIRED.

- (2) Use No. 240 or finer Scotch-Brite or abrasive paper to remove cracks in the finish. Total removal of the top layer of finish is not necessary. Do not sand into the fibers.

NOTE: The recommended abrasive is No. 240 Scotch-Brite.

- (3) Use a clean cheesecloth to clean the area with solvent. Wipe the area dry with a clean cheesecloth before the solvent dries.
- (4) Apply a finish to the repair area. Refer to SRM 51-70-17, Paragraph 3.H

C. Permanent Repairs

- (1) General

- (a) There are two permanent repair alternatives. The first repair alternative uses BMS 5-95. BMS 5-95 will seal the cracks so that water cannot get into the composite. The second repair alternative uses a BMS 9-3 wet layup. Refer to 51-30-03, GENERAL for the sources of repair materials.

- (2) Alternative 1: BMS 5-95 Permanent Repair

- (a) Find the level of damage.

WARNING: WHEN YOU WORK WITH SOLVENTS AND COMPOSITE MATERIALS, USE APPROVED GLOVES, PROTECTIVE CLOTHING, AND MECHANICAL VENTILATION OR RESPIRATORY PROTECTION. USE EYE PROTECTION.



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STRUCTURAL REPAIR MANUAL

(WARNING PRECEDES)

KEEP THE SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS.
AN EXPLOSION COULD OCCUR.

CAUTION: DO NOT USE PAINT STRIPPERS TO REMOVE FINISH. PAINT STRIPPERS WILL CAUSE DAMAGE TO THE RESIN SYSTEM. WHEN THE SURFACE IS SANDED, FIBERS IN THE COMPOSITE OR THE SURFACE BELOW THE BARE COMPOSITE MUST NOT BE DAMAGED OR PERMITTED TO BE OPEN TO THE AIR. A DECREASE IN THE STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. FIBERS WHICH HAVE NO PROTECTION OR ARE DAMAGED MUST BE REPAIRED.

WHEN YOU USE ALTERNATIVE MEDIA BLASTING PROCEDURES: THERE MUST BE NO FIBER DAMAGE WHEN A 10X MAGNIFIER IS USED. AFTER THE FINISH IS REMOVED, DO AN ULTRASONIC THROUGH TRANSMISSION TEST. REFER TO NDT 51-00-03, PART 4.

WHEN YOU DO ABRASIVE BLAST PROCEDURES IN AREAS WHERE LUBRICATION FLUIDS OR GREASE ARE APPLIED, USE CARE TO PREVENT CONTAMINATION OF THE LUBRICANT WITH THE BLAST RESIDUE. THIS CONTAMINATION CAN AFFECT THE LUBRICATION PROPERTIES AND THE RESULT CAN BE INCREASED WEAR OF THE LUBRICATED PARTS.

- (b) Remove all finishes to the graphite composite surface. Use No. 240 or finer Scotch-Brite or abrasive paper to remove the finishes. Do not sand into the fibers.

NOTE: The recommended abrasive is No. 240 Scotch-Brite.

Use of alternative media blasting procedures for finish removal is structurally satisfactory. The procedure must agree with the requirements given in D6-55564, "Requirements for Alternative Paint Stripping Processes".

- (c) Use a clean cheesecloth to clean the area with solvent. Wipe the area dry with a clean cheesecloth before the solvent dries.
- (d) There are two alternatives to find the level of damage:
 - 1) Use a 5X to 10X magnifier to examine the bare composite surface for surface cracks.
 - 2) Apply pinhole filler to the bare composite surface. Use a rigid flat edge to remove the unwanted filler.
- (e) There are cracks in the surface below the bare composite:
 - 1) If you see a white pattern on the surface.
 - 2) If that pattern did not occur when the surface was sanded.
- (f) If there are no cracks, apply a finish to the repair area. Refer to SRM 51-70-17, Paragraph 3.H.
- (g) If there are cracks, continue the procedure.
- (h) Mix BMS 5-95 Class F spray sealant base and accelerator to a ratio of 15 to 1 by weight (a ratio of 100 to 6.9 by volume). Add 20 percent of a 50/50 (by volume) mixture of MEK and Toluene to make the mixture thinner. The pot life of the material mixture is 1.5 hours at 75°F (24°C).



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- (i) Use an air spray at a minimum of 50 psi to apply two layers of BMS 5-95 to the repair surface. Each layer must be applied continuously to a wet film thickness of 0.005-0.008 of an inch.

Let the surface dry in the air for 15 minutes after the first layer is applied. The dry film thickness of the two layers must be 0.006-0.010 of an inch.

- (j) Let the surface dry for a minimum of 2 hours at 60-130°F (16-54°C) after the second layer is applied.
- (k) Apply a finish to the repair area. Refer to SRM 51-70-17, Paragraph 3.H. The use of primer is not necessary.

(3) Alternative II: BMS 8-301/BMS-9-3 Fiberglass Wet Layup Permanent Repair (Method 1)

- (a) Find the level of damage.

WARNING: WHEN YOU WORK WITH SOLVENTS AND COMPOSITE MATERIALS, USE APPROVED GLOVES, PROTECTIVE CLOTHING, AND MECHANICAL VENTILATION OR RESPIRATORY PROTECTION. USE EYE PROTECTION.

KEEP THE SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. AN EXPLOSION COULD OCCUR.

CAUTION: DO NOT USE PAINT STRIPPERS TO REMOVE FINISH. PAINT STRIPPERS WILL CAUSE DAMAGE TO THE RESIN SYSTEM. WHEN THE SURFACE IS SANDED, FIBERS IN THE COMPOSITE OR THE SURFACE BELOW THE BARE COMPOSITE MUST NOT BE DAMAGED OR PERMITTED TO BE OPEN TO THE AIR. A DECREASE IN THE STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. FIBERS WHICH HAVE NO PROTECTION OR ARE DAMAGED MUST BE REPAIRED.

WHEN YOU USE ALTERNATIVE MEDIA BLASTING PROCEDURES: THERE MUST BE NO FIBER DAMAGE WHEN A 10X MAGNIFIER IS USED. AFTER THE FINISH IS REMOVED, DO AN ULTRASONIC THROUGH TRANSMISSION TEST. REFER TO NDT 51-00-03, PART 4.

WHEN YOU DO ABRASIVE BLAST PROCEDURES IN AREAS WHERE LUBRICATION FLUIDS OR GREASE ARE APPLIED, USE CARE TO PREVENT CONTAMINATION OF THE LUBRICANT WITH THE BLAST RESIDUE. THIS CONTAMINATION CAN AFFECT THE LUBRICATION PROPERTIES AND THE RESULT CAN BE INCREASED WEAR OF THE LUBRICATED PARTS.

- (b) Remove all finishes to the graphite composite surface. Use No. 240 or finer Scotch-Brite or abrasive paper to remove the finishes. Do not sand into the fibers.

NOTE: The recommended abrasive is No. 240 Scotch-Brite. Use of alternative media blasting procedures for finish removal is structurally satisfactory. The procedure must agree with the requirements given in DOCUMENT D6-55564

- (c) Use a clean cheesecloth to clean the area with solvent. Wipe the area dry with a clean cheesecloth before the solvent dries.

- (d) There are two alternatives to find the level of damage:

- 1) Use a 5X to 10X magnifier to examine the bare composite surface for surface cracks.

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- 2) Apply pinhole filler to the bare composite surface. Use a rigid flat edge to remove the unwanted filler.
 - (e) There are cracks in the surface below the bare composite:
 - 1) If you see a white pattern on the surface.
 - 2) If that pattern did not occur when the surface was sanded.
 - (f) If there are no cracks, apply a finish to the repair area. Refer to SRM 51-70-17, Paragraph 3.H.
 - (g) If there are cracks, continue the procedure.
 - (h) Cut a piece of BMS 9-3 Style 120 fiberglass as large as the tool side surface area to be repaired. Weigh the piece of fiberglass. This is the weight of laminating resin necessary to impregnate the fabric.
 - (i) Mix the BMS 8-301 Class 1 (Hysol EA 9390A) or BMS 8-301 Class 2 (FR 7020) resin (part A) and hardener (part B) to the proportions given in the manufacturer's instructions. Mix parts A and B by hand for 2 to 3 minutes to cause a uniform mixture.
 - (j) Weigh out the quantity of resin calculated in Paragraph 10.C.(3)(h)/GENERAL. This resin must be used less than 2 hours after it is mixed.
 - (k) Brush apply an initial thin layer of resin to fill in any cracks or areas that have been pushed in.
 - (l) Apply the BMS 9-3 Style 120 fiberglass. Put the remaining resin over the fiberglass. Use a tool with a rigid, flat edge to equally apply the resin over the fiberglass. Put one layer of solid FEP parting film over the side of the repair area that the tool is used on. Use the tool to apply the resin as equally as possible. Remove as much porosity as possible.
Push the surface resin to the edges.
 - (m) Vacuum bag the repair. Refer to SRM 51-70-17, Paragraph 3.F. for Class 1 resin. Refer to SRM 51-70-17, Paragraph 4.G. for Class 2 resin.
 - (n) Cure the repair. Refer to SRM 51-70-17, Paragraph 3.G. for Class 1 resin. Refer to SRM 51-70-17, Paragraph 4.G for Class 2 resin.
- NOTE:** It is optional to cure the Class 1 resin repair at $180 \pm 10^{\circ}\text{F}$ ($82 \pm 6^{\circ}\text{C}$).
- (o) Visually examine the repair for porosity on the surface.
 - (p) If there is porosity on the surface, make the surface rough with No. 240 or finer Scotch-Brite or abrasive paper. Apply resin to the surface. Use a tool with a rigid, flat edge to equally apply the resin. Cure the resin. Refer to SRM 51-70-06, Paragraph 3.J. for Class 2 resin.
 - (q) Apply a finish to the repair area. Refer to SRM 51-70-17, Paragraph 3.H. for Class 1 resin. Refer to SRM 51-70-03, Paragraph 4.H. for Class 2 resin.
- (4) Alternative II: BMS 8-301/BMS-9-3 Fiberglass Wet Layup Permanent Repair (Method 2)
- (a) Find the level of damage.

WARNING: WHEN YOU WORK WITH SOLVENTS AND COMPOSITE MATERIALS, USE APPROVED GLOVES, PROTECTIVE CLOTHING, AND MECHANICAL VENTILATION OR RESPIRATORY PROTECTION. USE EYE PROTECTION.



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(WARNING PRECEDES)

KEEP THE SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS.
AN EXPLOSION COULD OCCUR.

CAUTION: DO NOT USE PAINT STRIPPERS TO REMOVE FINISH. PAINT STRIPPERS WILL CAUSE DAMAGE TO THE RESIN SYSTEM. WHEN THE SURFACE IS SANDED, FIBERS IN THE COMPOSITE OR THE SURFACE BELOW THE BARE COMPOSITE MUST NOT BE DAMAGED OR PERMITTED TO BE OPEN TO THE AIR. A DECREASE IN THE STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. FIBERS WHICH HAVE NO PROTECTION OR ARE DAMAGED MUST BE REPAIRED.

WHEN YOU USE ALTERNATIVE MEDIA BLASTING PROCEDURES: THERE MUST BE NO FIBER DAMAGE WHEN A 10X MAGNIFIER IS USED. AFTER THE FINISH IS REMOVED, DO AN ULTRASONIC THROUGH TRANSMISSION TEST. REFER TO NDT 51-00-03, PART 4.

WHEN YOU DO ABRASIVE BLAST PROCEDURES IN AREAS WHERE LUBRICATION FLUIDS OR GREASE ARE APPLIED, USE CARE TO PREVENT CONTAMINATION OF THE LUBRICANT WITH THE BLAST RESIDUE. THIS CONTAMINATION CAN AFFECT THE LUBRICATION PROPERTIES AND THE RESULT CAN BE INCREASED WEAR OF THE LUBRICATED PARTS.

- (b) Remove all finishes to the graphite composite surface. Use No. 240 or finer Scotch-Brite or abrasive paper to remove the finishes. Do not sand into the fibers.

NOTE: The recommended abrasive is No. 240 Scotch-Brite.

Use of alternative media blasting procedures for finish removal is structurally satisfactory. The procedure must agree with the requirements given in D6-55564, "Requirements for Alternative Paint Stripping Processes".

- (c) Use a clean cheesecloth to clean the area with solvent. Wipe the area dry with a clean cheesecloth before the solvent dries.
- (d) There are two alternatives to find the level of damage:
 - 1) Use a 10X magnifier to examine the bare composite surface for surface cracks.
 - 2) Apply pinhole filler to the bare composite surface. Use a rigid flat edge to remove the unwanted filler.
- (e) There are cracks in the surface below the bare composite:
 - 1) If you see a white pattern on the surface.
 - 2) If that pattern did not occur when the surface was sanded.
- (f) If there are no cracks, apply a finish to the repair area. Refer to SRM 51-70-17, Paragraph 3.H. for Class 1 resin. Refer to SRM 51-70-06, Paragraph 3.H. for Class 2 resin.
- (g) If there are cracks, continue the procedure.
- (h) Cut one piece of fabric the same dimension as the repair area. Cut two pieces of solid parting film, make them 3 inches larger (on each side) than the fabric.
- (i) Put one piece of solid parting film on a smooth surface. Hold the solid parting film to the surface with tape.



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- (j) Weigh the fabric to be impregnated. Multiply the weight by 1.3. This is the weight of laminating resin necessary to impregnate the fabric.

NOTE: The resin to fiber content will be approximately 1 to 1 by weight after the parting film is separated.

- (k) Mix the BMS 8-301 Class 1 (Hysol EA 9390A) or BMS 8-301 Class 2 (FR 7020) resin (part A) and hardener (part B) to the proportions given in the manufacturer's instructions. Mix parts A and B by hand for 2 to 3 minutes to cause a constant mixture.
- (l) Put half of the laminating resin in the center of the solid parting film.
- (m) Put the fabric above the solid parting film and laminating resin.
- (n) Put the remaining laminating resin over fabric in the center.
- (o) Put the second piece of solid parting film above the fabric. Make sure the solid parting film is smooth.
- (p) Sweep the resin from the center to the edge of the fabric. Make the resin and fabric smooth. Keep all of the resin in the fabric.
- (q) Remove the parting film and apply the impregnated fabric to the repair area.
- (r) Vacuum bag the repair. Refer to 51-70-17, GENERAL, for Class 1 resin. Refer to 51-70-03, GENERAL for Class 2 resin.
- (s) Cure the repair. Refer to 51-70-17, GENERAL for Class 1 resin. Refer to 51-70-03, GENERAL for Class 2 resin.

NOTE: It is optional to cure the Class 1 resin repair at $180 \pm 10^{\circ}\text{F}$ ($82 \pm 6^{\circ}\text{C}$).

- (t) Visually examine the repair for porosity on the surface.
- (u) If there is porosity on the surface, make the surface rough with No. 240 or finer Scotch-Brite or abrasive paper. Apply resin to the surface. Use a tool with a rigid, flat edge to equally apply the resin. Cure the resin. Refer to 51-70-06, GENERAL for Class 2 resin.
- (v) Apply a finish to the repair area. Refer to 51-70-17, GENERAL for Class 1 resin. Refer to 51-70-03, GENERAL for Class 2 resin.

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MATERIAL	TREATMENT OF MATING SURFACES OTHER THAN THOSE TO BE BONDED OR SITUATED IN INTEGRAL FUEL TANKS, INCLUDING THOSE EXPOSED TO HYDRAULIC FLUID B C		SURFACES TO BE STRUCTURALLY BONDED	SURFACES IN INTEGRAL FUEL TANKS
	SIMILAR MATERIALS A	DISSIMILAR MATERIALS A D		
ALUMINUM ALLOYS E	APPLY A CHEMICAL CONVERSION COATING (SEE PARA 2) AND APPLY ONE COAT OF BMS 10-11, TYPE I PRIMER TO EACH SUR- FACE	APPLY A CHEMICAL CONVERSION COATING (SEE PARA 2) AND APPLY TWO COATS OF BMS 10-11, TYPE I PRIMER TO EACH SURFACE F	REFER TO 51-70-09	REFER TO 51-20-05
NON-CORROSION RESISTANT STEEL	CADMIUM PLATE (REFER TO COMPO- NENT MAINTENANCE CHAPTER 20) AND APPLY ONE COAT OF BMS 10-11, TYPE 1 PRIMER TO EACH SURFACE	CADMIUM PLATE G (REFER TO COMPO- NENT MAINTENANCE CHAPTER 20) AND APPLY TWO COATS OF BMS 10-11, TYPE 1 PRIMER TO EACH SURFACE		
CORROSION RESISTANT STEEL (CRES)	NONE REQUIRED	CADMIUM PLATE G (REFER TO COMPO- NENT MAINTENANCE CHAPTER 20) AND APPLY TWO COATS OF BMS 10-11, TYPE 1 PRIMER TO EACH SURFACE		
OTHER METALS NOT LISTED ABOVE H	APPLY TWO COATS OF BMS 10-11, TYPE 1 PRIMER TO EACH SURFACE	APPLY TWO COATS OF BMS 10-11, TYPE 1 PRIMER TO EACH SURFACE		
MATERIALS LISTED IN FIGURE 2 GROUP IV OTHER THAN CRES OR GRAPHITE	NONE REQUIRED	APPLY TWO COATS OF BMS 10-11, TYPE 1 PRIMER TO EACH SURFACE		
GRAPHITE	NONE REQUIRED	BOND ONE PLY OF FIBERGLASS FABRIC AND APPLY ONE COAT OF BMS 10-11 TYPE I PRIMER TO EACH SURFACE UP TO 4.0 AWAY FROM DIS- SIMILAR MATERIAL. PROTECT CUT EDGES WITHIN 4.0 OF DIS- SIMILAR MATERIAL WITH BMS 5-92 ADHESIVE	REFER TO 51-70-03, 51-70-04, 51-70-05, OR 51-70-17	

Protective Treatment of Mating Surfaces
Figure 1 (Sheet 1 of 2)



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NOTES

- A** REFER TO FIG. 2 FOR GROUPING OF SIMILAR AND DISSIMILAR MATERIALS.
- B** ALL NON-BONDED FUSELAGE, WING, AND ENGINE PYLON SKIN FAYING SURFACES REQUIRE A FAYING SURFACE SEAL APPLIED ACCORDING TO 51-20-05 IN ADDITION TO PRIMER.
- C** HYDRAULIC FLUID, FIRE RESISTANT, BMS 3-11
- D** ALL NON-BONDED FAYING SURFACES OF DISSIMILAR METALS REQUIRE A FAYING SURFACE SEAL APPLIED ACCORDING TO 51-20-05 IN ADDITION TO PRIMER. FAY SEALED SURFACES REQUIRE ONLY ONE PRIMER COAT.
- E** WHEN PRACTICAL, IT IS PREFERABLE THAT BARE ALUMINUM SURFACES BE CHROMIC ACID ANODIZED. REFER TO SOPM 20-43-01 (D6-51702).
- F** ALUMINUM ALLOYS IN CONTACT WITH GRAPHITE REQUIRE A CHEMICAL CONVERSION COATING TREATMENT, ONE COAT OF BMS 10-79 TYPE III PRIMER AND ONE COAT OF BMS 10-60 TYPE I ENAMEL. DO NOT USE CLAD 7075 IN CONTACT WITH GRAPHITE.
- G** CADMIUM PLATE IS NOT PERMITTED TO BE IN CONTACT WITH GRAPHITE MATERIAL.
- H** ANODIZE REWORKED MAGNESIUM SURFACES PRIOR TO APPLICATION OF PRIMER. REFER TO SOPM 20-43-01 (D6-51702).

**Protective Treatment of Mating Surfaces
Figure 1 (Sheet 2 of 2)**



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STRUCTURAL REPAIR MANUAL

GROUP I	MAGNESIUM AND ITS ALLOYS. ALUMINUM ALLOYS 1100, 5052, 5056, 5356, 6061, 6063. BERYLIUM
GROUP II	CADMIUM, ZINC, ALUMINUM AND THEIR ALLOYS (INCLUDES GROUP I ALUMINUM ALLOYS) A
GROUP III	IRON, LEAD, TIN AND THEIR ALLOYS (EXCEPT CORROSION RESISTANT STEEL) B . DIFFUSED NICKEL-CADMIUM
GROUP IV	COPPER, CHROMIUM, NICKEL, SILVER, GOLD, PLATINUM, TITANIUM AND THEIR ALLOYS. CORROSION RESISTANT STEEL B . COBALT AND RHODIUM AND THEIR ALLOYS. MONEL, INCONEL, BRASS, BRONZE. GRAPHITE FIBER, FABRIC, OR TAPE C
MEMBERS OF ANY ONE GROUP ARE SIMILAR. MEMBERS OF DIFFERENT GROUPS ARE DISSIMILAR.	

NOTES

- A** EXCEPT FOR 5056 RIVETS DRIVEN IN 2024, 2224 OR 2324 ALUMINUM ALLOYS
- B** CORROSION RESISTANT STEEL CONTAINS 14% OR MORE CHROMIUM
- C** GRAPHITE IS AN ELECTRICALLY CONDUCTIVE MATERIAL EVEN THOUGH IT IS CLASSIFIED AS A NON-METAL

Classification of Dissimilar Materials
Figure 2

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FASTENER MATERIAL IN CONTACT WITH STRUCTURE	MATERIAL IN CONTACT WITH FASTENER			
	MAGNESIUM AND MAGNESIUM ALLOYS	ALUMINUM ALLOYS, CAD- MIUM AND ZINC PLATE	LEAD, TIN, BARE IRON AND CARBON OR LOW ALLOY STEELS	CORROSION RESISTANT STEELS, NICKEL AND COBALT BASE ALLOYS, TITANIUM, COPPER, BRASS, CHROME PLATE AND GRAPHITE
ALUMINUM EXCEPT 5056	A	B	A	A F
ALUMINUM ALLOY 5056	B	E	A	A F
CADMIUM OR ZINC PLATE	A	C	A	D F
CHROME PLATE	A	A	A	B F
UNPLATED CORROSION RESISTANT STEEL	A	A	A	G
NICKEL OR COBALT BASE ALLOYS	A	A	A	G
UNPLATED TITANIUM	A	A	A	B

NOTES

- REFER TO PAR. 5 FOR REQUIRED PROTECTIVE TREATMENT

A PROTECTIVE TREATMENT IS NECESSARY

B PROTECTIVE TREATMENT IS NOT NECESSARY

C PROTECTIVE TREATMENT IS UNNECESSARY EXCEPT FOR CADMIUM PLATED ALLOY STEEL BOLTS THROUGH ALUMINUM ALLOYS IN CRITICAL CORROSION AREAS

D PROTECTIVE TREATMENT NECESSARY EXCEPT FOR CORROSION RESISTANT STEEL FASTENERS IN MATERIALS LISTED IN FIG. 2 GROUP IV. DO NOT INSTALL CADMIUM PLATED FASTENERS IN TITANIUM STRUCTURE

E PROTECTIVE TREATMENT IS UNNECESSARY EXCEPT FOR 5056 RIVETS DRIVEN IN 2024, 2224 AND 2324 ALUMINUM ALLOYS

F NOT ALLOWED IN GRAPHITE MATERIAL

G PROTECTIVE TREATMENT IS UNNECESSARY EXCEPT FOR FASTENERS INSTALLED IN GRAPHITE MATERIAL

**Protective Treatment for Fastener Installation
Figure 3**



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FUSELAGE (REF DWG 140N3600) [B]	INTERIOR	<ol style="list-style-type: none">1. ALL METALLIC STRUCTURE (OTHER THAN THE MONOCOQUE) BELOW THE PASSENGER FLOOR.2. ALL MONOCOQUE STRUCTURES BELOW THE PASSENGER FLOOR INCLUDING DOORS, BELOW & ABOVE.3. UPPER SURFACE OF THE PRESSURE DECK ASSEMBLY.4. THE SURROUNDING STRUCTURE TO ONE BAY AWAY FROM DOORWAYS, GALLEYS AND LAVATORIES.5. INSIDE OF THE KEEL BEAM.6. FORWARD AND AFT SURFACES OF THE FORWARD PRESSURE BULKHEAD ASSEMBLY.7. AFT SURFACES OF THE AFT WHEEL WELL BULKHEAD BELOW THE PRESSURE DECK.8. BILGE AREA OF FUSELAGE, INBOARD SIDE OF S-25R TO INBOARD SIDE OF S-25L, FROM STA 200 (AFT SIDE OF FORWARD PRESSURE BULKHEAD) TO STA 900 (FORWARD SIDE OF FRONT SPAR BULKHEAD) [A]9. BILGE AREA OF FUSELAGE, INBOARD SIDE OF S-25R TO INBOARD SIDE OF 25L, FROM STA 1180 (AFT SIDE OF WHEELWELL BULKHEAD) TO STA 1720 (AFT PRESSURE BULKHEAD) [A]10. KEEL BEAM BOX, INTERIOR AND EXTERIOR OF BOX, FROM STA 900 (FRONT SPAR BULKHEAD) TO STA 1180 (WHEELWELL BULKHEAD) [A]
	EXTERIOR	<ol style="list-style-type: none">1. EXTERIOR SIDE OF MONOCOQUE SKIN UNDER THE WING TO BODY FAIRING.2. WING/BODY FAIRING ATTACHMENT STRUCTURE.
EMPENNAGE (REF DWGS 170N3219 & 180N3501) [B]	INTERIOR	<ol style="list-style-type: none">1. ALL METALLIC INTERIOR SURFACES OF THE SECTION 48 MONOCOQUE FORWARD OF THE APU FIREWALL.2. FORWARD AND AFT SURFACES OF THE AFT PRESSURE BULKHEAD ASSEMBLY.3. ALL INTERNAL SURFACES OF THE VERTICAL FIN AND HORIZONTAL STABILIZER AFT TORQUE BOX.
	EXTERIOR	<ol style="list-style-type: none">1. FORWARD SURFACE OF THE FRONT SPAR ASSEMBLY. (VERTICAL FIN AND HORIZONTAL STABILIZER)2. FIXED TRAILING EDGE CAVITY (VERTICAL FIN AND HORIZONTAL STABILIZER)3. CONTROL SURFACE BALANCE WEIGHTS.4. FORWARD SURFACE OF STA 1720 PRESSURE BULKHEAD BELOW THE PASSENGER FLOOR (WL 208.1) [A]

NOTES

[A] APPLY BMS 3-29 SOLVENT-DISPERSED CORROSION-INHIBITING COMPOUND.

[B] APPLY BMS 3-23, TYPE II OR BMS 3-29, EXCEPT AS NOTED BY [A].

The Application of Solvent-Dispersed Corrosion-Inhibiting Compounds Figure 4 (Sheet 1 of 2)



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WING CENTER SECTION (REF DWG 110N3202) B	INTERIOR	1. UPPER AND LOWER SURFACES OF UPPER AND LOWER PANEL ASSEMBLIES (RESPECTIVELY). 2. ALL INTERIOR SURFACES. 3. FORWARD SURFACES OF FRONT SPAR ASSEMBLY, AFT SURFACES BELOW LOWER PANEL ASSEMBLY ONLY. 4. AFT SURFACES OF THE REAR SPAR ASSEMBLY. 5. UPPER SURFACE OF PRESSURE DECK AND WING CENTER SECTION FROM STA 1020 TO STA 1060 A
	EXTERIOR	1. DRY BAYS 2. CONTROL SURFACE BALANCE WEIGHT ASSEMBLIES. 1. FORWARD AND AFT SURFACES OF FRONT AND REAR SPAR ASSEMBLIES (RESPECTIVELY). 2. WING TIP

The Application of Solvent-Dispersed Corrosion-Inhibiting Compounds
Figure 4 (Sheet 2 of 2)



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - HEAT TREAT VERIFICATION - HARDNESS AND CONDUCTIVITY TESTING

1. Applicability

- A. The information in this subject can be found in Boeing Process Specifications BAC5617 and BAC5946.

NOTE: Refer to Boeing Process Specification BAC5602 for heat treatment of aluminum alloys. Refer to Boeing Process Specification BAC5617 for heat treatment of alloy steels. Refer to Boeing Process Specification BAC5619 for heat treatment of corrosion resistant steels.

2. General

- A. As an alternative to the procedure that follows, you can refer to NDT Part 6, 51-00-18 Electrical Conductivity Measurement for Aluminum, or Boeing Process Specification BAC5650 Hardness Testing.
- B. The heat treat condition of materials can be identified by running comparative tests with samples of known conditions. Heat treat identification can be made with portable hardness testers (which indent the part being tested) or with eddy current conductivity tests. Both types of tests require access to only one side of the test part. In many cases, hardness tests alone do not always give satisfactory results. For better results, do both hardness tests and conductivity tests (especially when assessing fire-damaged structure). Refer to 51-20-03, GENERAL for Fire Damage Evaluation.
- C. The portable hardness testers that follow, require access to only one side of the part. (Refer to Figure 1/GENERAL.)
- (1) New Age Rockmate from New Age Industries, Willow Grove, PA (Figure 1 (Sheet 1), Detail I). The Rockmate can take readings in various hardness scales for use on both aluminum and steel. The Rockmate is the most accurate of the listed instruments.
 - (2) The Microdur from Krautkramer Branson, Lewiston, PA (Figure 1 (Sheet 1), Detail II). The Microdur can take readings in the Rockwell B (aluminum), and C (steel) scales.
 - (3) New Age MRD1 (formerly Ernst Portable Hardness Tester models RAR and RBR), from New Age Industries (Figure 1 (Sheet 2), Detail III). The MRD1 can take readings in the Rockwell A (steel) and B (aluminum) scales. It requires samples of known hardness for calibration.
 - (4) Barcol Tester from Barber-Coleman Co., Rockford, IL (Figure 1 (Sheet 2), Detail IV). The Barcol Tester does not give a direct hardness number. It does give a dial reading which must be compared to a dial reading taken on a sample of known hardness. The Barcol is not recommended for use on steel because of its limited dial range for hard materials.

3. References

Reference	Title
51-20-03, GENERAL	Fire Damage Evaluation
NDT Part 6, 51-00-18	Electrical Conductivity Measurement of Aluminum

4. Procedure

- A. Do the hardness tests using a portable hardness tester as follows:
- (1) Remove any protective finishes from an area approximately 1/2 inch in diameter to gain access to the bare metal.

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CAUTION: GRINDING MUST NOT BE USED TO REMOVE PLATING MATERIALS. CHROMIUM OR NICKEL PLATING MAY BE PRESENT. IF PLATING RESISTS REMOVAL, REMOVE USING STANDARD METHODS AND PROCEDURES. IF NECESSARY, POSITIVELY IDENTIFY THE PLATING AS DESCRIBED IN SRM 51-10-02. DO NOT CHEMICAL SPOT TEST IN AREAS WHERE PLATING IS REMOVED.

- (2) Check calibration of instrument per manufacturers instructions.

NOTE: The ASTM specifications that follow give data for the test blocks that are used as reference standards. These test blocks can also be purchased from the manufacturer of the test equipment. ASTM E 10 Brinell Hardness of Metallic Materials ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

- (a) For direct readout instruments, check calibration against similar materials of known hardness.
- (b) For Barcol instruments, determine the scale acceptance limits on materials of known hardness.

CAUTION: AVOID SIDE THRUST ON POINT OF INDENTER WHEN APPLYING PRESSURE.

- (3) Hold the indenter perpendicular to the surface and apply pressure.
- (4) Take several readings over the surface of the structure being tested.
- (5) Determine from Figure 2/GENERAL if the material meets the heat treat requirements of the metal.

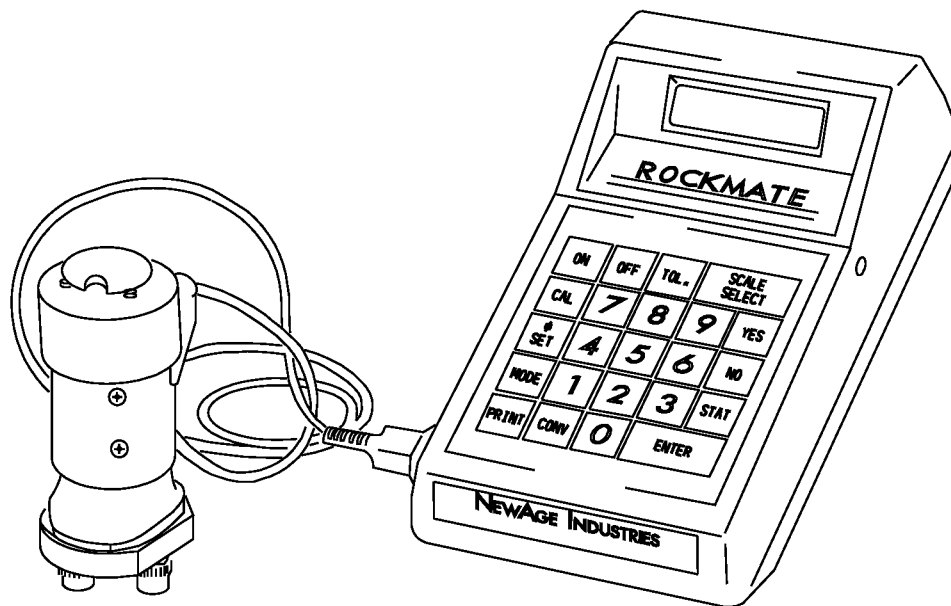
B. Eddy current methods may also be used to evaluate material heat treat.

- (1) Detailed procedures for the use of conductivity testing (equipment required, test area preparation, instrument calibration, inspection procedure) to evaluate the heat treat condition of aluminum are contained in NDT Part 6, 51-00-18.
- (2) Determine from Figure 2/GENERAL the conductivity values (percent IACS) for the material being tested (alloy, temper, bare or clad).

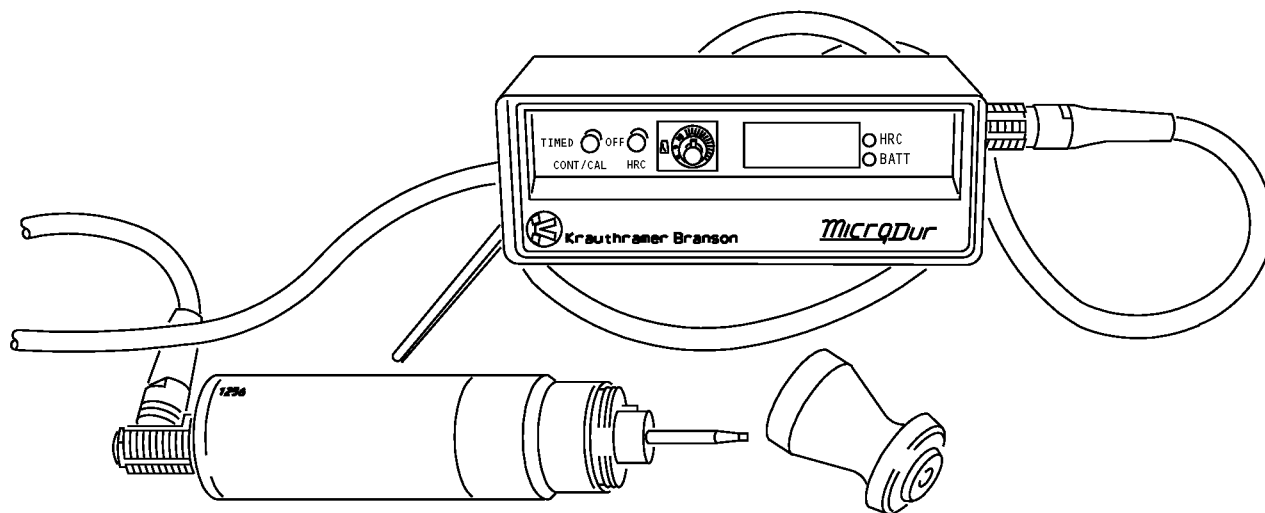
C. Use these precautions when you use the portable hardness testers to prevent further damage to existing structures:

- (1) Do not use these testers on material which is too thin to prevent distortion of the test piece under the impact of the indenter. Do tests on comparative samples to make sure that the part will not be damaged.
- (2) Do not apply the indenter too near the edge of the material. Buckling can occur.
- (3) Before you test clad aluminum alloys, remove the clad material from the areas to be tested. The pure aluminum of the clad surface will cause the indicated hardness values to be different from the specified values.

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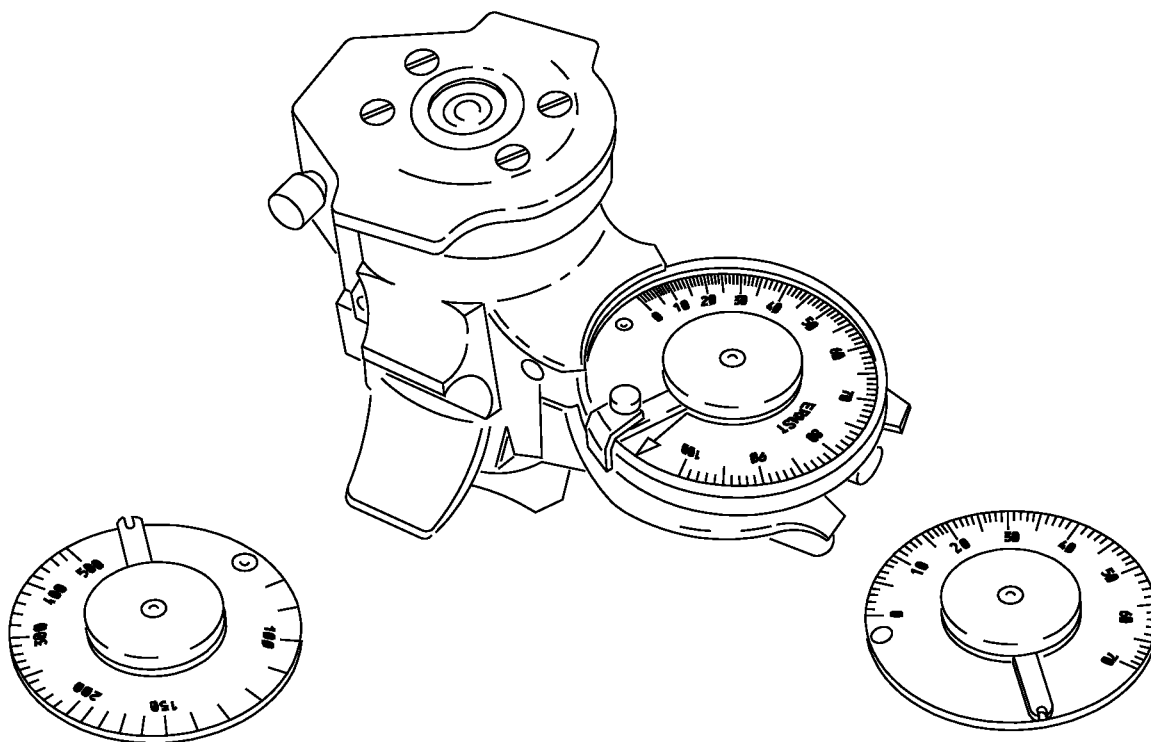
NEW AGE ROCKMATE
DETAIL I



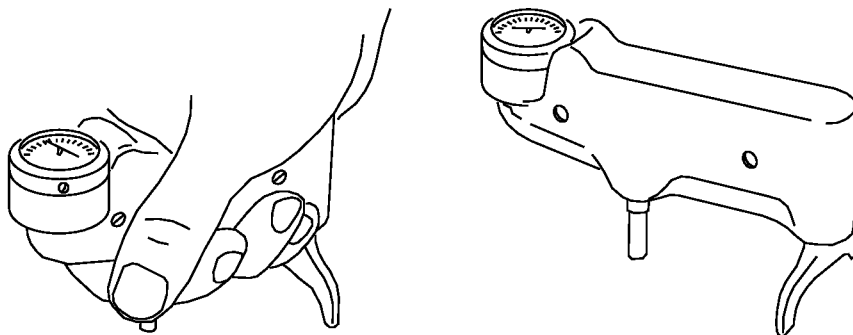
MICRODUR
DETAIL II

**Portable Hardness Testers
Figure 1 (Sheet 1 of 2)**

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NEW AGE MRD1
DETAIL III



BARCOL PORTABLE HARDNESS TESTER
DETAIL IV

Portable Hardness Testers
Figure 1 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5946
- MECHANICAL HARDNESS TESTING PROCEDURES MUST BE DONE ON A NON-CLAD SURFACE. IF ALL SURFACES OF A PART HAVE AN ALUMINUM CLAD COATING, THEN THE CLAD MUST BE REMOVED FROM THE TEST AREA.

[A] THE VALUES THAT ARE SHOWN ARE FOR FLAT, BARE ALUMINUM ONLY. IF THE PART HAS ONE OR MORE SURFACES WITH AN ALUMINUM CLAD COATING THEN A CLAD CORRECTION FACTOR IS REQUIRED. IF THE SURFACE IS NOT FLAT, A CORRECTION FACTOR IS REQUIRED. REFER TO BSS7351 FOR A SOURCE OF BOEING APPROVED CORRECTION FACTORS. ALTERNATIVE METHODS AND CORRECTION FACTORS ARE ACCEPTABLE FOR CLAD AND CURVED SURFACES IF APPROVED BY BOEING OR YOUR LOCAL REGULATORY AGENCY. REFER TO NDT, PART 6, 51-00-18 FOR THE DETAILED PROCEDURE ON ELECTRICAL CONDUCTIVITY MEASUREMENTS FOR ALUMINUM. FOR ADDITIONAL INFORMATION ON EDDY CURRENT TESTING OF ALUMINUM ALLOYS REFER TO BOEING PROCESS SPECIFICATIONS BAC5946 AND BSS7351, OR ASK BOEING.

[B] VALID ONLY FOR PARTS WHICH HAVE BEEN SUPERPLASTIC FORMED (SPF) AND HEAT TREATED.

[C] CONDUCTIVITY MAXIMUM FOR 2024 RIVETS IS 33.5 PERCENT IACS.

[D] CONDUCTIVITY VALUES ARE FOR INFORMATION ONLY AND MUST NOT BE USED FOR REJECTION OF AL-LI ALLOYS.

[E] USE THE BRINELL (500KG) SCALE FOR HARDNESS TESTING. REFER TO BAC5650.

[F] UNLESS OTHERWISE SPECIFIED, DO NOT TEST WELDED PARTS IN WELD BEAD OR ADJACENT HEAT-AFFECTED AREA WHEN WELDED IN THE -T4 OR -W CONDITION AND SUBSEQUENTLY AGED TO THE -T6 CONDITION.

[G] IT IS POSSIBLE THAT ADDITIONAL RESTRICTIONS OR QUALIFICATIONS ARE IN BAC5602 OR THE MATERIAL SPECIFICATIONS FOR THE OVERAGED TEMPER (T73, T73XX, T74XX, T76XX) OF THESE ALLOYS. TENSILE YIELD STRENGTH CAN LIMIT ACCEPTANCE OF MATERIALS THAT HAVE CONDUCTIVITY AND HARDNESS WITHIN THE ABOVE RANGES. REFER TO THE APPLICABLE SPECIFICATION.

[H] ELECTRICAL CONDUCTIVITY FOR 7050-T735XX IN THE RANGE OF 40.0 TO 44.0 PERCENT IACS IS PERMITTED FOR THE CONDITIONS THAT FOLLOW:

- a. FOR THE 40.0 TO 40.9 RANGE, ELECTRICAL CONDUCTIVITY IS PERMITTED IF THE LONGITUDINAL YIELD STRENGTH IS LESS THAN 69 KSI.
- b. FOR THE 41.0 TO 44.0 RANGE, ELECTRICAL CONDUCTIVITY IS PERMITTED IF THE LONGITUDINAL YIELD STRENGTH MEETS THE REQUIREMENTS OF AMS 4341.

[I] TEMPER - T74XX (WAS DESIGNATED 767T736XXX)

[J] ELECTRICAL CONDUCTIVITY FOR 7050-T74XXX IN THE RANGE OF 38.0 TO 44.0 IS PERMITTED UNLESS:

- YOU VERIFY A MATERIAL RESPONSE TO A SOLUTION HEAT TREATMENT AND AGING AS SPECIFIED IN BAC5602.
- WHEN THIS OCCURS, ELECTRICAL CONDUCTIVITY IN THE RANGE OF 38.0 TO 44.0 IS PERMITTED ONLY IF THE CONDITIONS THAT FOLLOW ARE APPLICABLE:

(1) YS (xx.x ksi) - EC (xx.x(IACS))
- ≤ 32.0 WHERE E.C. IS ELECTRICAL CONDUCTIVITY YS IS YIELD STRENGTH (LONGITUDINAL FOR EXTRUDED AND FORGED PRODUCTS; LONG TRAVERSE FOR PLATE PRODUCTS).

(2) THE YIELD STRENGTH CANNOT EXCEED 72 KSI.

(3) MECHANICAL PROPERTIES FROM CERTIFICATION RECORDS OF THE LOT CAN BE USED IN THESE EQUATIONS IF NO ADDITIONAL HEAT TREATMENT HAS BEEN DONE SINCE PURCHASE.

NOTE: FOR 7050-T74XX, THE PROCUREMENT SPECIFICATIONS ARE AMS 4050 AND BMS 7-323 FOR PLATE; AMS 4342 FOR EXTRUDED BAR, ROD, AND SHAPES, AND BMS 7-214 FOR FORGINGS.

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 1 of 9)



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NOTES (CONT'D)

- [K]** ELECTRICAL CONDUCTIVITY FOR 7050-T76XXX IN THE RANGE OF 37.0 TO 44.0 IS PERMITTED UNLESS:
- YOU VERIFY MATERIAL RESPONSE TO A SOLUTION HEAT TREATMENT AND AGING AS SPECIFIED IN BAC5602.
 - WHEN THIS OCCURS, ELECTRICAL CONDUCTIVITY IN THE RANGE OF 38.0 TO 40.0 IS ACCEPTABLE ONLY IF THE CONDITIONS THAT FOLLOW ARE APPLICABLE:
 - (1) AMS 4340: LONGITUDINAL YS
(xx.x KSI) - EC (xx.x IACS) < 39.0
 - (2) AMS 4201: LONG TRAVERSE YS
(xx.x KSI) - EC (xx.x IACS) < 36.0
 - (3) BAC5602: LONGITUDINAL YS
(xx.x KSI) - EC (xx.x IACS) < 36.0
 - (4) MECHANICAL PROPERTIES FROM CERTIFICATION RECORDS OF THE LOT CAN BE USED IN THESE EQUATIONS IF NO ADDITIONAL HEAT TREATMENT HAS BEEN DONE SINCE PURCHASE.
- [L]** THE MINIMUM PERMITTED CONDUCTIVITY READING ON MACHINED SURFACES OF 7075-T73511 MUST BE 34.5 PERCENT IACS.
- [M]** HARDNESS MUST BE MEASURED ON SURFACES WHICH ARE BETWEEN 1T/4 AND 3T/4 OF THE SOLUTION HEAT TREATED THICKNESS.
- [N]** TABLE VALUES ARE UNCORRECTED FOR VARIATIONS DUE TO GEOMETRY CONDITIONS WHICH INFLUENCE HARDNESS MEASUREMENTS (FOR EXAMPLE, CURVATURE). CORRECTION FACTORS FOR THESE VARIATIONS ARE APPLIED TO THE ACCEPTANCE LIMITS AND/OR MEASURED VALUES AS APPLICABLE PRIOR TO ACCEPTANCE OR REJECTION.
- [O]** SUB-TEMPERS OF THE ALLOYS AND TEMPERS THAT FOLLOW DO NOT SHOW IMPORTANT DIFFERENCES TO PERMIT SEPARATION BY HARDNESS ALONE. FOR EXAMPLE, 2024-T3511 OT 7075-T73511 ARE INSPECTED TO THE VALUES SHOWN FOR 2024-T3 AND 7075-T73, RESPECTIVELY.

**Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 2 of 9)**



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ALLOY AND TEMPER		CONDUCTIVITY (PERCENT IACS) A		ROCKWELL HARDNESS			
				SCALE	THICKNESS RANGE (INCH)	MINIMUM	MAXIMUM
		MINIMUM	MAXIMUM				
1100	H42	---	---	E 15T	0.060 AND UP 0.026 TO 0.059	18 36.5	48 53.5
2004 B	T62	38.0	42.0	B 15T	0.040 AND UP 0.026 TO 0.039	55 78.5	75 85
2014	0	48.5	51.0	E 15T	0.060 AND UP 0.026 TO 0.059	---	60.0 60.5
	T3XX	31.5	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	68 82.5	80 86.5
	T4XXX	31.5	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	68 82.5	80 86.5
	T6XXX	35.0	40.0	B 15T	0.040 AND UP 0.026 TO 0.039	78.5 86	89.5 89.5
2017	0	48.5	51.0	E 15T	0.060 AND UP 0.026 TO 0.059	---	50 54
	T4XXX	31.5	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	68 82.5	80 86.5
2024	0	45.5	49.0	E 15T	0.060 AND UP 0.026 TO 0.059	---	62 61.5
	T3XXX	28.5	32.0	B 15T	0.040 AND UP 0.026 TO 0.039	63 81	83.5 88
	T4X	28.5	32.0 C	B 15T	0.040 AND UP 0.026 TO 0.039	63 81	83.5 87
	T6X	36.0	40.0	B 15T	0.040 AND UP 0.026 TO 0.039	72 84	86 88.5
	T8XXX	38.0	42.0	B 15T	0.040 AND UP 0.026 TO 0.039	74 84.5	86 88.5
2094 D	T3X	16.0	18.5	B 15T	0.040 AND UP 0.026 TO 0.039	34 69	49 74.5
	T83X	16.0	18.5	B 15T	0.040 AND UP 0.026 TO 0.039	80 86.5	90 90
	T86X	16.0	18.5	B 15T	0.040 AND UP 0.026 TO 0.039	80 86.5	90 90
2124	T8XXX	38.0	42.0	B 15T	0.040 AND UP 0.026 TO 0.039	74 84.5	86 88.5

CONDUCTIVITY AND HARDNESS ACCEPTANCE LIMITS
TABLE I

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 3 of 9)

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ALLOY AND TEMPER		CONDUCTIVITY (PERCENT IACS) ^A		ROCKWELL HARDNESS			
				SCALE	THICKNESS RANGE (INCH)	MINIMUM	MAXIMUM
		MINIMUM	MAXIMUM				
2219	0	44.0	49.0	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	70 66
	T3XXX	26.0	31.0	B 15T	0.040 AND UP 0.026 TO 0.039	64.5 81.5	--- ---
	T37	27.0	31.0	B 15T	0.040 AND UP 0.026 TO 0.039	65.5 82	--- ---
	T4X	28.0	32.0	B 15T	0.040 AND UP 0.026 TO 0.039	61 80.5	--- ---
	T6X	32.0	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	65.5 82	--- ---
	T8XXX	31.0	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	73 84.5	--- ---
	T87	31.0	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	77 85.5	--- ---
2224	T3511	29.5	33.5	B 15T	0.040 AND UP 0.026 TO 0.039	70 83.5	83.5 88
2324	T39	29.0	32.0	B 15T	0.040 AND UP 0.026 TO 0.039	77 85.5	86 88.5
2524 (C188)	T3XXX	28.5	32.0	B 15T	0.040 AND UP 0.026 TO 0.039	63 81	83.5 88
3003	0	44.5	50.5	H	---	---	65
5052	0	34.0	37.0	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	70 66
	H34	34.0	37.0	E 15T	0.060 AND UP 0.026 TO 0.059	66 64	--- ---
5083	0	---	---	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	75 69.5
	HXX	---	---	E 15T	0.060 AND UP 0.026 TO 0.059	80 72	--- ---
5154	0	---	---	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	51 55
	HXX	---	---	E 15T	0.060 AND UP 0.026 TO 0.059	55 57.5	80 72

CONDUCTIVITY AND HARDNESS ACCEPTANCE LIMITS
TABLE I (CONT)

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 4 of 9)



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STRUCTURAL REPAIR MANUAL

ALLOY AND TEMPER		CONDUCTIVITY (PERCENT IACS) A		ROCKWELL HARDNESS			
				SCALE	THICKNESS RANGE (INCH)	MINIMUM	MAXIMUM
		MINIMUM	MAXIMUM				
5456	0	---	---	E	---	---	70
	H112	---	---	E	---	70	---
	H311	---	---	E	---	75	---
	H321	---	---	E	---	90	---
	H323	---	---	E	---	90	---
	H343	---	---	E	---	94	---
6013	T4X	37.0	40.0	B 15T	0.040 AND UP 0.026 TO 0.039	41 74	60 80
	T6X	41.0	46.5	B 15T	0.040 AND UP 0.026 TO 0.039	64 79.5	79 86
6061	0	47.0	56.0	E 15T	0.060 AND UP 0.026 TO 0.059	---	25 40.5
	T4XXX	36.0	45.5	E 15T	0.060 AND UP 0.026 TO 0.059	64 63	---
	T42	36.0	45.5	E 15T	0.060 AND UP 0.026 TO 0.059	60 60.5	---
	T6XXX F	40.0	51.0	B 15T	0.060 AND UP 0.026 TO 0.059	47 76	80 86.5
6063	0	57.0	65.0	H	---	---	70
	T1X	48.0	58.0	E 15T	0.060 AND UP 0.026 TO 0.059	37 47.5	---
	T4X	48.0	58.0	E 15T	0.060 AND UP 0.026 TO 0.059	40 49	---
	T5X	50.0	60.0	E 15T	0.060 AND UP 0.026 TO 0.059	44 51	---
	T6X	50.0	60.0	E 15T	0.060 AND UP 0.026 TO 0.059	70 66	---
7049 G	0	44.0	50.0	E 15T	0.060 AND UP 0.026 TO 0.059	---	70 66
	T73XXX	40.0	44.0	B 15T	0.040 AND UP 0.026 TO 0.039	82 87	---

CONDUCTIVITY AND HARDNESS ACCEPTANCE LIMITS
TABLE I (CONT)

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 5 of 9)

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ALLOY AND TEMPER		CONDUCTIVITY (PERCENT IACS) A		ROCKWELL HARDNESS			
				SCALE	THICKNESS RANGE (INCH)	MINIMUM	MAXIMUM
		MINIMUM	MAXIMUM				
7050	0	44.0	50.0	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	70 66
	T735XX H	41.0	44.0	B 15T	0.040 AND UP 0.026 TO 0.039	82 87	92 90.5
	T74XX I J	40.0	44.0	B 15T	0.040 AND UP 0.026 TO 0.039	82 87	92 90.5
	T76XX K	39.0	44.0	B 15T	0.040 AND UP 0.026 TO 0.039	84 88	94 91.5
7055	T7751	35.5 L	38.0	B 15T	0.040 AND UP 0.026 TO 0.039	90.5 90	98 92.5
	T77511	35.5	38.0	B 15T	0.040 AND UP 0.026 TO 0.039	91.5 90.5	98 92.5
7075 G	0	44.0	47.5	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	65 63.5
	T6XXX	30.0	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	83.5 88	94 91.5
	T73XX	38.0	42.5	B 15T	0.040 AND UP 0.026 TO 0.039	79.5 86.5	89 89.5
	T73511	38.0	42.5	B B 15T	1.500 AND UP 0.040 TO 1.499 0.026 TO 0.039	78.5 79.5 86.5	89 89 89.5
	T76XXX	38.0	42.0	B 15T	0.040 AND UP 0.026 TO 0.039	82 87	91 90.5
7079	T6XX	30.0	33.5	E 15T	0.040 AND UP 0.026 TO 0.039	84 88	94 91.5
7150	T651	34.0	39.5	E 15T	0.040 AND UP 0.026 TO 0.039	90 90	98 92.5
	T651X T651XP	32.0	37.5	E 15T	0.040 AND UP 0.026 TO 0.039	90 90	98 92.5
	T77511	35.5	39.0	B	0.750 TO 2.500	92	98
				B	0.500 TO 0.749	91	98
				B	0.250 TO 0.499	90.5	98
				B 15T	0.040 TO 0.249 0.026 TO 0.039	90 90.5	98 92.5

CONDUCTIVITY AND HARDNESS ACCEPTANCE LIMITS
TABLE I (CONT)

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 6 of 9)

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ALLOY AND TEMPER		CONDUCTIVITY (PERCENT IACS) ^A		ROCKWELL HARDNESS			
				SCALE	THICKNESS RANGE (INCH)	MINIMUM	MAXIMUM
		MINIMUM	MAXIMUM				
7175 ^G	0	44.0	47.5	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	65 63.5
	T6x	30.0	34.0	B 15T	0.040 AND UP 0.026 TO 0.039	85 88.5	94 91.5
	T74XXX	38.0	42.5	B 15T	0.040 AND UP 0.026 TO 0.039	82 87	93 91
7178	0	43.0	47.0	E 15T	0.060 AND UP 0.026 TO 0.059	--- ---	65 63.5
	T6XXX	29.5	33.0	B 15T	0.040 AND UP 0.026 TO 0.039	87.5 89	94 91.5
	T76XXX	38.0	42.0	B 15T	0.040 AND UP 0.026 TO 0.039	84 88	--- ---
7475 ^B	T6X	30.0	35.0	B 15T	0.040 AND UP 0.026 TO 0.039	83.5 88	94 91.5
	T76X	37.0	42.0	B 15T	0.040 AND UP 0.026 TO 0.039	82 87	91 90.5
8090 ^D	T3X	14.5	16.5	B 15T	0.040 AND UP 0.026 TO 0.039	30 70.5	50 77

CONDUCTIVITY AND HARDNESS ACCEPTANCE LIMITS
TABLE I (CONT)

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 7 of 9)



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STRUCTURAL REPAIR MANUAL

ALLOY, TEMPER PRODUCT FORM	SOLUTION HEAT TREATED THICKNESS (INCHES)	ROCKWELL HARDNESS M N	
		MINIMUM	MAXIMUM
7075-T73 PLATE, FORGINGS	0 TO 3.000	79.5	89
	3.001 TO 4.000	76.5	89
	4.001 TO 5.000	75	89
	5.001 AND UP	74	89
7075-T7351 PLATE	0.250 TO 2.000	79.5	89
	2.001 TO 2.500	75.5	89
	2.501 TO 3.500	74	89
	3.501 AND UP	73	89
7075-T73511 EXTRUSION	3.000 AND UP, AREA LESS THAN 20 SQUARE INCHES	77.5	89
	3.000 AND UP, AREA GREATER THAN 20 SQUARE INCHES	75.5	89
7075-T7352 FORGINGS	0 TO 3.000	79.5	89
	3.001 TO 4.000	75	89
	4.001 TO 5.000	74	89
	5.001 AND UP	73	89
7175-T74 FORGINGS	0 TO 3.000	82	93
	3.001 TO 4.000	80.5	93
	4.001 TO 5.000	78.5	93
	5.001 AND UP	77	93
7175-T7452 FORGINGS	0 TO 3.000	82	93
	3.001 TO 4.000	78.5	93
	4.001 TO 5.000	76	93
	5.001 AND UP	74.5	93

CENTERLINE HARDNESS ACCEPTANCE LIMITS FOR MACHINED WROUGHT
ALUMINUM ALLOYS
TABLE II

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 8 of 9)



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STRUCTURAL REPAIR MANUAL

ALLOY, TEMPER AND THICKNESS [0]	ROCKWELL HARDNESS THROUGH CLAD [N]		
	SCALE	MINIMUM	MAXIMUM
2024-0 -T3XXX 0.040 TO 0.079 0.080 TO 0.125 -T4X 0.026 TO 0.032 0.033 TO 0.039 0.040 TO 0.079 0.080 TO 0.125 -T6X 0.026 TO 0.032 0.033 TO 0.039 0.040 TO 0.079 0.080 TO 0.125 -T8XXX 0.026 TO 0.032 0.033 TO 0.039 0.040 TO 0.079 0.080 TO 0.125	B	58	83.5
	B	55	83.5
	15T	81	87
	15T	79.5	87
	B	57	83.5
	B	54	83.5
	15T	84	88.5
	15T	82.5	88.5
	B	70	86
	B	64	86
	15T	84	88.5
	15T	83	88.5
2219-T62 0.026 TO 0.032 0.033 TO 0.039 0.040 TO 0.079 0.080 TO 0.125	B	58	83.5
	B	55	83.5
	15T	80	-
	15T	78.5	-
2524-T3XX (C188) 0.026 TO 0.079 0.080 TO 0.125	B	58	83.5
	B	55	83.5
	15T	88	91.5
	15T	86.5	91.5
7075-0 [6] -T6XXX 0.026 TO 0.032 0.033 TO 0.039 0.040 TO 0.079 0.080 TO 0.125 -T73XXX 0.026 TO 0.032 0.033 TO 0.039 0.040 TO 0.079 0.080 TO 0.125	B	79	94
	B	75	94
	15T	86.5	89.5
	15T	85	89.5
	B	77	89
	B	74	89
	15T	88	91.5
	15T	86.5	91.5

HARDNESS ACCEPTANCE LIMITS FOR CLAD WROUGHT ALUMINUM ALLOYS
TABLE III

Hardness and Conductivity Values of Aluminum Materials
Figure 2 (Sheet 9 of 9)



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NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5617

TENSILE STRENGTH KSI	ROCKWELL		SUPERFICIAL ROCKWELL			VICKERS	KNOOP DIAMOND 500 GRAMS	BRINELL 10MM BALL 3000 KG		
	C (150 KG)	A (60 KG)	45N (45 KG)	30N (30 KG)	15N (15 KG)	136 DEG		TUNGSTEN CARBIDE BALL	STEEL BALL	
						DIAMOND PYRAMID 10 KG				
	72	88	79.5	87	94.5	1245	1024			
	71	87	78.5	86.5	94	1160	988			
	70	86.5	77.5	86	94	1076	972			
	69	86	76.5	85	93.5	1004	946			
	68	85.5	75.5	84.5	93	940	920			
	67	85	74	83.5	93	900	895			
	66	84.5	73	83	92.5	865	870			
	65	84	72	82	92	832	846			
	64	83.5	71	81	92	800	822			
	63	83	70	80	91.5	772	799			
	62	82.5	69	79	91	746	776			
	61	82	67.5	78.5	90.5	720	754			
	60	81	66.5	77.5	90	697	732			
	59	80.5	65.5	76.5	89.5	674	710			
	58	80	64	75.5	89.5	653	690	615		
	57	79.5	63	75	89	633	670	595		
	56	79	62	74	88.5	613	650	577		
	301	55	78.5	61	73	88	595	630	560	
	292	54	78	59.5	72	87.5	577	612	543	
	283	53	77.5	58.5	71	87	560	594	525	
273	52	77	57.5	70.5	86.5	544	576	512		
264	51	76.5	56	69.5	86	528	558	496		
255	50	76	55	68.5	85.5	513	542	481		
246	49	75	54	67.5	85	498	526	469		
238	48	74.5	52.5	66.5	84.5	484	510	455		
229	47	74	51.5	66	84	471	495	442	442	
221	46	73.5	50	65	83.5	458	480	432	432	
215	45	73	49	64	83	446	466	421	421	
208	44	72.5	48	63	82.5	434	452	409	409	
201	43	72	46.5	62	82	423	438	400	400	
194	42	71.5	45.5	61.5	81.5	412	426	390	390	

CONVERSION OF HARDNESS TO TENSILE STRENGTH
TABLE I

Hardness Values of Steel Materials
Figure 3 (Sheet 1 of 3)



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STRUCTURAL REPAIR MANUAL

TENSILE STRENGTH KSI	ROCKWELL		SUPERFICIAL ROCKWELL			VICKERS	KNOOP DIAMOND 500 GRAMS	BRINELL 10MM BALL 3000 KG	
	C (150 KG)	A (60 KG)	45N (45 KG)	30N (30 KG)	15N (15 KG)	136 DEG		TUNGSTEN CARBIDE BALL	STEEL BALL
						DIAMOND PYRAMID 10 KG			
188	41	71	44.5	60.5	81	402	414	381	381
182	40	70.5	43	59.5	80.5	392	402	371	371
177	39	70	42	58.5	80	382	391	362	362
171	38	69.5	41	57.5	79.5	372	380	353	353
166	37	69	39.5	56.5	79	363	370	344	344
161	36	68.5	38.5	56	78.5	354	360	336	336
156	35	68	37	55	78	345	351	327	327
152	34	67.5	36	54	77	336	342	319	319
149	33	67	35	53	76.5	327	334	311	311
146	32	66.5	33.5	52	76	318	326	301	301
141	31	66	32.5	51.5	75.5	310	318	294	294
138	30	65.5	31.5	50.5	75	302	311	286	286
135	29	65	30	49.5	74.5	294	304	279	279
131	28	64.5	29	48.5	74	286	297	271	271
128	27	64	28	47.5	73.5	279	290	264	264
125	26	63.5	26.5	47	72.5	272	284	258	258
123	25	63	25.5	46	72	266	278	253	253
119	24	62.5	24	45	71.5	260	272	247	247
117	23	62	23	44	71	254	266	243	243
115	22	61.5	22	43	70.5	248	261	237	237
112	21	61	20.5	42.5	70	243	256	231	231
110	20	60.5	19.5	41.5	69.5	238	251	226	226

CONVERSION OF HARDNESS TO TENSILE STRENGTH
TABLE I (CONT)

Hardness Values of Steel Materials
Figure 3 (Sheet 2 of 3)



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STRUCTURAL REPAIR MANUAL

TENSILE STRENGTH KSI	ROCKWELL				VICKERS	KNOOP DIAMOND 500 GRAMS	BRINELL 10MM BALL 3000 KG	
	A (60 KG)	G (150 KG)	B (150 KG)	F (60 KG)	136 DEG		TUNGSTEN CARBIDE BALL	STEEL BALL
					DIAMOND PYRAMID 10 KG			
109	60	79	98		228	241	226	226
104	59.5	77.5	97		222	236	222	222
102	58.5	76	96		216	231	216	216
100	58	74	95		210	226	210	210
98	57.5	72.5	94		205	221	205	205
94	57	71	93		200	216	200	200
92	56.5	69	92		195	211	195	195
90	56	67.5	91		190	206	190	190
89	55.5	66	90		185	201	185	185
88	55	64	89		180	196	180	180
86	54	62.5	88		176	192	176	176
84	53.5	61	87		172	188	172	172
82	52.5	57.5	85		165	180	165	165
81	52	56	84		162	176	162	162
80	51	54	83		159	173	159	159
77	50.5	52.5	82		156	170	156	156
73	50	51	81		153	167	153	153
70	49	47.5	79		147	161	147	147
68	48	44	77		141	155	141	141
67	47	42.5	76		139	152	139	139
65	46	39	74	99	135	147	135	135
63	45	36	72	98	130	143	130	130
62	44	34.5	71	97.5	127	141	127	127
59	43	29.5	68	95.5	121	135	121	121
57	42	26.5	66	94.5	117	131	117	117
54	41.5	23.5	64	93.5	114	127	114	114

CONVERSION OF HARDNESS TO TENSILE STRENGTH
TABLE II

Hardness Values of Steel Materials
Figure 3 (Sheet 3 of 3)



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GENERAL - FIRE DAMAGE EVALUATION

1. Applicability

- A. This subject is applicable to metal and composite structure that has been open to fire or high temperature.

2. General

- A. High temperature can decrease the strength of metal and composite structures.
- B. A change in paint color can be an indication that fire or high temperature in an airplane structure has occurred.
- C. In composite structures, an indication of fire or high temperature can be blisters, scorches, wrinkles, ablation, paint discoloration, visible fibers, warping, cracks, and delamination.
- D. Fire suppression materials can cause corrosion in metal parts, and damage to composite parts. Remove all fire suppression materials as given in CPM 20-42-00.
- E. Carbon soot and other combustion products accelerate corrosion. Fully remove all of these unwanted materials.

3. References

Reference	Title
51-20-02, GENERAL	Heat Treat Verification - Hardness and Conductivity Testing
CPM 20-42-00	Corrosion Removal Techniques - Procedure After Fire Damage
NDT Part 1, 51-01-03	NDT Assessment of Lightning Strike Damage to Graphite / Epoxy Composite Structure
NDT Part 6, 51-00-03	Fire Damage in Aircraft Structure; Investigation of

4. Damage Analysis

- A. Examine the areas where fire or high temperature has occurred to see if the structure is weak or damaged.
 - (1) To find weak structure in metal parts, use one of the steps that follows:
 - (a) Use a conductivity test procedure as given in NDT Part 6, 51-00-03.
 - (b) Do a hardness test procedure as given in 51-20-02, GENERAL.
 - (2) If visual damage occurs in composite parts, use instrumented NDI procedures to find other unseen damage. Inspect all the adjacent areas up to 6 inches away from the visual damage. Refer to NDT Part 1, 51-01-03 for Lightning Strike Damage procedure.
- B. Repair or replace all the weak or damaged structure immediately.



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GENERAL - MERCURY SPILLAGE CORRECTIVE ACTION

1. References

Reference	Title
51-10-02, GENERAL	Inspection and Removal of Damage
CPM 20-41-00	Corrosion Removal Techniques - Procedure After Mercury Spillage

2. General

- A. It is assumed that any significant quantity of mercury on board an airplane is properly contained, packaged, and labeled for loading in a cargo compartment.
- B. The spillage of mercury or a mercury compound within an airplane requires immediate action for its isolation and recovery to prevent possible corrosion damage to and weakening of aluminum alloy structural components. The presence of even small amounts of mercury can be detected by a "sniffer". This is an electronic device sensitive to mercury vapor. Refer to AMM 05-51-21, (Mercury Spillage Condition) and CPM 20-41-00 for procedures to be taken in case of mercury spillage.
- C. Mercury, by the amalgamation process, can penetrate any break in the finish, paint, or sealing coating of a metal structural element. An oxide coating on a dry metallic surface will tend to inhibit an immediate action while a bright, polished, shining or scratched surface will hasten the process. Moisture will also promote the amalgamation process.

Soils, greases, or other inert contaminants present on the metal surfaces will prevent the start of the action. The corrosion and embrittlement which results from an initial penetration can be extremely rapid in structural members under load. Once it has begun, there is no known method of stopping it. Complete destruction of the load carrying capacity of the metal will result.
- D. Damage to an aluminum alloy structural component by mercury appears externally as a grayish, powdery dust or fuzzy coating. Corrosion may show up as tree-like forms penetrating a structural component. Such external evidence may be an indication of damage beyond an allowable amount by embrittlement. The extent of such damage should be determined by an X-ray examination. Refer to Part 2 of the Non-Destructive Test (NDT) Manual for procedures generally adaptable to mercury spillage and corrosion.
- E. Damage which has been discovered by X-ray examination as in Paragraph 2.D./GENERAL is not allowable. Refer to 51-10-02, GENERAL for definition of allowable damage.
- F. Refer to Chapter 53 for repairs to fuselage structure which has been damaged.



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GENERAL - REPAIR SEALING

1. Applicability

- A. This subject contains the information and procedures necessary to seal structural repairs on the airplane.

2. References

Reference	Title
51-00-04, GENERAL	Structural Classification
AMM 28-11-00/801	Aircraft Maintenance Manual
AMM 51-31-01/201	Aircraft Maintenance Manual
AMM 51-41-00/201	Aircraft Maintenance Manual
SOPM 20-50-19	General Sealing

3. General

- A. Some areas of the fuselage and wing are sealed to make a pressurized zone of the fuselage and the integral fuel tanks. Other areas of the airplane are sealed to prevent the entry of fluids and moisture (example: below the toilets and galleys). Areas that are sealed at the initial manufacture of the airplane, must be sealed again when you do repairs in these areas.

- (1) Refer to AMM 51-31-01/201 for seals and sealing.
- (2) Refer to AMM 28-11-00/801 for fuel tank repairs.
- (3) Refer to SOPM 20-50-19 for sealing of repairs.

- B. See Figure 1/GENERAL for substitute sealants. Sealants specified in repairs have been selected for their special qualities. Substitute sealants shown in Figure 1/GENERAL can be used when the specified sealant is not available.

CAUTION: DO NOT SEAL AIRFRAME DRAIN HOLES. KEEP THE DRAIN PATHS CLEAR. IF YOU DO NOT OBEY, MOISTURE CAN COLLECT IN SOME AREAS. THE RESULT CAN BE CORROSION AND DAMAGE TO THE AIRPLANE.

- C. The airplane has external drain holes and internal drain paths so that water and other moisture will not collect in areas around the airframe. Do not fill or block these holes or drain paths when you seal repairs. Refer to AMM 51-41-00/201 for the locations of these drain holes and drainage paths.

CAUTION: DO NOT USE TOOLS THAT CAN CAUSE DAMAGE WHEN YOU REMOVE SEALANT FROM STRUCTURAL PARTS. BE VERY CAREFUL IF YOU REMOVE SEALANT FROM AREAS ADJACENT TO (OR ON) AN ALUMINUM CLAD SURFACE THAT IS PRIMARY STRUCTURE. (FOR EXAMPLE: CLAD ALUMINUM FUSELAGE SKIN ADJACENT TO A LAP JOINT, WING-TO-BODY FAIRING, OR TO A SPLICE PLATE BEHIND A BUTT JOINT. BE VERY CAREFUL ALSO, WHEN YOU REMOVE SEALANT FROM AROUND EXTERNAL PATCH REPAIRS AND JOINTS AROUND FLUSH PATCH REPAIRS).

- D. To remove initial sealant from a structural part, Refer to AMM 51-31-01/201 for sealant removal in non-fuel tank areas and AMM 28-11-00/801 for sealant removal in fuel tank areas. Be careful not to cause damage to the part surface.



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- (1) Examine the structure after you remove the sealant to see if there are nicks, scratches, scribe marks or other damage. Tell an engineer or The Boeing Company if you find damage in primary structure that is adjacent to a lap joint, wing-to-body fairing, or to a splice plate that is behind a butt joint. Refer to 51-00-04, GENERAL for structural classification. For all other damage, refer to instructions in the applicable allowable damage section of the SRM before you continue.



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PERMITTED SUBSTITUTES FOR INITIAL SPECIFIED SEALANT							
INITIAL SPECIFIED SEALANTS	PERMITTED ALTERNATIVE SEALANTS						
	BMS 5-45	BMS 5-63	BMS 5-95	BMS 5-142 [A]	PR-1826 [B]	PR-1828	BMS 5-150
BMS 5-19	YES	NO	NO	NO	YES	NO	NO
BMS 5-26	SEE TABLE III	NO	NO	NO	YES	YES	NO
BMS 5-32	YES	NO	YES	YES	YES	YES	NO
BMS 5-45	---	NO	NO	NO	YES	NO	NO
BMS 5-63	NO	---	NO	NO	NO	NO	NO
BMS 5-79	YES	NO	SEE TABLE II	YES	YES	YES	NO
BMS 5-95	YES	NO	---	YES	YES	YES	YES (CLASS B-2 ONLY)
BMS 5-142	YES	NO	YES	---	YES	YES	YES

TABLE I

BMS 5-79 SEALANT ALTERNATIVES	
INITIAL MATERIAL	ALTERNATIVE MATERIAL
BMS 5-79 CLASS B-1/2 CLASS B-2 CLASS B-4 CLASS B-8 CLASS C-24 CLASS C-48 CLASS D-2	BMS 5-95 CLASS B-1/2 CLASS B-2 CLASS B-4 NONE CLASS C-20 CLASS C-80 BMS 5-16

TABLE II

NOTES

- [A] THIS ALTERNATIVE IS NOT PERMITTED FOR MATING SURFACE SEAL, PRE-PACK SEALING, AND WET FASTENER INSTALLATION PROCEDURES.
- [B] THIS SEALANT HAS A PRIMER THAT MUST ALSO BE USED.

Alternative Sealants Data Figure 1 (Sheet 1 of 2)



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BMS5-26, TYPES, CLASSES, GRADE	SUPERSEDED BY BMS5-45, CLASSES, GRADE
TYPE I, CLASS A-1/2, GRADE 1	CLASS A-2, GRADE 1 OR GRADE 2
TYPE I, CLASS A-2, GRADE 1	CLASS A-2, GRADE 1 OR GRADE 2
TYPE I, CLASS B-1/2	CLASS B-1/2
TYPE I, CLASS B-2	CLASS B-2
TYPE II, CLASS A-2, GRADE 1	CLASS A-2, GRADE 1
TYPE II, CLASS A-2, GRADE 2	CLASS A-2, GRADE 2
TYPE II, CLASS B-2	CLASS B-2
TYPE II, CLASS C-24	CLASS C-24
TYPE II, CLASS C-48	CLASS C-48
TYPE II, CLASS C-168	CLASS C-168

TABLE III

Alternative Sealants Data
Figure 1 (Sheet 2 of 2)



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GENERAL - SHOT PEENING

1. Applicability

- A. This section gives data regarding shot peening of reworked aluminum, steel, and titanium parts. Figure 1/GENERAL displays this information in chart form, stating minimum part thicknesses, intensities, and shot numbers.

2. References

Reference	Title
SOPM 20-10-03	General - Shot Peening Procedures

3. General

- A. As part thickness is decreased due to damage removal, shot peening intensity may also decrease. It is, therefore, important that the part thickness is determined after damage rework in order to specify the correct intensity.
- B. Parts thinner than the minimum thickness indicated in the table shall not be shot peened. When shot peening a tapered area, do not shot peen past the point where minimum thickness is achieved.
- C. Refer to SOPM 20-10-03 for additional shot peening data.



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SHOT PEENING PARAMETERS			
MATERIAL/HEAT TREAT	MINIMUM THICKNESS	INTENSITY	SHOT NUMBER
STEEL HEAT-TREATED LESS THAN 150 KSI	0.04	0.002A-0.004A	230-780
	0.05	0.002A-0.005A	↓
	0.07	0.003A-0.006A	↓
	0.08	0.004A-0.007A	↓
	0.10	0.006A	↓
	0.12	0.008A	↓
	0.15	0.010A	↓
	0.17	0.012A	↓
	0.20	0.014A	↓
	0.240 AND THICKER	0.016A	230-780
STEEL HEAT-TREATED BETWEEN 150 AND 240 KSI	0.01	0.002A-0.004A	170-460
	0.05	0.003A-0.005A	↓
	0.07	0.003A-0.006A	↓
	0.08	0.006A	↓
	0.10	0.008A	↓
	0.12	0.010A	↓
	0.14	0.012A	↓
	0.16	0.014A	↓
	0.200 AND THICKER	0.016A	170-460
STEEL HEAT-TREATED BETWEEN 270 AND 300 KSI	0.03	0.002A-0.004A	170-460
	0.04	0.003A-0.005A	↓
	0.05	0.006A	↓
	0.06	0.008A	↓
	0.08	0.010A	↓
	0.10	0.012A	↓
	0.12	0.014A	↓
	0.150 AND THICKER	0.016A	170-460
ALUMINUM	0.05	0.002A-0.004A	230-550
	0.06	0.003A-0.005A	↓
	0.08	0.004A-0.007A	↓
	0.10	0.006A	↓
	0.13	0.008A	↓
	0.16	0.010A	↓
	0.19	0.012A	↓
	0.230 AND THICKER	0.014A	230-550
TITANIUM	0.04	0.002A-0.004A	230-460
	0.05	0.002A-0.005A	↓
	0.07	0.003A-0.006A	↓
	0.08	0.004A-0.007A	↓
	0.10	0.006A	↓
	0.12	0.008A	↓
	0.15	0.010A	↓
	0.17	0.012A	↓
	0.20	0.014A	↓
	0.24	0.016A	230-460

Shot Peening Parameters
Figure 1



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STRUCTURAL REPAIR MANUAL

GENERAL - FREEZE PLUG INSTALLATION

1. General

- A. This subject gives the procedures for a repair with an aluminum freeze plug. A structural engineering review is necessary before freeze plugs are installed. If necessary, Boeing can help with the structural engineering review.
- B. The freeze plug installation repair procedure is applicable for aluminum alloy material that is a minimum of 0.063 inch (1.60 mm) thick.
- C. A freeze plug can be used to repair damage in aluminum structure. Because the freeze plug is installed with interference in a hole, it will transmit compressive loads. A freeze plug is better for durability than a non-interference plug or an open hole.
- D. It is best to have parts on each side of the freeze plug to contain it. Refer to Figure 1/GENERAL, Detail I. When the freeze plug cannot be contained between two other parts, use straps, washers or countersinks to hold the freeze plug. Refer to Figure 1/GENERAL, Detail II. Install the washers and straps with BMS 5-95 sealant between the mating surfaces. Refer to 51-20-05, GENERAL.

If more than one structural member is damaged, a separate freeze plug must be used in each part. Refer to Figure 1/GENERAL, Detail III. Shims can be used temporarily between the structural members to make sure the freeze plugs are installed flush. Remove those shims after the freeze plug is installed. Apply BMS 5-95 sealant to the mating surfaces of the structure before the freeze plug is installed. Skin and hot-bonded doublers can be plugged together if there is no delamination. Refer to Figure 1/GENERAL, Detail IV.

NOTE: To define the edge margin and the diameter of the freeze plug installation, use the diameter of the freeze plug hole and not the diameter of the fastener hole through the freeze plug.

2. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-05, GENERAL	Repair Sealing

3. Freeze Plug Installation

A. Straight Shank Freeze Plug Installation

- (1) Use the smallest diameter drill and reamer possible to remove the damage. Refer to 51-10-00. Remove the nicks, scratches, burrs, and sharp edges from the freeze plug hole. Make sure the freeze plug will have a minimum 0.05 inch wall thickness when the fastener hole is drilled through it. Refer to Figure 2/GENERAL, Detail I. Measure the diameter of the freeze plug hole to 4 decimal positions (.XXXX). The cylindricity tolerance on the freeze plug hole is 0.0003 inch. Refer to Figure 3/GENERAL for the definition of cylindricity. The surface finish of the freeze plug hole must be 63 microinches Ra or smoother. Measure the thickness of the damaged aluminum structure to 3 decimal positions (.XXX). Refer to Figure 2/GENERAL, Section A-A.
- (2) The freeze plug shank diameter must be 1.0035 to 1.0040 times larger than the diameter of the hole. For example, if the hole has a diameter of 0.4500 inch, then the freeze plug diameter must be 0.4516/0.4518 inch.

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- (3) Make the straight shank freeze plug from 7075-T6 aluminum with a cylindricity tolerance of 0.0002 inch.
- (4) Machine the freeze plug outer diameter to a surface finish of 63 microinches Ra or smoother. Measure the final outer diameter of the freeze plug to 4 decimal positions (.XXXX). Apply a chemical conversion coating to the freeze plug. Refer to 51-20-01, GENERAL.
- (5) For freeze plugs in more than one structural member, chamfer the mating edges of the freeze plug 45° x 0.003/0.006 inch. Refer to Figure 4/GENERAL, Detail I.
- (6) The thickness of the freeze plug must be the same or larger than the material thickness that is measured. Drill a pilot hole through the center of the freeze plug, if a fastener will be installed.

WARNING: LIQUID NITROGEN IS APPROXIMATELY MINUS 320°F (MINUS 196°C). WEAR PROTECTIVE CLOTHING, AND USE IN A WELL-VENTILATED AREA TO PREVENT INJURY.

- (7) Put the freeze plug in liquid nitrogen for a minimum of 10 minutes immediately before installation. In thick structure, apply BMS 5-95 sealant to the edges of the hole to help the installation of the freeze plug. Install the freeze plug flush to +0.003/-0.000 inch. Microshave the freeze plug if necessary. Refer to 51-10-01, GENERAL.
- (8) For freeze plugs in more than one structural member, the freeze plug mating surface must be 0.003 inch or less above or below the structure mating surface. Refer to Figure 4/GENERAL, Detail I.
- (9) Drill the fastener hole through the freeze plug pilot hole and the structure that is attached. Make sure the freeze plug has a minimum wall thickness of 0.05 inch. Refer to Figure 2/GENERAL, Detail I. Apply a finish to the bare surfaces of the freeze plug that is the same as the finish on the adjacent structure. Refer to 51-20-01. Install a fastener through the freeze plug and the structure that is attached.

B. Countersunk Freeze Plug Installation

NOTE: The countersunk depth of the freeze plug must not be larger than 50 percent of the aluminum structure thickness.

CAUTION: COUNTERSUNK FREEZE PLUGS MAY BE UNACCEPTABLE IN CERTAIN SITUATIONS.

- (1) Use the smallest diameter drill and reamer possible to remove the damage. Refer to 51-10-00. Remove the nicks, scratches, burrs, and sharp edges from the freeze plug hole. Make sure the freeze plug will have a minimum 0.05 inch wall thickness when the fastener hole is drilled through it. Refer to Figure 5/GENERAL, Section A-A. Measure the diameter of the freeze plug hole to 4 decimal positions (.XXXX). The cylindricity tolerance on the freeze plug hole is 0.0003 inch. Refer to Figure 3/GENERAL for the definition of cylindricity. The surface finish of the freeze plug hole must be 63 microinches Ra or smoother. Measure the thickness of the damaged aluminum structure to 3 decimal positions (.XXX). Refer to Figure 5/GENERAL, Section A-A.

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- (2) The freeze plug shank diameter must be 1.0035 to 1.0040 times larger than the diameter of the hole. For example, if the hole has a diameter of 0.4500 inch, then the freeze plug diameter must be 0.4516/0.4518 inch. Make the countersunk freeze plug from 7075-T6 aluminum with a cylindricity tolerance of 0.0002 inch. Machine the freeze plug to the countersink diameter given in Figure 6/GENERAL. The freeze plug must have a 100° countersink. Machine the freeze plug outer diameter to a surface finish of 63 microinches Ra or smoother. Measure the final shank diameter of the freeze plug to 4 decimal positions (.XXXX). Apply a chemical conversion coating to the freeze plug. Refer to 51-20-01, GENERAL.

NOTE: The countersink depth of the freeze plug must not be larger than 50 percent of the aluminum structure thickness.

- (3) For freeze plugs in more than one structural member, chamfer the mating edges of the freeze plug 45° x 0.003/0.006. Refer to Figure 4/GENERAL, Detail I.
- (4) The thickness of the freeze plug must be the same or larger than the material thickness that is measured. The thickness of clad freeze plugs must be within +0.003/-0.000 of the material thickness. Drill a pilot hole through the center of the freeze plug, if a fastener will be installed.
- (5) Make a 100° countersink in the structure so that the diameter of the countersink is the same as the diameter of the freeze plug. If you are not sure that the adjustment of the countersink tool is correct, make a countersink in a piece of metal that has been discarded. You can do this to make sure that the depth of countersink in the structure will be correct. Refer to 51-40-08.
- (6) Measure the countersink diameter in the structure, and make sure that it is the same as the diameter given in Figure 6/GENERAL.

WARNING: LIQUID NITROGEN IS APPROXIMATELY MINUS 320°F (MINUS 196°C). WEAR PROTECTIVE CLOTHING, AND USE IN A WELL-VENTILATED AREA TO PREVENT INJURY.

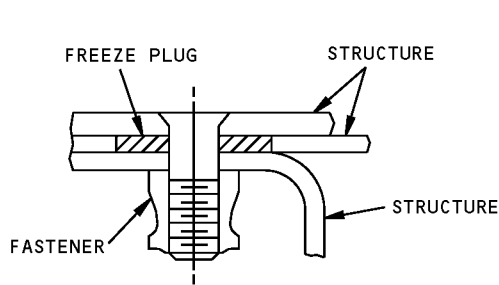
- (7) Put the freeze plug in liquid nitrogen for a minimum of 10 minutes immediately before installation. In thick structure, apply BMS 5-95 sealant to the edges of the hole to help the installation of the freeze plug. Install the freeze plug flush to +0.003/-0.000 inch.

Microshave the freeze plug if necessary. Refer to 51-10-01, GENERAL.

NOTE: Do not microshave the clad side of clad freeze plugs that will be installed in external surfaces that are not painted.

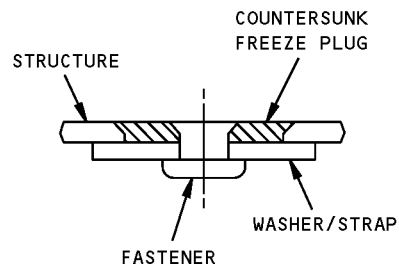
- (8) For freeze plugs in more than one structural member, the freeze plug mating surface must be 0.003 inch or less above or below the structure mating surface. Refer to Figure 4/GENERAL, Detail I.
- (9) Drill the fastener hole through the freeze plug pilot hole and the structure that is attached. Make sure the freeze plug has a minimum wall thickness of 0.05 inch. Refer to Figure 5/GENERAL. Apply a finish to the bare surfaces of the freeze plug that is the same as the finish on the adjacent structure. Refer to 51-20-01. Install a fastener through the freeze plug and the structure that is attached.

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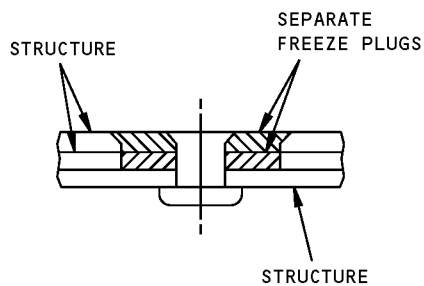
FREEZE PLUG THAT IS
CONTAINED BETWEEN TWO
OTHER PARTS

DETAIL I



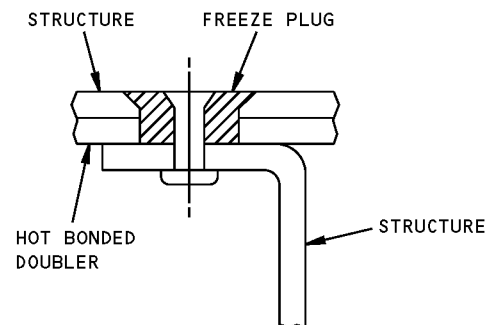
FREEZE PLUG WITH WASHER/STRAP

DETAIL II



FREEZE PLUGS IN MORE THAN
ONE STRUCTURAL MEMBER

DETAIL III

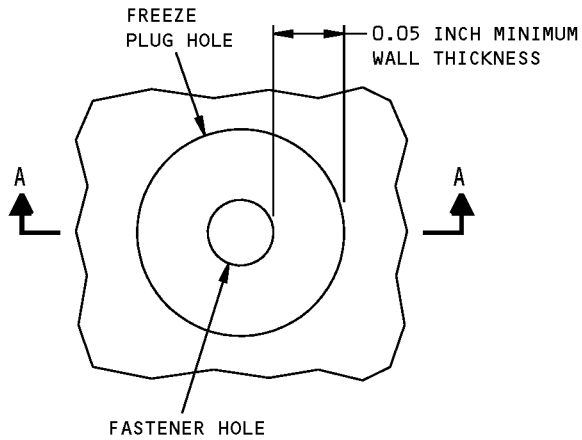


SINGLE FREEZE PLUG IN STRUCTURE
WITH HOT BONDED DOUBLER

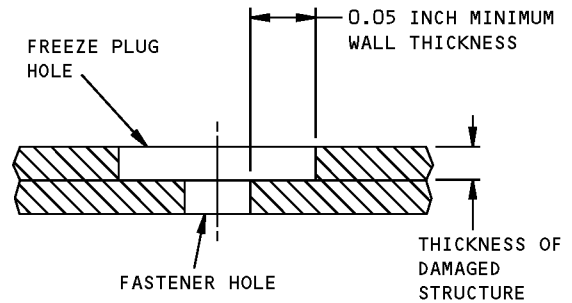
DETAIL IV

Examples of Freeze Plug Installation
Figure 1

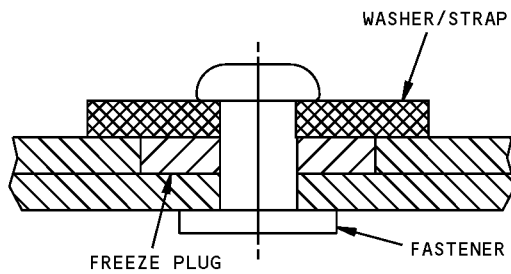
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**BEFORE INSTALLATION OF
THE FREEZE PLUG
DETAIL I**



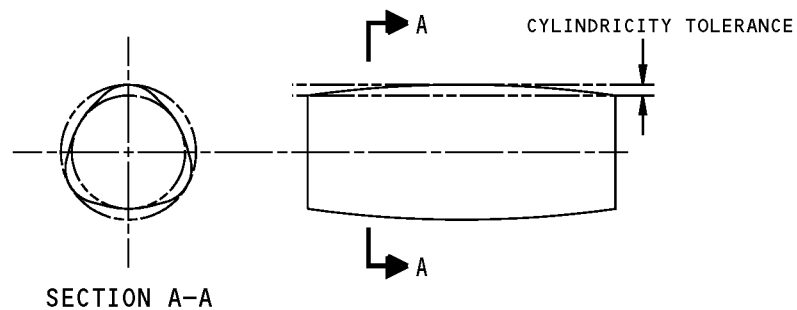
SECTION A-A



**AFTER INSTALLATION OF
THE FREEZE PLUG**

**Straight Shank Freeze Plug Installation
Figure 2**

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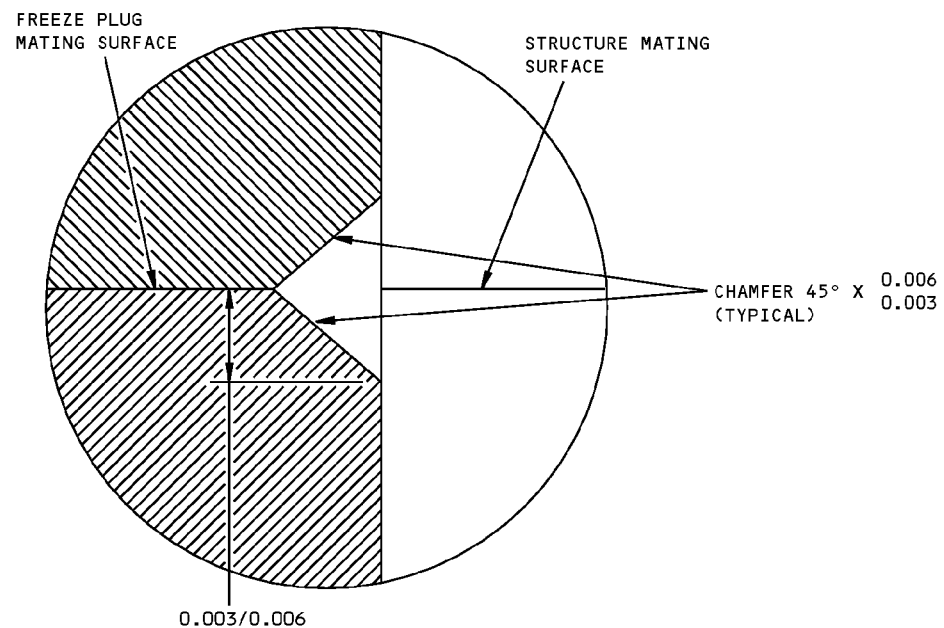
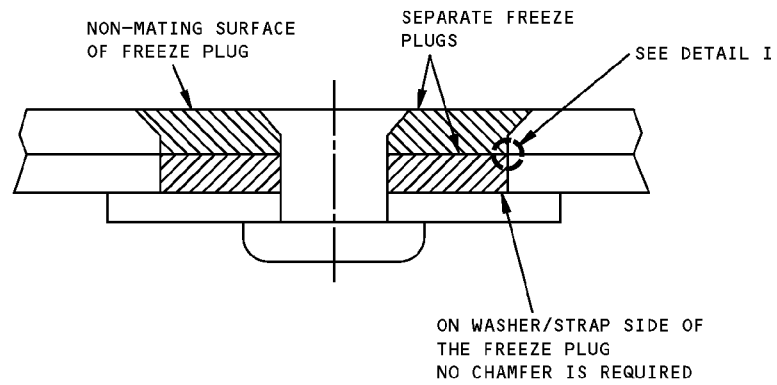


NOTES

- CYLINDRICITY IS A CONDITION WHERE ALL POINTS ON A SURFACE ARE AN EQUAL DISTANCE FROM THE SAME AXIS. A CYLINDRICITY TOLERANCE SPECIFIES AN AREA WITH TWO CYLINDERS AS LIMITS, THAT THE SURFACE MUST BE BETWEEN.
- FOR THE FREEZE PLUG INSTALLATION, THOSE AXES ARE:
 - THE CENTER OF THE HOLE THAT WILL BE REPAIRED.
 - THE CENTER OF THE FREEZE PLUG USED TO REPAIR THE HOLE.
- THE SURFACES THAT THE TOLERANCES APPLY TO ARE:
 - THE HOLE THAT WILL BE REPAIRED.
 - THE FREEZE PLUG USED TO REPAIR THE HOLE.

Cylindricity
Figure 3

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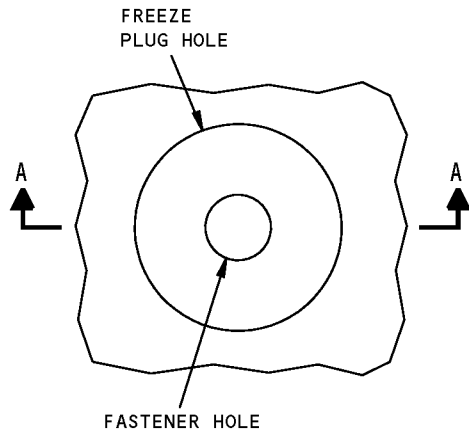
DETAIL I

NOTES

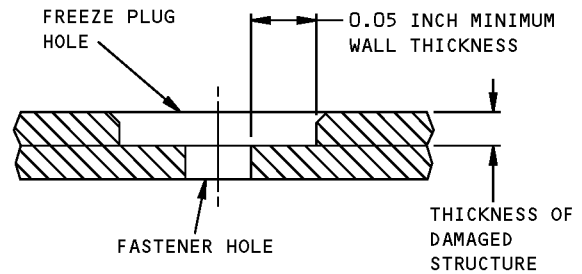
- ALL DIMENSIONS SHOWN ARE IN INCHES.
- THE FREEZE PLUG MATING SURFACE MUST BE 0.003 INCH OR LESS ABOVE OR BELOW THE STRUCTURE MATING SURFACE.

Freeze Plugs in More Than One Structural Member
Figure 4

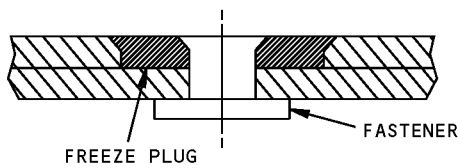
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BEFORE INSTALLATION OF
THE FREEZE PLUG
DETAIL I



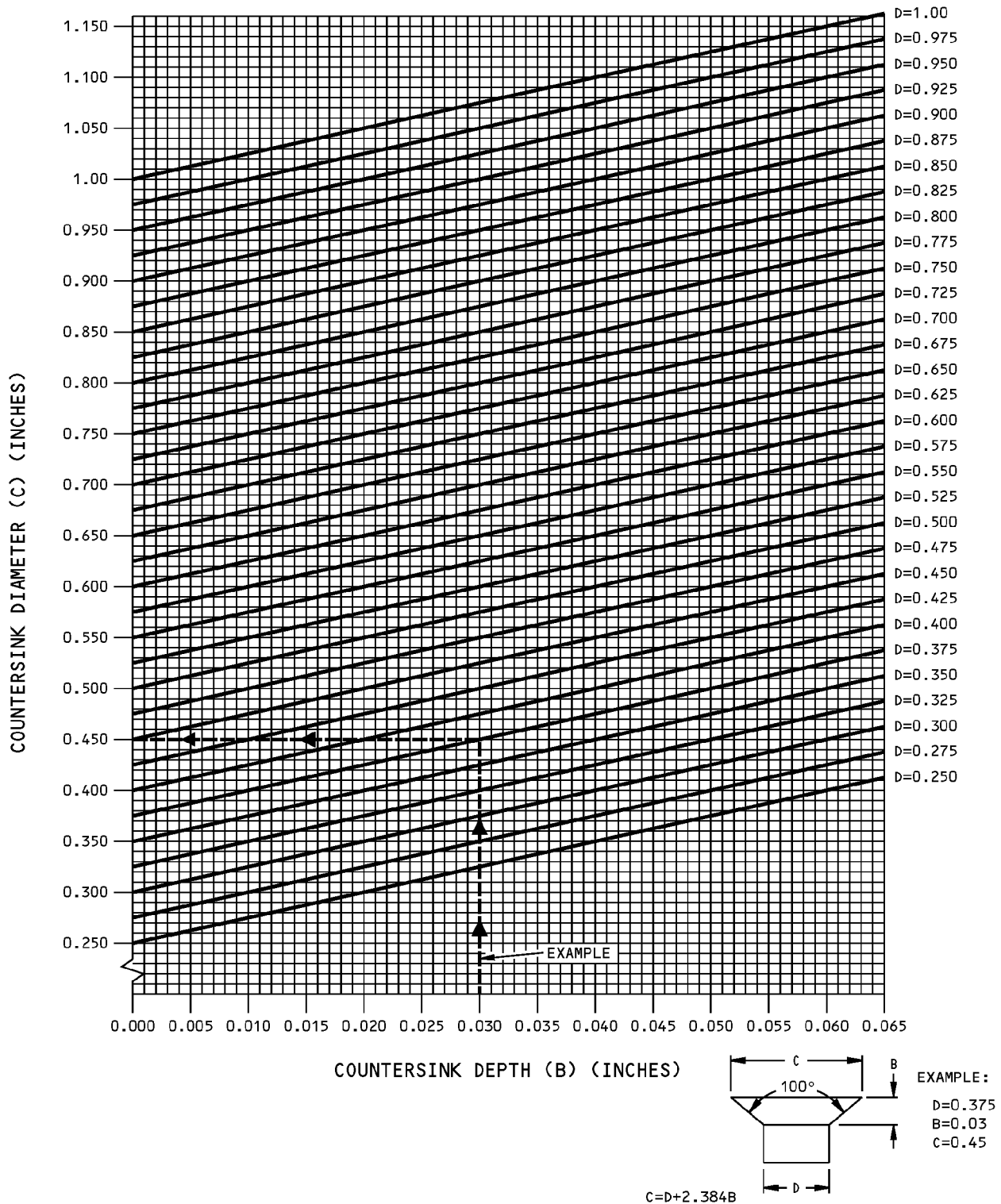
SECTION A-A



AFTER INSTALLATION OF
THE FREEZE PLUG

Countersunk Freeze Plug Installation
Figure 5

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Countersink Diameter Versus Countersink Depth
Figure 6



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GENERAL - EXPANDED FIT BUSHING INSTALLATION REQUIREMENTS

1. Applicability

- A. This section gives a list of final design and functional requirements for the expanded fit bushing installation applicable to the engine strut fitting lug hole repairs as given in NACELLES AND PYLONS, CHAPTER/54. The expanded fit bushing installation is an option to the shrink-fit bushing installation procedure as published in the specific fitting lug hole section.

NOTE: It is the responsibility of the user and/or the manufacturer of the expanded fit tool kit to get certification for each specific application. This section outlines the minimum design and functional requirements for the bushing installation with the use of the expanded fit procedure. Boeing can assist the user and/or the manufacturer of the expanded fit bushing process to review and document the applicable technical data. The user and/or the manufacturer of the expanded fit bushing process must contact Boeing for this assistance.

2. General

- A. The expanded fit bushing installation procedure installs bushings into lug housings with a mandrel which is larger than the bore of the installed bushing. The mandrel is pulled through the bore of the bushing, which makes the bushing outer diameter larger and expands the bushing to create interference with the lug bore. Refer to Figure 1/GENERAL for an example of a typical expanded fit bushing installation.
- B. This bushing installation procedure is both tool and part critical. When the expanded fit procedure is used, it is necessary to get approval for the use of the special tools and bushings for each specific fitting. It is the responsibility of the user and the manufacturer of the expanded fit tool kit to make sure the requirements listed in this section are satisfied and certified for each specific application. The optional expanded fit bushing installation tools may be supplied by any manufacturer that can meet the requirements listed in par. Paragraph 4./GENERAL satisfactorily.

NOTE: The procedures to remove damage from the fitting lug hole, inspect the bore, prepare and finish the lug hole before the repair bushing is installed, are the same as that used for the shrink-fit bushing installation procedure.

3. References

Reference	Title
54	NACELLES AND PYLONS
NDT Part 6, 51-00-01	Aluminum Part Surface Inspection (Meter Display)
SOPM 20-20-02	Penetrant Methods of Inspection

4. Installation Criteria for Expanded Fit Bushing Procedure

- A. Special tools are necessary for each specific lug bore diameter and location. The tool kit shall include tools to remove, install, inspect, and test for bushing retention. In addition, the kit shall include tool instructions, installation procedures, rework allowances and specific tests as necessary to get the proper bushing retention for each application. You must also establish and certify a test program such that the following requirements are satisfied before you do the lug hole repair.

- (1) Make sure that the final bushing installation has a minimum interference fit of 0.15% to a maximum interference fit of 0.40%.

Make an analysis of the interference level from the test coupons and examine the test results for validation. Keep a record of all the bushing installation and pushout loads.

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- (2) Make sure the expansion level of the bushing inside diameter is not more than 1.5%. Measure and make a record of this dimension from the test coupons for validation.
- (3) Make sure that the expanded fit bushing procedure will not increase the diameter of the lug hole permanently after the repair bushing is removed. Measure the test coupon fitting lug hole diameter without the mating repair bushing before and after the bushing installation for validation.
- (4) Make sure there is clearance between the outside diameter of the repair bushing and the mating fitting lug hole (with finishes on lug and bushing) before you do the expanded fit bushing installation.

Check the outside diameter of the mandrel and the inside diameter of the bushing before the bushing installation.

- (5) Do the following inspection and test for the new bushings:
 - (a) Do a high frequency eddy current inspection for cracks after final machining and prior to bushing installation. Refer to NDT Part 6, 51-00-01 for inspection procedures.
 - (b) Use a 10-power magnifying glass and do a detailed visual inspection of the bushings to make sure there are no cracks after the mandrel is pulled through the bushings. As an alternative, do a penetrant inspection of the bushings. Use Type I, method C, sensitive level 3 or higher penetrant for the inspection. Refer to SOPM 20-20-02 for the penetrant inspection procedure.
 - (c) Use lug test coupons to verify and validate bushing installation for the most critical dimensional tolerance condition. A list of some examples are: largest hole, smallest bushing outside diameter, largest percent expansion, largest hole chamfer, least lubrication on mandrel and/or bushing. Remove bushing and do a high frequency eddy current inspection for cracks or defects.

NOTE: For flanged bushings which react mandrel forces, check for flange flatness after the bushings are installed. Bushing flange cupping is not permitted. Measure and make a record of the bushing installation and the pushout loads.

- (6) Make sure that the force used to pull the mandrel through the fitting lug hole and the force used in "reseating" the bushing (if allowed) are evenly balanced through the lug thickness. No lug ear bending is permitted for either single lug or clevis applications.
- (7) Part mark the repair bushing or the repair installation with part number for identification.
- (8) Rework the lug hole again each time before the repair bushing is reinstalled. If the test and analysis can show that local cold-work around the lug hole will not increase the hole diameter permanently or cause any damage to the lug housing, then the repair bushing can be reinstalled without lug rework.
- (9) Wet bushing installation that causes hydraulic lock is not permitted when the fluid stays in the bore as the mandrel is pulled through the bushing.
- (10) Bushing reseating is not permitted. If the test and analysis can show that there is no damage to the lug bore during the "reseating" and or bushing removal procedure, then bushing reseating is permitted.
- (11) The fit, function and the structural integrity requirements of the detailed parts, assembly and installation drawings of the lug-pin connection must be satisfied when the expanded fit bushing installation procedure is used.
- (12) Make an analysis of the effect of adverse geometric tolerances and material properties used in the test. Make sure that all the requirements for expanded fit bushing installation listed above are satisfied.



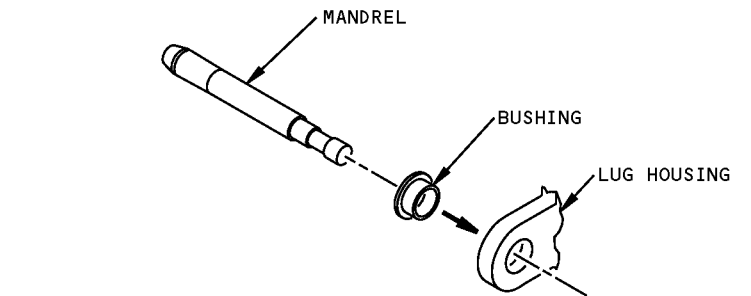
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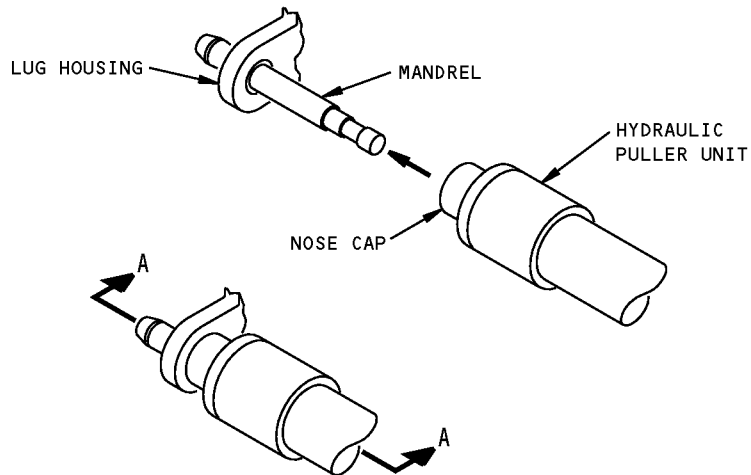
- (13) Before you use the expanded fit bushing installation process on your engine strut fittings, the first-time users must demonstrate compliance with the requirements of this section.
- (a) You must install, remove, and inspect bushings in test lug coupons used to develop the expanded fit bushing installation process.
 - (b) Keep a record of the validation test reports and any special procedures for expanded fit bushing removal, repair, inspection and installation. Make sure that all the requirements for expanded fit bushing installation listed in this section are satisfied.
 - (c) The user and/or the manufacturer of the expanded fit bushing process must get approval for its use on aircraft installation.

See the applicability note stated in this section.

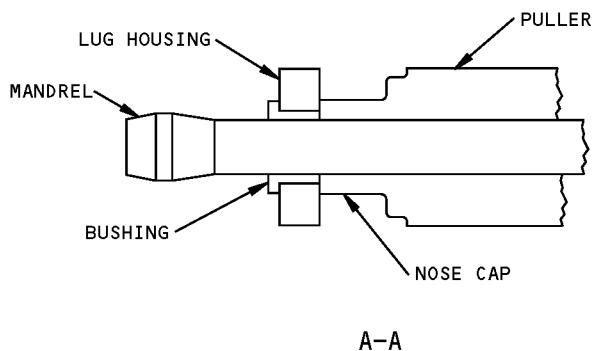
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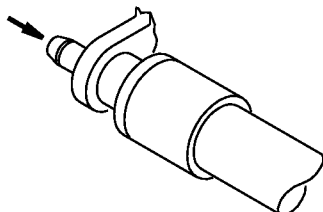
1. PUT THE BUSHING INTO THE LUG HOLE.



2. PUT THE MANDREL UNIT INTO THE LUG HOLE.
3. PUT THE END OF THE MANDREL INTO THE PULLER, WITH THE NOSE CAP AGAINST THE HOUSING.
4. MAKE SURE THE NOSECAP IS AGAINST THE HOUSING.



5. OPERATE THE PULLER TO PULL THE MANDREL THROUGH THE BUSHING.



Typical Expanded Fit Bushing Installation
Figure 1



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GENERAL - SURFACE ROUGHNESS FINISH REQUIREMENTS

1. Applicability

A. This chapter-section-subject tells how to measure the surface roughness on a metal surface.

2. General

A. Surface roughness affects fatigue life. Smoother (finer) surface finishes improve fatigue life. Most machining or abrasive grinding operations create notch patterns on the surface which result in stress fatigue cracks.

- (1) Surface roughness and finish requirements on reworked parts are shown as arithmetic values.
- (2) These arithmetic values, are numbers in micro-inches. The lower the number, the smoother the surface finish. Refer to Figure 1/GENERAL for the Arithmetic Average Deviation.

B. Refer to Figure 2/GENERAL for an example list of tools and suppliers.

3. General Machining

A. Roughness Values

NOTE: The following are maximum acceptable roughness values for machine finishes. There are no limits to the smoothness unless specified by a lower limit.

- (1) 500 micro-inch rough machine finish. Rough, low grade surfaces that result from heavy cuts and course feeds in milling, turning, shaping, boring and from very rough filing, rough disc grinding and snagging. Examples of this surface are sand castings or rough forgings or the ripple finish on parts made by Keller end milling.
 - (a) Not permitted on critically loaded parts, the failure of which would be unsafe to ground personnel or the flight of the airplane.
- (2) 250 micro-inch normal machine finish on steel that is heat treated up to 200,000 psi. Coarse production surfaces that results from very coarse surface grind, rough file, disc grind, and from rapid feeds in turning, milling, shaping, drilling, boring, grinding, and so on, where definite tool marks are permitted. This roughness can also be produced on the natural surfaces of forgings, permanent mold castings, extrusions, and rolled surfaces.
 - (a) Surfaces with this roughness value can be produced very economically and are used frequently for parts where stress requirements, appearance, conditions of operations, and design permit.
 - (b) Not permitted on:
 - 1) Steel that is heat treated over 200,000 psi or in areas with high fatigue stresses.
 - 2) Aluminum alloys.
 - 3) Steel surfaces mated with aluminum alloys.
- (3) 125 micro-inch machined finish on steel or aluminum surfaces.
 - (a) The roughest surface recommended for parts with fatigue stress or vibration. This surface roughness is also permitted for bearing surfaces when the motion is slow and the loads are light or infrequent. This surface finish can also be on permanent mold castings, die castings, cold rolled surfaces, aluminum extrusions, and some titanium 6AL-4V extrusions.
 - (b) Not permitted on:
 - 1) Surfaces with high fatigue stresses.
 - 2) Fast rotating shafts and axles, or parts that have severe vibration.



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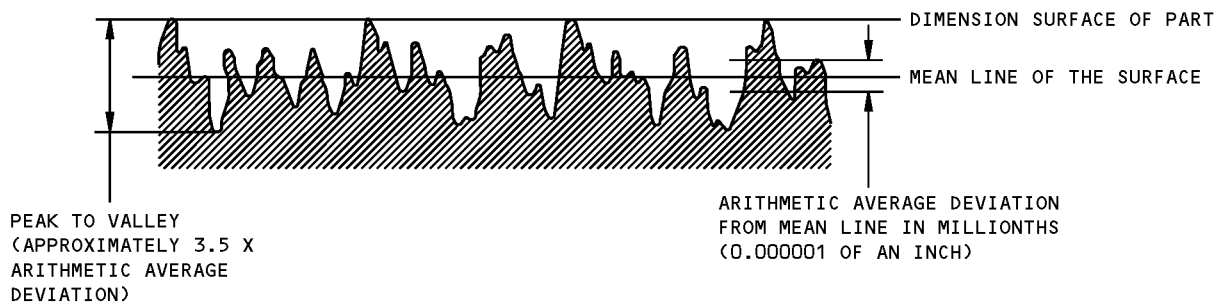
- 3) The mating surfaces of steel and 7075 aluminum alloy parts when these parts are in areas with fatigue stresses.
- (4) 63 micro-inch machined finish.
 - (a) A good machine finish, produced under controlled production procedures that use high speeds and fine feeds that take light cuts with well sharpened cutters. This surface value may be specified where close fits are required and may be used for all stressed parts.
 - (b) This surface roughness is satisfactory for bearing surfaces when the motion is slow and the loads are light or infrequent.

This surface roughness can also be on aluminum extrusions, coldrolled surfaces, die castings, and permanent mold castings when tightly controlled. Can be used where close fits are required for stressed parts. Adequate for bores in highly stressed parts that are exposed to vibration but little or no relative motion.
 - (c) Also permitted on:
 - 1) Thin, highly loaded sections or areas of high stress concentration under fatigue loading.
 - 2) Surfaces mated with highly stressed areas.

4. Measurement

- A. Surface roughness can be measured by one of the methods that follow:
 - (1) Physical comparator such as surface roughness scratch plates or finish blocks used in machine shops. Do the steps that follow:
 - (a) Select a comparator with a value specified in a repair drawing.
 - (b) Select the roughest area on the part surface to be measured.
 - (c) Feel the comparator and the part with a fingernail.
 - (d) Select the direction on the comparator and the part surface which gives the highest roughness.
 - (e) See if the part surface is as smooth as the comparator.
 - (2) Electronic or Mechanical Inspection Instrument.
 - (a) There are different types of inspection instruments. Make sure that the instruments can accurately find the correct surface roughness as specified in American National Standard (ANSI) B46.1 (or an equivalent standard for precision and accuracy).
 - (b) Operate the inspection instrument as specified in the manufacturer's instructions.

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Arithmetic Average Deviation
Figure 1



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TOOL	SUPPLIER
SURFACE FINISH COMPARATORS AND INSPECTION INSTRUMENTS	FLEXBAR MACHINE CORPORATION 250 GIBBS ROAD ISLANDIA, NY 11749 PHONE (800) 879-7575 FAX: (631) 582-8487 E-MAIL: SALES@FLEXBAR.COM WEB: HTTP://WWW.FLEXBAR.COM/SUFRUF.HTM
PORTABLE BATTERY POWERED LASERCHECK SURFACE ROUGHNESS GAGE	OPTICAL DIMENSIONS 25422 TRABUCO RD. #105-435, LAKE FOREST, CA 92630-2797 PHONE (949) 768-0405 FAX: (949) 768-0419 WEB: HTTP://WWW.OPTICALDIMENSIONS.COM
ELECTRONIC SURFACE ROUGHNESS TESTER	GAGING.COM 5016 TROPICAL CLIFF AVE. LAS VEGAS, NV 89130 PHONE: (702) 456-2264 FAX: (702) 456-2275 WEB: HTTP://WWW.GAGING.COM
SURFACE ROUGHNESS GAGE	HOUSTON PRECISION, INC. 8729 GULF FREEWAY HOUSTON, TX 77017-6504 PHONE: (800) 943-3812 OR (713) 943-1155 E-MAIL: SALES@HOUSTONPRECISION.COM WEB: HTTP://WWW.HOUSTONPRECISION.COM

TOOLS AND SUPPLIERS
TABLE I

Example List of Surface Inspection Tools and Suppliers
Figure 2

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GENERAL - PROTECTIVE TREATMENT OF METALLIC AND NONMETALLIC MATERIALS - RB211-535 ENGINE NACELLE

1. General

A. Nonmetallic repair parts

- (1) This section establishes the requirement for application of exterior coating to repair parts during accomplishment of repairs. The coatings, including primers with or without topcoats, will provide resistance to acid, fuel, lubrication oil, hot di-ester oil 178°C (350°F) and solvents. The topcoat system consists of a two component epoxy primer and two component polyurethane coating.

B. Metallic repair parts

- (1) Any repair which breaks the protective surface treatment of metallic parts, thus exposing them to possible corrosion, must be protected as detailed in Paragraph 5./GENERAL. Any area to be protected must be thoroughly degreased. The protective treatment is a pre-treatment, primer and application of gloss enamel.

2. References

Reference	Title
51-31-03, GENERAL	Nonmetallic Materials - RB211-535 Engine Nacelle
AMM 20-31-85	Aircraft Maintenance Manual
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
SOPM 20-30-85	Solvents For Final Cleaning of all Organic Coatings Before Painting (Series 85)
SOPM 20-30-88	Solvents For Final Cleaning Metal Before Non-Structural Bonding (Series 88)

3. Materials

- A. For non-metallic repair materials and their sources, refer to Protective Material Sources, Figure 1/GENERAL.
- B. For metallic repair materials and their sources refer to Protective Material Sources, Figure 2/GENERAL.

4. Protective Treatment of Non-Metallic Parts

A. Surface preparation

- (1) Surface preparation consists of the following three methods:

- (a) Dry abrasion
- (b) Wet abrasion
- (c) Dry abrasive blast

- (2) Dry abrasion

- (a) Wash surface with MEK, MPK, CDG-110, CDG-211, ethyl alcohol, or isopropyl alcohol and clean wipers.
- (b) Dry sand surface using waterproof abrasive paper, grit size 180 through 400.
- (c) Use abrasive nylon web pads (Scotchbrite) to clean and remove gloss from indentations or depressions.

NOTE: Use a light circular sanding motion and avoid exposing fibers of composite material surfaces.

- (d) Remove sanding residue with clean, dry compressed air.

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CAUTION: DO NOT ALLOW SOLVENTS TO DRY ON SURFACE.

- (e) Wash surface with MEK, CDG-110, CDG-211, MPK, Turco 6709, or FCC-55 and clean wipers; wipe dry.

(3) Wet abrasion

CAUTION: DO NOT ALLOW SOLVENT TO DRY ON SURFACE.

- (a) Remove soil from surface using clean cotton wipers dampened with MEK, CDG-110, CDG-211, MPK, Turco 6709, or FCC-55.
- (b) Dry with clean cotton wipers.
- (c) Following preliminary solvent wash; water sand, using tap water and waterproof abrasive paper, grit size 180 through 400.

NOTE: All areas must present a matt appearance after sanding.

- (d) Rinse with clean, tap water.
- (e) Perform a water break test. Refer to (Paragraph 4.A.(5)/GENERAL).

(4) Dry abrasive blast

- (a) Remove soil from surface using clean cotton wiper dampened with MEK, CDG-110, CDG-211, MPK, Turco 6709, or FCC-55.
- (b) Abrasive blast, using 240 grit or fine aluminum oxide. The blast shall be directed at approximately a 45-degree angle to surface being abraded and air pressure at nozzle not to exceed 40 psi.
- (c) Abrade composite material to produce a matt finish without exposing any of the reinforcement fibers.
- (d) Remove abrasive residue using clean, dry compressed air and a brush or a clean dry cloth.

(5) Surface break test.

- (a) Using a clean soft hair brush and the specified fluid, quickly apply a uniform film over the bonding area.

NML 21 fluid

Industrial or Ethly Alcohol - 25 to 30 ml. (OMat 155 or 156)

Distilled water - 1000 ml.

Crystal violet - 1 g. (OMat 1/59)

- (b) Immediate observation must be made for any break in continuity of the film.
- (c) If breaks occur within 30 seconds, the appropriate surface cleaning procedure must be repeated until a continuous film is observed.
- (d) Remove the break test fluid by swabbing with clean acetone (OMat 1/13) and then allowing the surface to dry.

B. Application of protective treatment

(1) Apply coatings

- (a) Remove peel ply from surface.

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- (b) Apply one cross coat of epoxy primer 513 x 319 base and 910 x 456 curing agent, 0.500 to 0.800 mm. (0.0197 to 0.0315 in.) thick.

NOTE: Refer to Paragraph 4.C./GENERAL paragraph C. for mixing instructions.

- (c) Cure for a minimum of two hours or a maximum of eight hours.
- (d) Abrade surface of primer to remove matt appearance.
- (e) Remove high spots to produce a smooth finish.
- (f) Apply white filler putty 467-9/CA-41B to fill surface imperfections prior to application of surfacer, primer, and topcoat.

CAUTION: FILLER PUTTY, WHEN CATALIZED, HAS A USABLE WORK LIFE OF EIGHT HOURS AT TEMPERATURES BELOW 26.7 DEG.C. (80 DEG.F.).

- (g) Work filler putty into surface defects with a putty knife, plastic squeegee or a pad of cheesecloth.

NOTE: 1. Use a knife or plastic squeegee with a firm criss-cross motion.

2. Use a pad of cheesecloth with a circular motion.

3. A pad of cheesecloth is preferred method.

- (h) Before curing filler putty, remove all possible excess to prevent subsequent excessive abrading.

NOTE: A knife, razor blade or plastic squeegee is recommended for this purpose.

- (i) Cure filler putty by one of the following methods before abrading:
- 1) Air dry at ambient $70 \pm 10^{\circ}\text{F}$ ($21 \pm 6^{\circ}\text{C}$) temperature for 6 hours minimum.
 - 2) Force cure: Allow to air dry at ambient temperature approximately 45 minutes, then force cure at $160 + 20 / - 0^{\circ}\text{F}$ ($71 + 11 / - 0^{\circ}\text{C}$) for 60 to 90 minutes.
- (j) Sand cured filler putty with 240 through 320 grit abrasive paper.
- (k) Remove sanding residue with clean, dry, compressed air.
- (l) Wash with MEK, CDG-110, CDG-211, Turco 6709, MPK, or FCC-55 and cheesecloth, wipe dry.
- (m) Spray apply one uniform cross-coat of surfacer (464-3-1/CA-142).

NOTE: Admixed surfacer has a usable work life of 4 hours at temperatures below 27°C (80°F).

- (n) Cure surfacer by one of the following methods before abrading:
- 1) Air dry at $70 \pm 10^{\circ}\text{F}$ ($21 \pm 6^{\circ}\text{C}$) for 6 hours.
 - 2) Air dry at ambient temperature for 45 minutes minimum and force cure at $160 + 20 / - 0^{\circ}\text{F}$ ($71 + 11 / - 0^{\circ}\text{C}$) for 1 hour.
- (o) Abrade cured surfacer using 240 through 400 grit abrasive paper, removing majority of surfacer without abrading through to substrate.
- (p) Remove abrading residue with dry, filtered, compressed air and a brush or clean wipers.

CAUTION: DO NOT ALLOW SOLVENT TO DRY ON SURFACE.

- (q) Wash with clean wipers dampened with MEK, CDG-110, CDG-211, Turco 6709, MPK, or FCC-55 to remove abrading residue.
- (r) Wipe dry with clean wipers.

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C. Mixing and Thinning Protective Coating

(1) Epoxy primer (513 x 319 base and 910 x 456 curing agent)

- (a) Mix material to manufacturer's instructions.
- (b) Allow mixture to catalize a minimum of 25 minutes before using.

NOTE: 1. Mix only the amount of material which can be used immediately to avoid gelation in the pot.

2. Discard material after 8 hours.

(2) Topcoat

- (a) Mix an equal amount of base and catalyst by volume.
- (b) Add up to 10 per cent thinners (TL59) by volume to obtain spraying viscosity.
- (c) Allow mixture to catalize 30 minutes before using.

NOTE: Immediately after mixing, mark containers with date and hour of mixing and pot life expiration date.

- (d) Pot life is 8 hours in a closed container.

NOTE: 1. Mix only the amount of material which can be used immediately to avoid gelation in the pot.

2. Discard material after 8 hours.

D. Application procedures for protective coating

(1) Apply epoxy primer (513 X 329 base, 910 X 456 curing agent)

- (a) Apply a coat of epoxy primer, 0.5 to 0.8 mm. (0.0197 to 0.0315 in.) thick.
- (b) Topcoat (external surface) (822-315/910-331A or 643-3-9/ X 310A).
 - 1) Apply a thin wet coat approximately 0.5 to 1.0 mm. (0.0197 to 0.0394 in.) thick and allow to dry for 60 minutes.

CAUTION: DO NOT APPLY A MIST OR FOG COAT, THIS WILL CAUSE A ROUGH SURFACE RESULTING IN LOSS OF GLOSS.

- 2) Apply a second wet coat to form total dry topcoat film thickness of 1.0 to 2.0 mm. (0.0394 to 0.079 in.).

(2) Apply topcoat (internal surface) 822-315/910-331A or 643-3-9/ X 310A.

- (a) Apply directly over adhesive primed surfaces that have been solvent cleaned with solvent, Series 85 (Refer to AMM 20-30-85 and SOPM 20-30-85).
- (b) Apply a topcoat to a dry film thickness of 0.8 to 1.0 mm. (0.0315 to 0.0394 in.).

E. Curing and drying protective coating

(1) Primer

- (a) The minimum air dry time of the primer prior to application of a topcoat is 2 hours.
- (b) The maximum allowable air dry time of the primer prior to application of a topcoat is 24 hours.

(2) Topcoat

- (a) Full cure at ambient temperature is 14 days, or at 140 + 20 / -0°F (60 + 11 / -0°C) for 8 to 12 hours.
- (b) Dry for stacking, handling, and taping.

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STRUCTURAL REPAIR MANUAL

- 1) At 160 +20 / -0°F (71 +11 / -0°C) for 1 hour.
OR
- 2) At 120 +10 / -0°F (49 +6 / -0°C) for 2 hours.
OR
- 3) At 80 +10 / -0°F (27 +6 / -0°C) for 5 hours.

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STRUCTURAL REPAIR MANUAL

MATERIAL	SOURCE	SUBJECT																	
		51-21-01	54-30-70	54-10-01															
MATERIALS FOR PROTECTIVE TREATMENT																			
COATING COLOR 707 GREY 822 - 315/910 - 331A	A	X																	
COATING COLOR 707 GREY 643 - 3-9/X 310A	D	X																	
URETHANE PAINT	C	X																	
THINNERS TL 59	D	X																	
P33 POLYURETHANE PRIMER CATALYST CSH 3334	E I J	X	X																
P33 POLYURETHANE PRIMER BASE CSH 3233	E I J	X	X																
P33 POLYURETHANE THINNER TSL 3335	E I J	X	X																
P66 POLYURETHANE FINISH BASE (GREY) SH3266	E I J	X	X																
P66 POLYURETHANE FINISH CATALYST CSH 3367	E I J	X	X																
P66 POLYURETHANE THINNERS TSL 3261A	E I J	X	X																
PRIMERS																			
513 X 319 BASE		X	X																
910 X 456 CURING AGENT	A	X	X																
RMS 118 TYPE 1		X																	
FILLERS																			
WHITE FILLER PUTTY 467 - 9/CA - 41/B	D	X																	
WHITE SURFACER 464 - 3 - 1/CA - 142	D	X																	
FILLER TWO PACK EC3524B/A PART A, PART B	I K L (OR ANY APPROVED LOCAL AGENT)			X															
CLEANERS																			
METHYL-ETHYL-KETONE H-N-95		X	X																
TRICHLOROETHYLENE - INHIBITED 1.1.1 (CHLOROETHANE VG. BS 4487: 1969 MIL-T-81533	G H E	X																	
METHYL-ETHYL-KETONE M-M-95	LOCAL PURCHASE																		

Protective Material Sources (Nonmetallic)
Figure 1 (Sheet 1 of 3)

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STRUCTURAL REPAIR MANUAL

MATERIAL	SOURCE	SUBJECT															
		51-21-01	54-30-70	54-10-01													
MISCELLANEOUS ITEMS																	
ABRASIVE PAPER 120 TO 400 GRIT	B	X															
NYLON WEB PADS		X															
LINT-FREE COTTON WIPERS		X															
METHYLATED SPIRIT BS 3951:1963	E F G (OR LOCAL PURCHASE)	X															
ETHYL ALCOHOL BS 507:1966	E F G (OR LOCAL PURCHASE)	X															
DISTILLED WATER	E F G (OR LOCAL PURCHASE)	X															
INDICATOR, CRYSTAL VIOLET	E F (OR LOCAL PURCHASE)	X															
ACETONE	E F (OR LOCAL PURCHASE)	X															
PVC SHEETING GRADE DO, UNEMBOSSED, GREEN 317, BS 1763	I M (OR ANY APPROVED LOCAL AGENT)		X														
SCOTCH BRITE TYPE A 7496 COARSE (LIGHT GREEN) FINE TO MEDIUM	I K	X	X														
SURFACE INSPECTION FLUID NML21 MSRR9015	E	X	X														
WATERPROOF SILICON CARBIDE SANDPAPER GRIT SIZE 400,360, 320,280,240 AND 220	E N O P (OR LOCAL PURCHASE)	X	X														

Protective Material Sources (Nonmetallic)
Figure 1 (Sheet 2 of 3)

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STRUCTURAL REPAIR MANUAL**NOTES**

- | | |
|--|--|
| A DE SOTO INC., PACIFIC PLANT
FOURTH AND CEDER STS
BERKLEY, CA 94710
USA | I INTERNATIONAL PAINT CO. LTD
(PINCHIN JOHNSON PAINT DIVISION)
380 RICHMOND ROAD,
KINGSTON, SURRY KT2 5PS
ENGLAND |
| B 3-M COMPANY
ST. PAUL, MN 55101
USA | J INTERNATIONAL PAINT CO., INC.
21 WEST STREET
NEW YORK CITY, NEW YORK 10006 |
| C U.S. PAINT DIV, GROW GROUP
831 S. 21 STREET
ST. LOUIS, MO 63103
USA | K 3M'S (UK) LTD
3M HOUSE
PO BOSE 1
BRACKNELL, BERKSHIRE RG12 1JU |
| D BOSTICK
20846 S NORMANDY AVE.
TORRANCE, CA 90502
USA | L CANADIAN GENERAL ELECTRIC
5000 JEAN TALON WEST
MONTREAL QUEBEC, CANADA |
| E MED-LAB LTD
COPELAND ST.
DERBY, DEL 2PU | M WALLINGTON WESTON CO., LTD
FROME, SOMERSET BA11 3EQ
ENGLAND |
| F THE BRITISH DRUG HOUSES LTD
BDH LABORATORY CHEMICAL DIVISION
POOLE, DORSET OR BINKBECK STREET
LONDON, E2 SJW | N CARBORUNDUM CO., LTD
PO BOX 55
TRAFFORD PARK
MANCHESTER M17 1HP
ENGLAND |
| G IMPERIAL CHEMICAL INDUSTRIES LTD
NEW YORK LTD, AMERICA INC.
444 MADISON AVE.
NEW YORK 22
USA | O ENGLISH ABRASIVES CORPORATION
MARSH LANE
TOTTENHAM, LONDON M17 |
| H IMPERIAL CHEMICAL INDUSTRIES LTD
ICI HOUSE
MILLBANK
LONDON SW1P 355 | P NORTON CO.
COATED ABRASIVES DIVISION
TROY, NEW YORK 12181 |

Protective Material Sources (Nonmetallic)
Figure 1 (Sheet 3 of 3)

STRUCTURAL REPAIR MANUAL**5. Protective Treatment of Metallic Parts (Nose Cowl External Surface)**

A. Clean surface in preparation for protective treatment.

WARNING: WHEN USING DEGREASING FLUID, ENSURE ADEQUATE VENTILATION, AVOID SKIN CONTACT AND AVOID INHALING VAPOR.

(1) Cold liquid degrease solvent, Series 88 (Refer to AMM 20-30-88 and SOPM 20-30-88).

NOTE: It is important that a clean lint-free cloth is used for each separate degreasing operation and that the cloth is moistened by means of a suitable dispenser so that liquid runs on to cloth and thereby avoiding contamination of the bulk of liquid. It is essential that degreased areas remain free from any form of contamination due to handling and soiling.

(a) Moisten a clean, dry, lint-free cloth with degreasing liquid and swab surfaces to be cleaned.

CAUTION: IF DRYING TIME IS OMITTED, CORROSION CAN RESULT FROM BREAKDOWN OF ANY RESIDUAL LIQUID TRAPPED IN A RESTRICTED SPACE.

(b) Allow parts that have internal pockets or passage ways to dry for at least one hour.

B. Pretreat Surfaces (refer to Protective Materials, Figure 2/GENERAL)

WARNING: USE GOOD VENTILATION TO PREVENT OPERATOR BREATHING THE FUMES. AVOID SKIN CONTACT BY WEARING P.V.C. GLOVES, APRON, AND GOGGLES. IF CONTACT OCCURS, WASH IMMEDIATELY WITH WATER.

(1) Degrease as detailed in Paragraph 5.A./GENERAL.

NOTE: Surfaces which have been wet or dry blasted do not require operations (2) to (5) being affected.

(2) Further clean area by brushing with Synperonic 'N' solution.

(3) Swill area with clean, cold water.

(4) Brush on phosphoric acid etch solution.

(5) Swill area with clean, cold water.

(6) Brush on Alocrom 1200 solution until surface shows an iridescent gold to a light, golden brown color.

(7) Swill area with clean, cold water and dry off either by use of warm air blast or by carefully wiping with clean cloths.

C. Mixing of Primer (463-6-5 Bostick Finch Yellow)

NOTE: Primer consists of a two-component kit containing resin base and curing agent. Thinner is supplied separately when required.

(1) Agitate primer base material and curing agent thoroughly just prior to mixing. Agitate sufficiently to incorporate all solids that may have settled out during storage.

(2) Catalyze primer by adding proper amount of curing agent to resin base according to Figure 3/GENERAL. Stir base continuously while adding curing agent. Immediately after catalyzing, thin primer with proper amount of reducer required for spray viscosity according to Figure 3/GENERAL.

(3) Label container with date and hour of mixing and date and hour pot life expires.

STRUCTURAL REPAIR MANUAL

CAUTION: PRESSURE POT LINERS AND EQUIPMENT OF STAINLESS STEEL WILL RESIST ATTACK BY THE ACID IN THE WASH PRIMER. DO NOT USE ALUMINUM LINERS.

- (4) Spray equipment used for wash primer must be clean. Flush out with alcohol before and after using.
- (5) Spray equipment used for application of other primers shall be thoroughly flushed with solvent, Series 85 (AMM/SOPM 20-30-85) and dried before and after use.

D. Application of Primer (463-6-5 Bostick Finch Yellow)

- (1) Do not apply primer over previously painted surfaces.
- (2) Primer films that are too thick or that have cured over 4 hours shall be stripped according to AMM 51-21-01 and reapplied.
- (3) Primer dry-to-tape time is dependant on temperature and humidity and is given in Figure 3/GENERAL as a guide only. This time may be shortened or lengthened as need be providing tape after removal has had no visible effects on primer film.
- (4) If overspray or other surface roughness of primer film is apparent, lightly hand-sand dry primer with 400 or finer grit abrasive paper or Scotch-Brite pads. Use extreme care to prevent removal of primer to substrate. If this occurs, repair per Paragraph 5.G./GENERAL
- (5) Primer films that are soiled from dust, dirt and/or paint overspray, or that have been sanded shall be carefully cleaned immediately prior to overcoating by wiping with a tack rag.

E. Mixing of Enamel (653-3-9 Bostick Finch Grey)

- (1) Agitate enamel base material thoroughly just prior to mixing. Agitate sufficiently to incorporate all solids that may have settled out during storage.

NOTE: Enamel consists of a two-part component kit containing resin base and a catalyst. Thinner is supplied separately when required.

- (2) Catalyze enamel by adding proper amount of catalyst to resin base. Stir base continuously while adding curing agent. Thin enamel with amount of reducer required for spray application. Stir mixture thoroughly prior to application.
- (3) Label container with date and hour of mixing and date and hour of pot life expiration.

F. Application of Enamel (653-3-9 Bostick Finch Grey)

- (1) Apply 2 to 3 coats with 15 minutes to 78 hours between coats. If application temperature is below 90°F (32°C) and cure is to be accelerated at temperatures above 90°F (32°C), control heating rate so air temperature does not exceed 90°F (32°C) during first 30 minutes of cure.
- (2) The total enamel and primer thickness must not exceed 5.8 mils. Final color shall uniformly hide substrate color.
- (3) Dry-to-tape times for BMS 10-60 Type I enamels at 90°F (32°C) are approximately 6 hours. Drying time is dependent on temperature and humidity. Time may vary providing tape, after removal, has had no visible effects on enamel film. Exact time can be determined on practice panels under shop conditions identical to those under which airplane is painted.
- (4) Cure 8 hours minimum before exposing paint to rain or outdoor temperatures below 75°F (24°C). Cure 72 hours minimum before flight.

G. In-Process Correction

- (1) Surfaces with Minor Damage (Not to Bare Metal)
 - (a) Sand smooth with 280-grit or finer wet or dry abrasive paper.

STRUCTURAL REPAIR MANUAL

- (b) Remove sanding dust with a clean cheesecloth saturated with TL-52 solvent, wipe dry with clean cheesecloth.
 - (c) Reprime if necessary masking surrounding areas. Feather edges of dry primer with Scotch-Brite pads to make a smooth finish.
 - (d) Remove masking and repaint enamel. Spray overlap to make a continuous unblemished surface.
- (2) Areas with Extensive Damage (Bare Metal Exposed)

CAUTION: DO NOT ALLOW PAINT STRIPPER TO CONTACT FIBERGLASS OR SEAMS OF ADHESIVE BONDED PARTS.

- (a) Strip paint film from damaged area as given in AMM 51-21-00/701 (use Turco 5351 only) or sand to a smooth surface taking care not to sand to bare metal. Feather edges of adjacent area with 280-grit or finer abrasive paper wet with water.
 - (b) Remove sanding dust with clean cheesecloth saturated with TL-52 solvent. Wipe dry with clean cheesecloth.
 - (c) Reapply appropriate primer systems and topcoats as required. Feather all edges to make a continuous smooth finish.
- (3) Areas with Defective Paint Films (Sags, Runs, Drips or Orange Peel)
- (a) Sand area to degree necessary to correct defects using 280 or finer wet or dry abrasive paper. Feather edges into surrounding areas.
 - (b) Wipe sanding residue from area with cheesecloth dampened with TL-52 solvent.
 - (c) Touch up with appropriate enamel.

6. Restoration of Surface Protection to Nose Cowl, Thrust Reverser and Fan Cowl Components

NOTE: This Repair details the restoration of surface condition by application of filler material to surface imperfections and application of exterior coating. Coatings, including primers with or without topcoats provide corrosion protection and resistance to acid, fuel, lubrication oil, hot diester oil and solvents. The topcoat system consists of a two component polyurethane primer and a two component polyurethane topcoat.

A. Clean repair area.

- (1) Thoroughly degrease repair area, use solvent, Series 85 (AMM 20-31-85 and SOPM 20-30-85) and clean lint-free cloths..
- (2) Dry area immediately using oil-free dry air supply.

CAUTION: AVOID EXPOSING FIBRES. USE LIGHT CIRCULAR MOTIONS AND ABRADE REPAIR SURFACES. USE GARNET PAPER 320 TO 400 OR 220 TO 230.

- (3) Clean surface and remove gloss from indentations and depressions. Use Scotch Brite.
- (4) Remove sanding residue from repair area. Use oil-free air blast.
- (5) Repeat step 1.
- (6) Water break test surfaces. If unsuccessful, repeat steps 4, 5, and 6.

NOTE: If component is not to be treated immediately cover prepared area with PVC sheeting. Avoid contaminating prepared area during this operation.

B. Application of Resin Filler

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- (1) Mix EC3524B/A resin filler. Measure one hundred (100) parts EC3524B (blue) to ninety-four (94) parts of EC3524A (white) by weight. Mix materials by kneading until uniform blue color, free of streaks is obtained (Ref 51-31-03, GENERAL). Remove PVC sheeting if previously used.

C. Cure the resin filler

- (1) Partially cure at 72°F (22°C) until resin filler starts to stiffen.
- (2) Using clean warm pallet knife or similar, remove excess filler. Use a planing or burnishing action; clean blade before reheating.
- (3) Complete cure for 24 hours at 72°F (22°C) or half an hour at 200°F (93°C).
- (4) Blend filler material to contours. Use garnet 220 to 280 or 324 to 400.
- (5) Remove sanding residue from area. Use oil-free air blast.
- (6) Clean area again as given in Paragraph A, Steps 1 and 2.

NOTE: If surface is not to be coated immediately, cover prepared area with PVC sheeting.

D. Application of polyurethane primer

- (1) Mix polyurethane primer constituents per manufactures' instructions.

NOTE: Viscosity of P33 polyurethane primer base and catalyst can be adjusted with P33 polyurethane thinner as required.

If Rohr and Boeing system 513X329 (primer) and Rohr and Boeing system 910X456 (catalyst) are used in place of P33 polyurethane, thinners are not available.

Pot life is 8 hours at 72°F 22°C.

- (2) Remove PVC sheeting if previously used.
- (3) Spray primer on prepared surface. Allow to air-dry for a minimum of 4 hours before applying topcoat.

NOTE: The recommended time between application of primer and topcoat is 24 hours. If this interval exceeds 72 hours then the surface must be reprepared and the primer reapplied.

E. Application of polyurethane topcoat.

- (1) Use polyurethane topcoat as per manufactures instructions.

NOTE: Viscosity of P66 polyurethane finish primer and catalyst can be adjusted with P66 polyurethane thinners as required if Rohr and Boeing system 643-3 finish base and Rohr and Boeing system 310A finish catalyst, are used. Viscosity can be adjusted using Rohr and Boeing system TL59 as required.

- (2) Apply one wet or wet topcoat on primed surface with a minimum of 10 minute drying time between coats.
- (3) Allow topcoat to air-dry for a minimum of 6 hours before handling.

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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT							SUPPLIER
	51-21-01	54-10-01						
MATERIALS FOR PROTECTIVE TREATMENT ENAMEL GLOSS BAC 707 GREY 653-3-9 THINNERS TL 59 TWO PACK EPOXY CLEAR ENAMEL BASE SL5459 PJP9110A 8000 CATALYST CSH5538 PJ92000.2.0538	X X	X X						B A C D A C D
PRIMER (EPOXY) YELLOW 463 - 6 - 5 THINNERS TL 52								B
FILLERS RESIN FILLER EC3524BA		X						A E
SURFACE PRE-TREATMENT ALOCROM 1200 DTD900/4413 31g/1 SEALER HYMOLAR SQ 32M	X	X						A F G H J
SYNPERONIC "N" SOLUTION PHOSPHORIC ACID (H3 PO4 S.G.I. 65)	X X							A A
ETCH CLEANING NITRIC ACID SG-142 3mL/L	X							A
CLEANING SOLVENT DEOXIDE 624 INHIBITED 1.1.1. TRICHLOROETHANE	X X							A
MISCELLANEOUS ITEMS LINT-FREE COTTON WIPERS SUITABLE PAINT BRUSH POLYTHENE CONTAINER GARNET PAPER 60-80	X X X	X						

Protective Material Sources (Metallic)
Figure 2 (Sheet 1 of 2)

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STRUCTURAL REPAIR MANUAL**NOTES**

- A** MED-LAB LIMITED
2-6 AGARD STREET
DERBY
DE1 1DZ
ENGLAND
OR
IMPERIAL CHEMICAL INDUSTRIES LTD.
I.C.I. HOUSE
MILLBANK
LONDON SW1
ENGLAND
OR
IMPERIAL CHEMICAL INDUSTRIES LTD.
NEW YORK LTD AMERICA INCORPORATED
444 MADISON AVENUE
NEW YORK
USA
- B** BOSTICK
20846 S NORMANDY AVE
TORRANCE CA 90502
USA
- C** PINCHIN JOHNSONS PAINTS
TRANSPORT DIVISION
ROTTON PARK STREET
LADYWOOD
P.O. BOX 359
BIRMINGHAM 16
ENGLAND
- D** INTERNATIONAL PAINT CO. INC.
21 WEST STREET
NEW YORK
NEW YORK CITY 10006
USA
- E** 3M COMPANY
3M HOUSE
WIGMORE STREET
LONDON W1
ENGLAND
OR
3M COMPANY
3M CENTRE
ST PAUL
MINNESOTA 55101
USA
- F** PINCHIN JOHNSONS PAINTS
TRANSPORT DIVISION
ROTTON PARK STREET
LADYWOOD
P.O. BOX 359
BIRMINGHAM 16
ENGLAND
- G** MARSTON LUBRICANTS LIMITED
7-11 NAYLOR STREET
LIVERPOOL L3 6DS
ENGLAND
- H** VAN DUSSEN AIRCRAFT SUPPLIES
TETERBORO AIRPORT
500 INDUSTRIAL AVENUE
TETERBORO NJ 07608
USA
- J** KINGSLEY AND KIETH (CANADA) LTD
310 VICTORIA AVENUE
P.O. BOX 140 VICTORIA STATION
MONTREAL 6
QUEBEC
CANADA

Protective Material Sources (Metallic)
Figure 2 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL

PRIMER AND ENAMEL CURE TABLE							
MATERIAL DESIGNATION	MIXING RATIO PARTS BY VOLUME	INDUCTION PERIOD	POT LIFE	MILS DRY FILM	DRY TIME TO RECOAT	DRY TIME TO TAPE ^A	SPRAY VISCOSITY #2 ZAHN
POLYURETHANE GLOSS BMS 10-60 TYPE I CLASS A BASE: 653-3-9 CATALYST: X-310A THINNER: TL-59	4 1 AS REQ'D	30 MIN	4 HRS	1.8 TO 2.2		6 HRS AT 90°F	15 TO 20 SEC
EPOXY PRIMER BOSTICK-FINCH BMS 10-1 (INTERMEDIATE) BASE: 463-6-5 CATALYST: X-306 THINNER: TL-52	3 1 4/5 MAX	30 MIN	8 HRS	0.5 TO 0.8	2 TO 96 HRS ^A	45 MIN AT 75°F	18 TO 20 SEC

TABLE I

NOTES

- ^A TAPE AFTER REMOVAL SHALL HAVE HAD NO VISIBLE EFFECTS ON PRIMER FILM

Primer and Enamel Cure Data
Figure 3

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STRUCTURAL REPAIR MANUAL**GENERAL - REPAIR SEALING - RB211-535 ENGINE NACELLE****1. Applicability**

A. The procedures detailed in this section are to be used when fay surface sealing is instructed.

2. General

A. For sources of sealing materials, refer to Figure 1/GENERAL

3. References

Reference	Title
51-21-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials - RB211-535 Engine Nacelle

4. Materials

A. Refer to sealing materials, Figure 1/GENERAL

5. Clean Area to be Sealed

A. Clean as given in 51-21-01, GENERAL.

6. Details of Sealing Compound

A. The compound is obtained under the brand name "Hylomar PL32M" (Refer to Figure 1/GENERAL). The particular grade, suffix M, denotes the consistency to be used in any repairs. The compound is resistant to water, water/glycol and water/methanol mixtures, petroleum and synthetic ester based lubricants and kerosine fuels. It can be used for sealing components operating from -50 deg.C. to +300 deg.C. (-58 deg.F. to +572 deg.F.).

7. Application of Sealing Compound

- A. The compound is to be applied, to both faces to be sealed, using a fairly stiff brush employing a stippling action.
- B. A minimum of 10 minutes air drying time must be allowed before components are assembled.

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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT							SUPPLIER
	54-10-01							
SEALING COMPOUND HYLOMAR (PL 32M)	X							<div>A</div> <div>B</div> <div>C</div> <div>D</div>

NOTES

- A** MED-LAB LIMITED
COPELAND STREET
DERBY
DE1 2PU
- B** MARSTON BENTLEY LIMITED
HYLO HOUSE
COLE LANE
NEW SPRINGS
WIGAN
WN 21JR
- C** INDESTRUCTIBLE PAINT CO. LTD.
25 PENTOS DRIVE
BIRMINGHAM
B11 3TA
- D** MARSTON BENTLEY
1848 STAR BATT DRIVE
ROCHESTER HILLS, MI 48309
U.S.A.

Sealing Material Sources
Figure 1



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - SHEET METAL MATERIALS

1. General

- A. Most of the sheet metal used in the structure of the airplane is aluminum alloy. Some sheet metal made from corrosion-resistant steel alloy, titanium alloy, and steel alloy is also used. Figure 1/GENERAL shows approximately equivalent strength materials.
- B. If you repair the airplane structure, apply a finish that gives protection to all aluminum alloy parts and surfaces that were cut and drilled. Other metals like titanium, CRES, and inconel may also need finishes. Refer to 51-20-01, GENERAL.
- C. Tool Terminology
- (1) A hand tool is a tool that you can hold and operate with your hands.
 - (2) A hand drill is a drill that:
 - You can hold and operate in your hand
 - Has adjustable speeds which you can change as you drill
 - Does not have automatic feed control.
 - (3) RPM is an abbreviation for Revolutions Per Minute.

2. References

Reference	Title
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-02, GENERAL	Heat Treat Verification - Hardness and Conductivity Testing
51-20-05, GENERAL	Repair Sealing
SOPM 20-10-07	Machining of Titanium
SOPM 20-30-03	Standard Overhaul Practices Manual
SOPM 20-41-02	Application of Chemical and Solvent Resistant Finishes
SOPM 20-50-12	Application of Adhesives

3. Aluminum Alloys

- A. You can identify aluminum alloys by symbols of the Aluminum Association four-digit index system. Two examples of an alloy identifier are 2024 and 7075.
- B. The "TXXX" code that follows an alloy identifier shows how the alloy was heat-treated. If an "O" follows the alloy identifier then the material has not been heat-treated. The alloy is in the annealed condition. You can form aluminum easily when it is annealed, but you must heat-treat the part before you install it on the airplane.
- C. The word "clad" before an alloy identifier shows that the alloy has a thin layer of pure aluminum on it. The layer of aluminum was applied to the alloy before the last rolling procedure.
- D. Figure 2/GENERAL shows alternative replacement materials. If the initial material is not available, then use one of the alternative materials shown. Figure 2/GENERAL also gives material replacement factors and an example of how they are used.
- E. The aluminum alloy sheet metals most frequently used are 2024-T3 and 7075-T6. 7075-T6 is stronger than 2024-T3. The two materials have different minimum bend radii. The two materials have different forming properties. The minimum bend radius of 7075-T6 is larger than 2024-T3, so it is often formed in the annealed condition (7075-O). After the 7075 sheet is formed in the annealed condition, it is heat-treated to 7075-T62. 2024-T3 is usually formed in the heat-treated condition. The minimum bend radii of different aluminum sheet metal materials are given in Figure 3/GENERAL.



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STRUCTURAL REPAIR MANUAL

- F. You must be careful with aluminum alloy materials. Small damage, such as scratches, burrs, and nicks can cause an important decrease in the fatigue strength of the aluminum alloy material.
- G. If the alloy identifier has been removed from a sheet of aluminum, you can test it to identify the alloy. Use the hardness and conductivity tests given in 51-20-02, GENERAL.

NOTE: Hardness and/or conductivity values may overlap for some alloys.

4. Magnesium Alloys

WARNING: KEEP MAGNESIUM PARTICLES AWAY FROM SOURCES OF IGNITION. SMALL PARTICLES OF MAGNESIUM BURN VERY EASILY. IN SUFFICIENT CONCENTRATION, THESE SMALL PARTICLES CAN CAUSE AN EXPLOSION.

IF WATER TOUCHES MOLTEN MAGNESIUM, A STEAM EXPLOSION COULD OCCUR. EXTINGUISH MAGNESIUM FIRES WITH DRY TALC, CALCIUM CARBONATE, SAND, OR GRAPHITE. APPLY THE POWDER ON THE BURNING METAL TO A DEPTH OF 1/2 INCH OR MORE. DO NOT USE FOAM, WATER, CARBON TETRACHLORIDE, OR CARBON DIOXIDE.

- A. Magnesium alloy looks almost the same as aluminum alloy. For equal volumes of magnesium and aluminum, the weight of magnesium alloy is approximately two-thirds the weight of aluminum.
- B. You can cut, drill and ream magnesium alloy with the same tools you use on steel or brass. The cutting edges of the tool must be sharp.
- C. Magnesium alloys must not touch methyl alcohol. Do not use magnesium alloys in liquid deicing and water injection systems. Do not use magnesium alloys in the integral fuel tank areas.
- D. Use Type B rivets (5056-F aluminum alloy) in magnesium alloy parts. Use clad 2024-T3 aluminum alloy for repair parts.

5. Titanium Alloys

WARNING: KEEP TITANIUM PARTICLES AWAY FROM SOURCES OF IGNITION. SMALL PARTICLES OF TITANIUM BURN VERY EASILY. IN SUFFICIENT CONCENTRATION, THESE SMALL PARTICLES CAN CAUSE AN EXPLOSION.

IF WATER TOUCHES MOLTEN TITANIUM, A STEAM EXPLOSION COULD OCCUR. EXTINGUISH TITANIUM FIRES WITH DRY TALC, CALCIUM CARBONATE, SAND, OR GRAPHITE. APPLY THE POWDER ON THE BURNING METAL TO A DEPTH OF 1/2 INCH OR MORE. DO NOT USE FOAM, WATER, CARBON TETRACHLORIDE, OR CARBON DIOXIDE.

- A. Titanium alloy looks almost the same as corrosion-resistant steel (CRES) and is almost as strong as the hardened forms. For equal volumes of titanium and CRES, the weight of titanium alloy is approximately 56 percent the weight of steel.
- B. Titanium is very resistant to atmospheric corrosion and you usually do not need to apply a finish to it. But, you must isolate titanium from magnesium, aluminum, or alloy steel. If titanium contacts magnesium, aluminum or alloy steel, galvanic corrosion or oxidation will occur.

Refer to 51-20-01, GENERAL and 51-20-05, GENERAL for finishes, treatments, and sealants that give protection.

STRUCTURAL REPAIR MANUAL

CAUTION: CADMIUM PLATING OF TITANIUM COMPONENTS IS NOT PERMITTED. UNDER CERTAIN CONDITIONS, TITANIUM AND ITS ALLOYS, WHEN IN CONTACT WITH CADMIUM WILL BECOME EMBRITTLED. THIS CAN CAUSE COMPONENT FRACTURE. AN EXCEPTION IS THAT CADMIUM PLATED NUTS OR COLLARS CAN BE USED ON TITANIUM BOLTS, BUT NOT AGAINST TITANIUM STRUCTURE.

- C. Some SRM repairs are formed 6AL-4V annealed titanium sheet. The procedures used to form 6AL-4V annealed titanium sheet are given below.
- (1) Hot forming 6AL-4V annealed titanium.
 - (a) Apply a scale inhibitor to the part before you heat it.
 - (b) Heat the part to a temperature above 1200°F (649°C), but below 1500°F (816°C).
 - (c) Form the titanium to the radii given in Figure 4/GENERAL, Table I. If you form to radii smaller than this, you must penetrant-inspect the bend. Refer to .
 - (d) Keep the part at this temperature for more than 10 minutes, but less than 10 hours.
 - (e) After the part is cool, remove the scale from the surface. To remove the scale, etch all the surfaces to the depths shown in Figure 4/GENERAL, Table II. Refer to SOPM 20-30-03 to etch titanium.
 - (2) Cold forming 6AL-4V annealed titanium (room temperature forming).
 - (a) Form the titanium to the radii given in Figure 4/GENERAL, Table I. If you form to radii smaller than this, you must penetrant inspect the bend. Refer to .
 - (b) Stress relieve the part as follows:
 - 1) Heat the part to a temperature above 1250°F (677°C), but below 1450°F (788°C).
 - 2) Keep the part at this temperature for more than 30 minutes but less than 10 hours.
- D. Use a hand drill only when you have to. If you can, you should use positive-power-feed drills. Refer to SOPM 20-10-07 D6-51702, for information on drilling titanium with positive-power-feed drills. Figure 5/GENERAL shows equipment that can be used to drill titanium.
- E. Use these guidelines when you drill titanium:
- (1) If you use a hand drill, the largest diameter hole you can drill (in a single step) is 0.1563 inch. This is because:
 - You must push on the drill with a large force
 - When you push on the drill with much force, the larger diameter drill bits will not cut satisfactorily
 - Drill bits that do not cut satisfactorily cause damage to the hole.
 - (2) Use a "pistol grip" type hand drill if you can because you can push harder with this type of drill.
 - (3) Holes with a diameter of 0.1875 inch and larger can be hand-drilled if:
 - You start with a hole with a diameter of 0.1563 inch
 - Increase the diameter of the hole in 0.0313 or 0.0625 inch increments.
 - (4) If you use a hand drill with a 90° angle head, then you must use 0.0313-inch increments. If you use the standard "pistol grip" type hand drill, then you can use an increment of 0.0625. You can use the larger increment because you can push harder with the "pistol grip" type hand drill.
 - (a) Holes with diameters as large as 0.75 inch have been made using this procedure.
 - (5) We recommend you use the usual high-speed steel drill bits when you hand drill. When you hand drill titanium, we recommend the RPM (revolutions per minute) ranges shown in Table 1/GENERAL.

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Table 1: Drill Speeds - RPM Ranges

DRILL SIZE	RPM RANGE
0.0625	920 to 1830
0.125	460 to 920
0.1875	230 to 460

- (6) The life of a drill bit is shorter when you drill titanium than when you drill steel. Do not:
 - Use a blunt drill bit
 - Let a drill bit rub the surface of the metal and not cut it.
 - (a) If one of these conditions occurs, the titanium surface will become work-hardened and it will be very difficult to start the drill again.
- (7) When you hand drill two or more titanium parts at the same time, you must clamp them together tightly. To clamp them together, use temporary bolts, Cleco clamps, or tooling clamps. Put the clamps around the area that you will drill, and as near the area as possible.
- (8) When you hand drill thin or flexible parts, put a support (such as a block of wood) behind the part. If you do this, you will:
 - Make good, clean holes
 - Break fewer drill bits
 - Make a smaller exit burr.
- (9) Titanium has a low thermal conductivity. When it becomes hot, other metals will become easily attached to it. Particles of titanium will often become welded to the sharp edges of the drill bit if the drill speed is too high. When you drill large plates or extrusions, use a water soluble coolant or sulphurized oil.
- (10) Cutting Fluids
 - (a) If you use a cutting fluid when you drill:
 - The holes will have a better tolerance
 - The drill bit will last longer.
 - (b) If the hole has a depth larger than the diameter of the drill bit, use a cutting fluid. If the hole has a depth less than the diameter of the drill bit, you can drill with or without a cutting fluid.
 - (c) Cutting fluid types are listed below. If you use a cutting fluid, you must clean the repaired area before you apply paint or sealant. Refer to SOPM 20-41-02 and SOPM 20-50-12.
 - 1) If you can clean the repair area after you drill, we recommend you use one of the cutting fluids that follow:
 - a) Daracool 706 (4% cutting fluid - 96% water mix)
 - b) BOELUBE

NOTE: BOELUBE comes in liquid, solid, and paste forms.
 - 2) If you cannot clean the repair area after you drill, use BOELUBE as a cutting fluid.
 - (d) Refer to Table 2/GENERAL for sources of the cutting fluids.

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Table 2: Sources for Cutting Fluids

CUTTING FLUID	SOURCE
Daracool 706	W.R. Grace and Co. Davison Chemical Division 10 East Baltimore Street Baltimore, MD 21202-1630
BOELUBE	The Orelube Corp. 201 East Bethpage Road Plainview, NY 11803-4202

F. Use these guidelines when you ream titanium alloy with a hand tool.

- (1) You can use straight-fluted-chucking reamers or reamers with minimum margins (0.010 inch or less). We recommend that you use the usual high-speed steel reamers when you ream with a hand tool.
- (2) The drill should have a motor with a maximum speed of less than 600 RPM.
- (3) When you ream a hole, use a higher feed rate than when you drill a hole. Ream the hole with a feed rate which will make a satisfactory finish. When you ream, the reamer must constantly cut the metal.
- (4) If the hole has a depth larger than the diameter of the drill bit, ream it with a cutting fluid. If the hole has a depth less than the diameter of the drill bit, you can ream it with or without a cutting fluid. For more information on cutting fluids, see the guidelines for drilling titanium.
- (5) When you ream a hole to the actual fastener dimension, you should remove as much material as possible. Remove at least 0.0156 inch from the hole when the diameter of the hole is less than 0.1563 inch. Remove at least 0.0313 inch from the hole when the diameter of the hole is 0.1563 inch and larger.
- (6) Remove the reamer from the hole before you stop its rotation.
- (7) When a reamer is made from a larger reamer, it is usually circle ground. When a reamer is circle ground, the reamer's margin width increases. If the reamer's margin width increases, then it will make a hole that is too large. To prevent oversize holes you must decrease the margin width to 0.010 to 0.015 inch.

G. Use these guidelines when you countersink titanium:

- (1) When you countersink, use the same speeds and feed rate as when you drill.
- (2) We recommend that you do not countersink into titanium with hand tools when the hole diameter is greater than 0.1875 inch.
- (3) Use the usual high speed steel cutters to countersink into titanium.
- (4) When you use a cutting fluid, the speed of the cutter should be 25 to 30 SFM (surface feet per minute). When you do not use a cutting fluid, the speed of the cutter should be 20 to 25 SFM.
- (5) For holes with a diameter of 0.1875 or less, you can use a microstop countersink tool.

H. Follow these guidelines when you cut titanium with a hand tool:

- (1) Tools which shear metal, like roller shears or nibblers, cut titanium well. But, most tools are designed for materials which are easy to cut, like aluminum or mild steel. To get good results when you cut titanium:
 - You must use a tool that is designed to cut a material that is twice as thick as the initial thickness
 - You must slow the speed of the tool.

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(2) Figure 5/GENERAL shows equipment that can be used to cut titanium.

(a) Roller Shears

- 1) For titanium sheets of gage 0.100 inch and less, roller shears cut well. For gages above 0.100, roller shears cause edge cracks.

(b) Nibblers

- 1) You can use nibblers to cut titanium sheet for gages up to 0.100. After the titanium is cut, the edge should be square, scalloped, and lightly burred. If there are many burrs, it is possible that the punch is damaged.
- 2) After you cut with nibblers, you must hand finish the edges. To make the edge clean, about 0.010 inch of the edge will usually need to be removed.
- 3) You should use a motor with a low speed (approximately 450 strokes per minute).
- 4) If you use a motor with a low speed, you do not need a cutting fluid. If you use a motor with a high speed (above 600 strokes per minute) you must use a cutting fluid. A water soluble oil, like TJ-73 spray must be used.

(3) Routers and similar tools do not cut titanium well. It is difficult to hold the tool stable and keep the chip rate constant.

(4) Saber saws may be used when you cannot use other tools. But, they cut more slowly and the blades become blunt quickly.

I. Refer to SOPM 20-10-07 when you machine titanium with equipment that is not movable.

J. When you machine titanium, you must remove all of the sharp edges. Unless specified differently by a repair, remove all machined edges to a radius of 0.008 inch or more.

(1) A color that is darker than light straw caused by an increase in temperature must be removed.

6. Corrosion-Resistant Steel (CRES)

A. Corrosion-resistant steel (CRES) sheet is used for some parts in corrosion susceptible environments and when high strength is necessary.

CAUTION: CRES THAT IS IN CONTACT WITH TITANIUM SHOULD BE LEFT BARE, AND MUST NOT BE PLATED WITH CADMIUM. THE CADMIUM CAN EMBRITTLE THE TITANIUM.

B. CRES that is in contact with magnesium, aluminum, alloy steel or cadmium must be plated with cadmium. The purpose of the cadmium plating is to provide galvanic protection to the metals in contact with the CRES. Refer to 51-20-01, GENERAL for details of protective finishes.

C. The minimum bend radii of CRES sheet material is shown in Figure 6/GENERAL. For sheet thickness of 0.063 inch or less the preferred new material is alloy 17-7PH.

7. Inconel

A. Inconel 625 and Inconel 718 are nickel-chromium alloys. Inconel is corrosion-resistant and stays strong at high temperatures. Because of these properties, Inconel is frequently used in the engine structure.

B. If you drill into Inconel 625 and 718 with the usual procedures, it can:

- Cause drill bits to break sooner
- Cause damage to the edge of the hole when the drill bit goes through the metal.

C. We recommend that you:

- Drill pilot holes in loose repair parts with power-feed equipment before you pre-assemble them
- Pre-assemble the repair parts and drill the pilot holes in the mating structure

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- Drill the pilot holes to their completed hole dimension.
- D. You can hand drill Inconel alloys of all heat-treat conditions. To hand drill gages of 0.09 and less, we recommend the procedure below:
- (1) Drill Bit Type
 - (a) A stove burner drill bit is better than a cobalt drill bit because it is stronger. Also, the 118-degree point does not cause damage to the edge of the hole as easily as the usual 135-degree cobalt drill bit. However, you can drill No. 30 or No. 40 pilot holes with cobalt "rivet knock-out" drill bits.
 - (b) You can use a 135-degree point steel drill bit. We recommend these steel drill bits:
 - NAS907, Types C, P3, or P5 for Inconel 718
 - NAS907, Type P9 for Inconel 625.
 - (2) Feed
 - (a) Feed rates are not used when you hand drill. When you hand drill you must push hard on the drill, but stay at a constant chip rate. Example: for a No. 30 hole, push the drill with approximately 50 pounds of force.
 - (b) Holes with a diameter between 3/16 and 3/8 should be drilled in two steps. One step is sufficient for holes with a diameter less than 3/16 inch. You can use 1 inch-foot taper reamers to increase the diameter of the pilot hole to 0.1563 inch.
 - (3) Refer to Table 3/GENERAL for the maximum drill speed values.

Table 3: Drill Speeds - Maximum

Drill Size	Maximum RPM
80-30	500
29-U	300
3/8	150

- (4) Cutting Fluid
 - (a) A cutting fluid is not necessary when you hand drill.

8. Flat Patterns

- A. A flat pattern is the shape of a flat piece of sheet metal necessary to make a bent part. To make a flat pattern, measure the dimensions and the radii of the damaged part or the opposite part. To measure the dimensions and radii you can use one of the two procedures below:
 - Bend a piece of soldering wire around the part
 - Make a sketch of the part as shown in step (1).
- B. The second procedure is more accurate. After you measure the dimensions, you can calculate the developed length and make the flat pattern.
 - (1) Make a sketch of the cross-section of the part. Refer to Figure 7/GENERAL. Show these dimensions of the part:
 - A = Developed Flange Width
 - B = Set-Back (Figure 8/GENERAL)
 - C = Web Length
 - D = Set-Back (Figure 8/GENERAL)
 - E = Developed Flange Width



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- R = Bend Radius (Figure 3/GENERAL
Figure 4/GENERAL and Figure 6/GENERAL)
- F = Flange Angle
- G = Flange Angle
- G = Material Thickness

(2) Calculate the developed length. Use this formula:

$$\text{Developed Length} = A - X + C - X1 + E$$

X (Refer to Figure 9/GENERAL)

X1 (Refer to Figure 9/GENERAL)

CAUTION: DO NOT USE A METAL SCRIBER. THE SCRATCHES ON THE METAL CAN CAUSE CRACKS.

- (3) Put the flat pattern on a flat sheet of repair material that has no pilot holes. Refer to Figure 7/GENERAL. With a sharp crayon, make a line on the sheet of repair material all around the flat pattern. Cut the repair part out. The repair part can be bent to the shape of the damaged part.

9. **Rules for Shimming**

- A. Figure 10/GENERAL shows the instructions for shims that are used in repairs.



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MATERIAL		DOMESTIC SPECIFICATION (USA) (Acceptable Alternatives)		UNITED KINGDOM DESIGNATION
		MATERIAL	SPECIFICATION	SPECIFICATION
ALUMINUM	SHEET	CLAD 2024-T3	QQ-A-250/5	L109 A
		CLAD 2024-T42	QQ-A-250/5	L110
		BARE 2024-T3	QQ-A-250/4 or AMS-QQ-A-250/4	L70 A
		CLAD 2014-T6	QQ-A-250/3	L165 (Replaced L73)
		2219-T81	QQ-A-250/30	DTD5070
		5052	AMS 4017	2L55
		6061	AMS 4117	BS 1474
		CLAD 7075	QQ-A-250/13	L88
	PLATE	2024-T351	QQ-A-250/4	L97
	BAR AND ROD	2024-T4	QQ-A-225/6	L64 B
		2024-T6	QQ-A-225/6	L65
	CASTING	A357.0	MIL-A-21180 CLASS II	L92
		A356.0	MIL-A-21180	BS 1490
	DIE FORGING	2014-T6	QQ-A-367	L77
TITANIUM	SHEET	COMPURE-70	MIL-T-9046, TYPE 1, COMP B	TA6
		COMPURE-60	MIL-T-9046, TYPE 1, COMP C	DTD5323
		Ti-6AL-4V	MIL-T-9046	BS 2TA.10
	BAR FORGING	COMPURE-70	MIL-T-9047, COMP 1	TA9
	FORGING	Ti-6AL-4V	MIL-F-83142, COMP 6	DTD5323
	CASTING	Ti-6AL-4V	MIL-T-81915, TYPE III, COMP A	DTD5363
	BAR	Ti-6AL-2Sn-4Zr-2Mo	MIL-T-9047	BS TA.45
	FORGING	Ti-6AL-2Sn-4Zr-2Mo	AMS 4976	BS TA.44

Approximately Equivalent Strength Materials
Figure 1 (Sheet 1 of 3)

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STRUCTURAL REPAIR MANUAL

MATERIAL		DOMESTIC SPECIFICATION (USA) (Acceptable Alternatives)		UNITED KINGDOM DESIGNATION
		MATERIAL	SPECIFICATION	SPECIFICATION
CARBON STEEL	SHEET/ PLATE/ BAR	1020	AMS 5032	040A20
	BAR/ROD	1040	060A40	MIL-S-11310
	SHEET/ BAR	1080	AMS 5110	80CS
ALLOY STEEL	SHEET/ PLATE	4340	AMS 6359	817M40
		4130	AMS 6348	708A30
		4140	AMS 6395	708M40
	BAR	52100	AMS 6440	534A99
		300M	AMS 6417	S155A
	FORGING	4340 (QUENCH AND TEMPER-HT 125-145 KSI)	MIL-S-5000B, COMP F	BSS154
CORROSION RESISTANT STAINLESS STEEL	SHEET/ PLATE	301	MIL-S-5059	301S21
		302	MIL-S-5059	302S25
	BAR/ROD	303	AMS 5640, TYPE 1	303S22
	SHEET/ PLATE	304	AMS 5501	304S15
		304L	MIL-S-4043	304S11
		316	AMS 5524	316S31
		321	QQ-S-766	321S20
		347	AMS 5512	347S31
		410	410S21	AMS 5504
		15-5PH	AMS 5862	15Cr5Ni
		17-4PH	AMS 5604	17Cr4Ni
		17-7PH	AMS 5528	301S81
		A286	AMS 5726	BS 1503
	BAR	420	AMS 5506	420S29
		431	AMS 5628	431S29

Approximately Equivalent Strength Materials
Figure 1 (Sheet 2 of 3)



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STRUCTURAL REPAIR MANUAL

MATERIAL		DOMESTIC SPECIFICATION (USA) (Acceptable Alternatives)		UNITED KINGDOM DESIGNATION
		MATERIAL	SPECIFICATION	SPECIFICATION
NICKEL	SHEET/ PLATE/	NICKEL ALLOY 625	AMS 5599	BS 3076
		NICKEL ALLOY X-750	AMS 5542	H505
COPPER	SHEET	Al-Ni-Bronze (C630000)	AMS 4640	BS 2870
	BAR/ROD/ PLATE/ TUBE/ FORGING	Cu-Be (C17200)	AMS 4650	CB101

NOTES

- A** ADD 10% THICKNESS FOR EQUIVALENT STRENGTH
- B** FOR t LESS THAN 4.0 INCHES ADD 10% EXTRA THICKNESS. FOR t GREATER THAN 4.0 INCHES ADD 20% EXTRA THICKNESS. t = MATERIAL THICKNESS

Approximately Equivalent Strength Materials
Figure 1 (Sheet 3 of 3)



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FORM	ORIGINAL MATERIAL	SUBSTITUTES				
0.016 TO 0.125 SHEET	CLAD 2024-T42	CLAD 2024-T3 2024-T3				
	CLAD 2024-T3	CLAD 7075-T6 <table border="1"><tr><td>A</td><td>G</td></tr></table> 7075-T6 <table border="1"><tr><td>A</td><td>G</td></tr></table>	A	G	A	G
		A	G			
A	G					
CLAD 7075-T6	2024-T3 CLAD 7075-T6 <table border="1"><tr><td>A</td><td>G</td></tr></table> 7075-T6 <table border="1"><tr><td>A</td><td>G</td></tr></table>	A	G	A	G	
A	G					
A	G					
FORMED OR EXTRUDED SECTION	2024-T42	2024-T3 <table border="1"><tr><td>A</td></tr><tr><td>B</td></tr><tr><td>G</td></tr></table>	A	B	G	
A						
B						
G						

MOST AVAILABLE STANDARD ALUMINUM SHEET METAL GAGES	
0.012	0.071
0.016	0.080
0.020	0.090
0.025	0.100
0.032	0.125
0.036	
0.040	0.160
0.045	
0.050	0.190
0.056	
0.063	0.200

SHEET MATERIAL TO BE REPLACED	MATERIAL SUBSTITUTION FACTOR											
	7075-T6	CLAD 7075-T6		2024-T3		CLAD 2024-T3		2024-T4 2024-T42		CLAD 2024-T4 CLAD 2024-T42		
	<div>C</div>	<div>C</div>	<div>H</div>	<div>D</div>	<div>E</div>	<div>D</div>	<div>E</div>	<div>D</div>	<div>E</div>	<div>D</div>	<div>E</div>	
7075-T6	1.00	1.10		1.25	<div>F</div>	1.33		<div>F</div>	<div>F</div>	<div>F</div>	<div>F</div>	
CLAD 7075-T6	1.00	1.00		1.16	<div>F</div>	1.23	<div>F</div>	<div>F</div>	<div>F</div>	<div>F</div>	<div>F</div>	
2024-T3	1.00	<div>A</div>	1.00	<div>A</div>	1.00	1.00	1.09	1.10	1.14	1.21	1.24	1.31
CLAD 2024-T3	1.00	<div>A</div>	1.00	<div>A</div>	1.00	1.00	1.00	1.00	1.00	1.08	1.16	1.29
2024-T42	1.00	<div>A</div>	1.00	<div>A</div>	1.00	1.00	1.00	1.00	1.00	1.00	1.09	1.14
CLAD 2024-T42	1.00	<div>A</div>	1.00	<div>A</div>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NOTES

- ALL DIMENSIONS ARE IN INCHES UNLESS GIVEN DIFFERENTLY
- THE USE OF BARE MATERIAL WHEN SUBSTITUTED FOR CLAD MATERIAL MAY REQUIRE ADDITIONAL CORROSION PROTECTION (REF 51-20-01)
- EXAMPLE:
TO REPLACE 0.040 7075-T6 MATERIAL WITH CLAD 7075-T6, MULTIPLY GAGE BY MATERIAL SUBSTITUTION FACTOR TO GET SUBSTITUTE GAGE (0.040 X 1.10 = 0.045 GAGE)

- | |
|---|
| A |
|---|

 THESE MATERIALS CANNOT BE USED AS REPLACEMENTS FOR THE INITIAL MATERIAL IN:
- THE AREAS THAT ARE PRESSURIZED
 - THE WING INTERSPAR STRUCTURE
 - THE WING CENTER SECTION STRUCTURE
 - THE UNPRESSURIZED FUSELAGE STRUCTURE IN FUSELAGE SECTION 48
 - THE STRUT OR NACELLE STRUCTURE
 - IN DAMAGE TOLERANT REPAIRS.

- | |
|---|
| B |
|---|

 USE NEXT HIGHER STANDARD GAGE WHEN USING A FORMED SECTION AS A SUBSTITUTE FOR AN EXTRUSION
- | |
|---|
| C |
|---|

 FOR FLAT SHEET AND FORMED SECTIONS ALL GAGES
- | |
|---|
| D |
|---|

 FOR FLAT SHEET LESS THAN 0.071 INCH THICK
- | |
|---|
| E |
|---|

 FOR FLAT SHEET AND FORMED SECTIONS GREATER THAN 0.071 INCH THICK
- | |
|---|
| F |
|---|

 THESE MATERIALS ARE NOT TO BE USED AS SUBSTITUTES
- | |
|---|
| G |
|---|

 TO PREVENT CRACKS WHEN YOU FORM THE MATERIAL, YOU MUST FORM IT IN THE O TEMPER, THEN HEAT TREAT IT TO T62 TEMPER.
- | |
|---|
| H |
|---|

 FOR STRUCTURAL BONDS, CLAD 7075-T6 CANNOT BE USED AS AN ALTERNATIVE.

Material Substitution
Figure 2



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STRUCTURAL REPAIR MANUAL

MINIMUM INNER BEND RADII					
GAGE	ALUMINUM				
	2024-0 5052-H34	2024-T3/T4	5052-0	7178-0 7075-0	7178-T6 7075-T6
A	0.03	0.06	0.03	0.03	0.09
0.016	0.03	0.06	0.03	0.03	0.09
0.018	0.03	0.06	0.03	0.03	0.12
0.020	0.03	0.06	0.03	0.03	0.12
0.022	0.06	0.09	0.03	0.06	0.12
0.025	0.06	0.09	0.03	0.06	0.12
0.028	0.06	0.09	0.03	0.06	0.16
0.032	0.06	0.12	0.03	0.06	0.16
0.036	0.06	0.16	0.06	0.06	0.19
0.040	0.06	0.16	0.06	0.06	0.19
0.045	0.09	0.19	0.06	0.09	0.25
0.050	0.09	0.19	0.06	0.09	0.25
0.056	0.12	0.22	0.06	0.12	0.28
0.063	0.12	0.22	0.06	0.12	0.31
0.071	0.12	0.28	0.09	0.12	0.38
0.080	0.16	0.34	0.09	0.19	0.44
0.090	0.19	0.38	0.09	0.19	0.50
0.100	0.22	0.44	0.12	0.22	0.62
0.112	0.25	0.50	0.12	0.28	0.75
0.125	0.25	0.56	0.12	0.28	0.88
0.140	0.34	0.62	0.12	0.38	1.00
0.160	0.38	0.75	0.16	0.44	1.12
0.180	0.44	0.88	0.19	0.50	1.25
0.190	0.50	0.88	0.19	0.56	1.25

NOTES

A ALL GAGES BELOW 0.016

Minimum Inner Radii for Straight Line Bends in Aluminum Sheet
Figure 3



757-200
STRUCTURAL REPAIR MANUAL

THICKNESS	MINIMUM BEND RADII	
	Ti-6Al-4V ANNEALED COLD FORMED	Ti-6Al-4V ANNEALED HOT FORMED ^[A]
0.016	0.12	0.06
0.020	0.16	0.09
0.025	0.19	0.09
0.032	0.22	0.09
0.036	0.25	0.12
0.040	0.25	0.12
0.050	0.31	0.12
0.056	0.34	0.16
0.063	0.38	0.16
0.071	0.44	0.19
0.080	0.50	0.19
0.090	0.56	0.22
0.100	0.62	0.25
0.112	0.69	0.25
0.125	0.75	0.28
0.140	0.88	0.34
0.160	1.00	0.34
0.180	1.13	0.41
0.190	1.63	0.41
0.200	2.00	0.44

STRESS RELIEVING TEMPERATURE °F (°C)	MINIMUM DEPTH OF METAL TO BE REMOVED (INCH)			
	LENGTH OF TIME FOR STRESS RELIEVING			
	30-60 MINUTES	1-2 HOURS	2-6 HOURS	6-10 HOURS
1201-1300 (649-704)	0.001	0.001	0.002	0.003
1301-1400 (705-760)	0.001	0.002	0.003	0.003
1401-1500 (761-816)	0.002	0.003	0.004	0.006

NOTES

- DIMENSIONS ARE IN INCHES, EXCEPT AS NOTED.

^[A] THE MINIMUM BEND RADII FOR HOT FORMING TI-6AL-4V IS APPLICABLE WHEN YOU USE A HEATED DIE AND THE PART TEMPERATURE IS KEPT ABOVE 1200°F (649°C).

Minimum Inner Radii for Straight Line Bends, and Minimum Etch Depths for Titanium Sheet
Figure 4



757-200 STRUCTURAL REPAIR MANUAL

MANUFACTURER	MODEL	SPEED (RPM)	DRILL CAPACITY (INCH)	HANDLE TYPE
COOPER BUCKEYE	31D-101-38	5200	1/4	OFFSET
	21D-501	4750	1/4	STRAIGHT
	21A-621	4750	1/4	90
	46A-508	540	1/2	90
DEUTSCH-APT	9824-4249	4950	1/4	OFFSET
	9328-4251	450	1/2	OFFSET
	9359	450/2000	1/2	OFFSET
	3951-5003	1000	3/8	STRAIGHT
	8191-8198-8201	4500	1/4	45
COOPER DOTCO	15CSL94-51	1600	3/8	OFFSET
	55CSS92-54	2150	1/4	OFFSET

DRILL MOTORS
TABLE I

TOOL TYPE	MANUFACTURER	MODEL
ROLLER SHEARS	COOPER-BUCKEYE	31U-113
PORTABLE NIBBLER	COOPER-BUCKEYE	31NR-502
SABER SAW	COOPER-BUCKEYE	31ZK-548

CUTTING TOOLS
TABLE II

TITANIUM THICKNESS (INCH)	BLADE PITCH (TEETH/INCH)	CUTTING RATE (INCH/MINUTE)	BLADE LIFE (INCH)
0.049	32	10	24
0.070	24	5	100
0.125	18	1	7

THIS DATA IS FOR HIGH-SPEED STEEL BLADES THAT CUT AT A RATE OF 90 SURFACE FEET PER MINUTE. USE A WATER SOLUBLE OIL SPRAY MIST LIKE DARACOL 760 WHEN YOU CUT TITANIUM WITH A SABER SAW. THE FORCE NECESSARY TO MANUALLY CUT WITH A SABER SAW IS LARGE. THIS FORCE INCREASES AS THE SHEET THICKNESS INCREASES. THE LARGEST THICKNESS TITANIUM SHEET THAT CAN BE EASILY CUT IS 0.070 INCH.

SABER SAW BLADE DATA
TABLE III

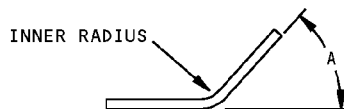
NOTES

- COOPER INDUSTRIES
COOPER POWER TOOLS DIVISION
P.O. BOX 1410
LEXINGTON, SC 29071-1410
- DEUTSCH AMERICAN PNEUMATIC TOOL CO.
14710 MAPLE AVE.
GARDENA, CA 90248-1934

Equipment Used to Hand Drill and Cut Titanium Figure 5

757-200 STRUCTURAL REPAIR MANUAL

MINIMUM INNER BEND RADII										
GAGE	CORROSION RESISTANT STEEL								ALLOY STEEL	
	18-8 CRES (300 SERIES)					15-5 PH ^[D]	17-7 PH ^[A] ^[B]		1020 1025 4130 8630 ANLD	4130 8630 NORM
	ANLD	QTR HARD	HALF HARD	THREE QTR HARD	FULL HARD	SOLUTION TREATED	COND A	COND TH1050		
^[C]	0.06	0.06	0.06	0.09	0.09	---	0.03	0.16	0.06	0.06
0.016	0.06	0.06	0.06	0.09	0.09	---	0.03	0.16	0.06	0.06
0.018	0.06	0.06	0.06	0.09	0.11	---	0.03	0.16	0.06	0.06
0.020	0.06	0.06	0.06	0.09	0.12	---	0.03	0.16	0.06	0.06
0.022	0.06	0.06	0.06	0.09	0.14	---	0.03	0.16	0.06	0.06
0.025	0.06	0.06	0.06	0.09	0.16	---	0.03	0.16	0.06	0.06
0.028	0.06	0.06	0.09	0.12	0.19	---	0.03	0.19	0.06	0.09
0.032	0.06	0.06	0.09	0.12	0.19	---	0.03	0.25	0.06	0.09
0.036	0.06	0.09	0.12	0.16	0.22	---	0.03	0.31	0.09	0.12
0.040	0.06	0.09	0.12	0.16	0.25	---	0.06	0.31	0.09	0.12
0.045	0.06	0.09	0.12	0.19	0.31	---	0.06	0.38	0.09	0.16
0.050	0.06	0.09	0.12	0.22	0.31	0.19	0.06	0.38	0.09	0.16
0.056	0.06	0.12	0.16	0.22	0.34	0.22	0.06	0.44	0.09	0.19
0.063	0.06	0.12	0.19	0.25	0.38	0.22	0.09	0.50	0.09	0.19
0.071	0.09	0.16	0.22	0.31	0.44	0.25	0.09	0.62	0.09	0.22
0.080	0.09	0.16	0.22	0.34	0.50	0.38	0.09	0.62	0.12	0.25
0.090	0.09	0.19	0.25	0.38	0.62	0.44	0.09	0.75	0.12	0.28
0.100	0.12	0.22	0.28	0.44	0.62	0.44	0.12	0.88	0.16	0.31
0.112	0.12	0.22	0.31	0.50	0.75	0.50	0.12	---	0.16	0.34
0.125	0.12	0.25	0.34	0.50	0.75	0.63	0.12	---	0.16	0.38
0.140	0.16	0.31	0.38	0.62	0.88	0.63	0.16	---	0.19	0.38
0.160	0.16	0.34	0.44	0.62	1.00	0.63	0.16	---	0.22	0.44
0.180	0.19	0.38	0.50	0.75	1.12	0.75	0.19	---	0.28	0.50
0.190	0.19	0.38	0.50	0.88	1.25	0.75	0.19	---	0.34	0.50



^[A] THESE LIMITS APPLY TO 17-7 PH CRES:

- USE A MAXIMUM THICKNESS OF 0.090 INCH WHEN HEAT TREATED TO 150-170 KSI.
- USE A MAXIMUM THICKNESS OF 0.063 INCH WHEN HEAT TREATED TO 180-200 KSI.

NOTE: 15-5 PH CRES STEEL IS RECOMMENDED FOR A SHEET THICKNESS OF 0.063 INCH OR HIGHER.

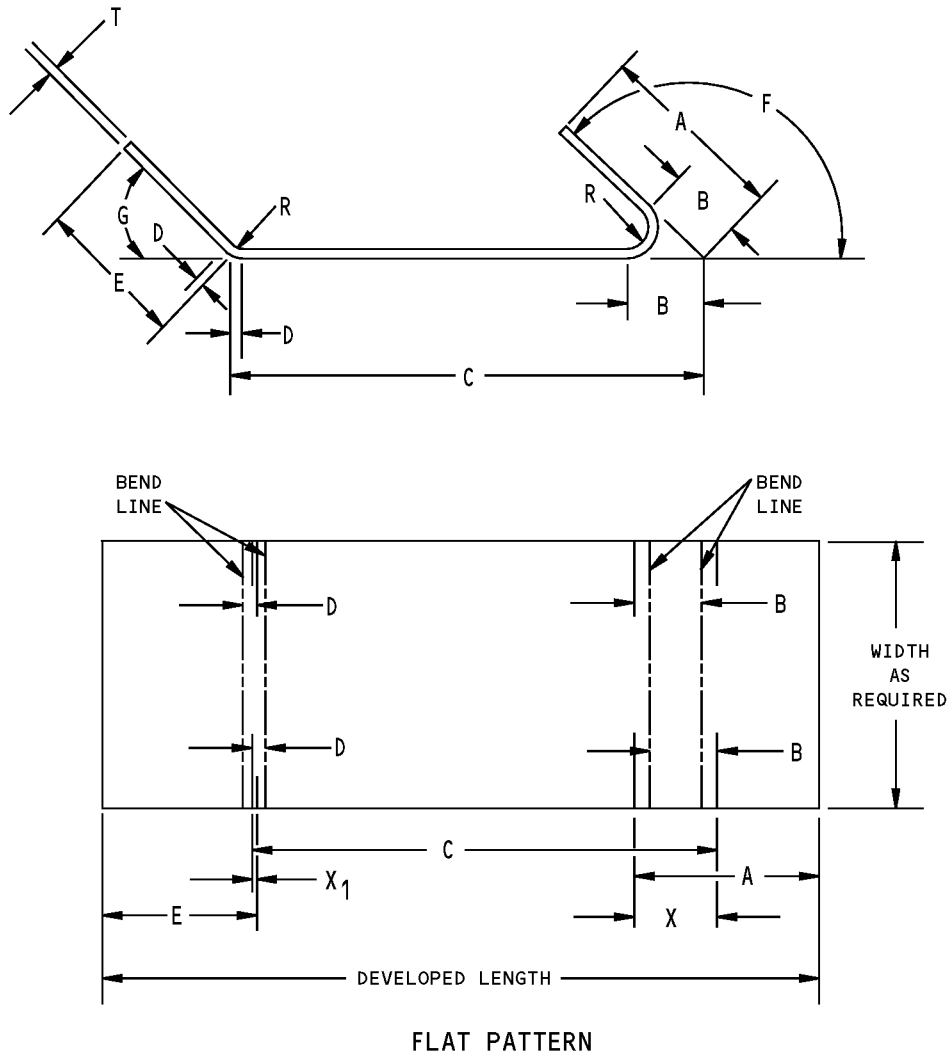
^[B] AFTER YOU FORM THE RADIUS, DO A DYE PENE-
TRANT INSPECTION OF THE RADIUS. REFER TO
SOPM 20-20-02.

^[C] ALL GAGES BELOW 0.016

^[D] IF ANGLE "A" IS LARGER THAN 90° YOU MUST
DO A MAGNETIC PARTICLE INSPECTION. REFER
TO SOPM 20-20-01.

Minimum Inner Radii for Straight Line Bends in Steel Sheet
Figure 6

757-200 STRUCTURAL REPAIR MANUAL



EXAMPLE:

$$A = 1.20$$

$$B = 0.453 \text{ (SEE FIG. 8)}$$

$$C = 3.00$$

$$D = 0.078 \text{ (SEE FIG. 8)}$$

$$E = 1.00$$

$$F = 135^\circ$$

$$G = 45^\circ$$

$$T = 0.063$$

$$R = 0.12 \text{ (SEE FIG. 3)}$$

$$X = 0.55 \text{ (SEE FIG. 9)}$$

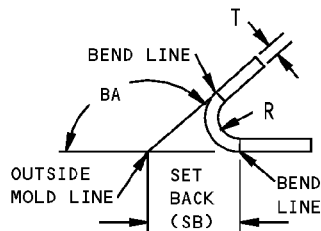
$$X_1 = 0.035 \text{ (SEE FIG. 9)}$$

$$\text{DEVELOPED LENGTH} = 1.20 - 0.55 + 3.00 - 0.035 + 1.00 = 4.615 \text{ USE } 4.62$$

**Flat Pattern Layout
Figure 7**

757-200

STRUCTURAL REPAIR MANUAL



SB = DISTANCE FROM MOLD LINE TO BEND LINE
 BA = BEND ANGLE
 R = BEND RADIUS
 T = THICKNESS

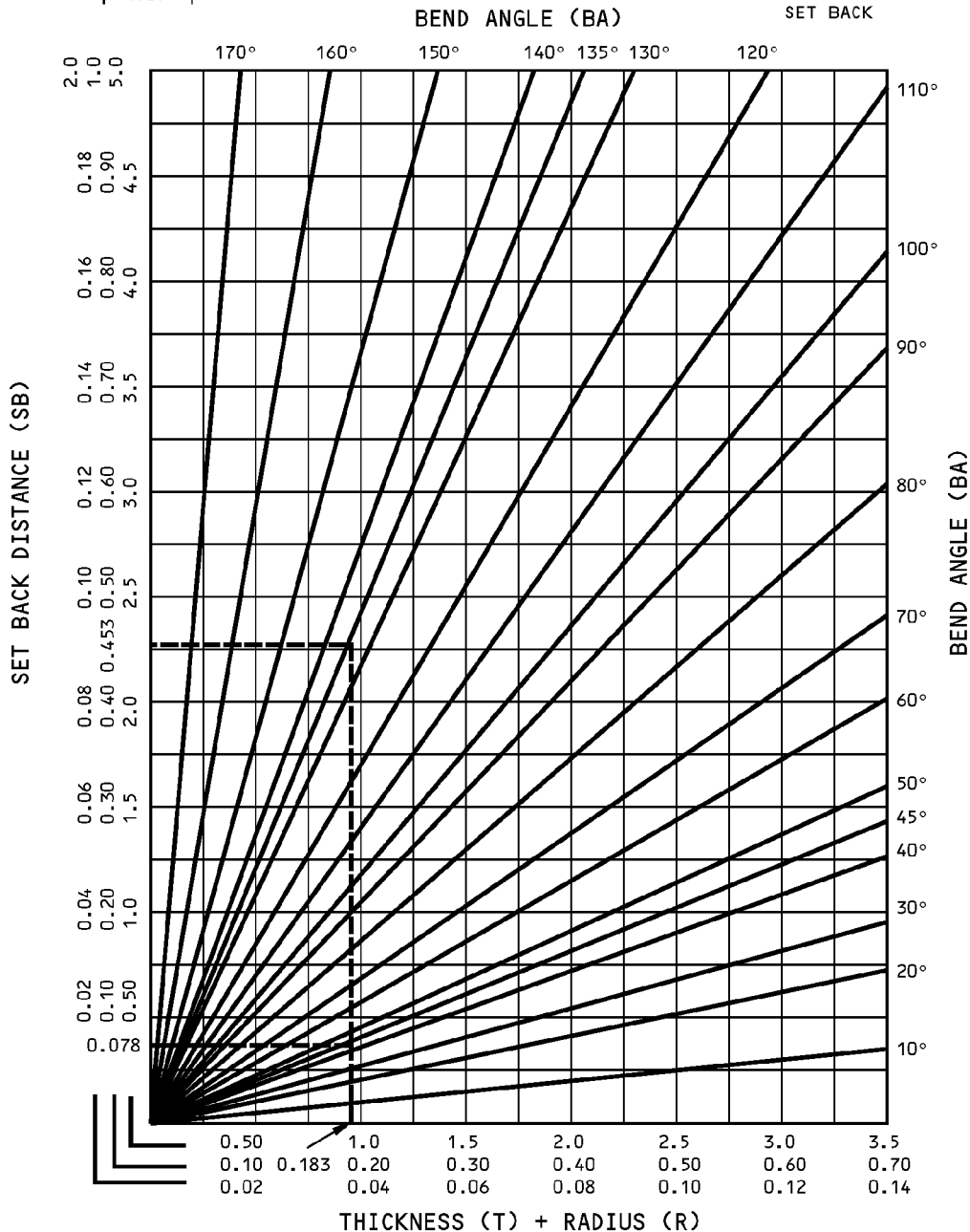
1. ENTER CHART AT BOTTOM ON APPROPRIATE SCALE USING SUM OF T + R
2. READ UP TO BEND ANGLE
3. DETERMINE SET BACK FROM CORRESPONDING SCALE ON LEFT

EXAMPLE:

$$T (0.063) + R (0.12) = 0.183$$

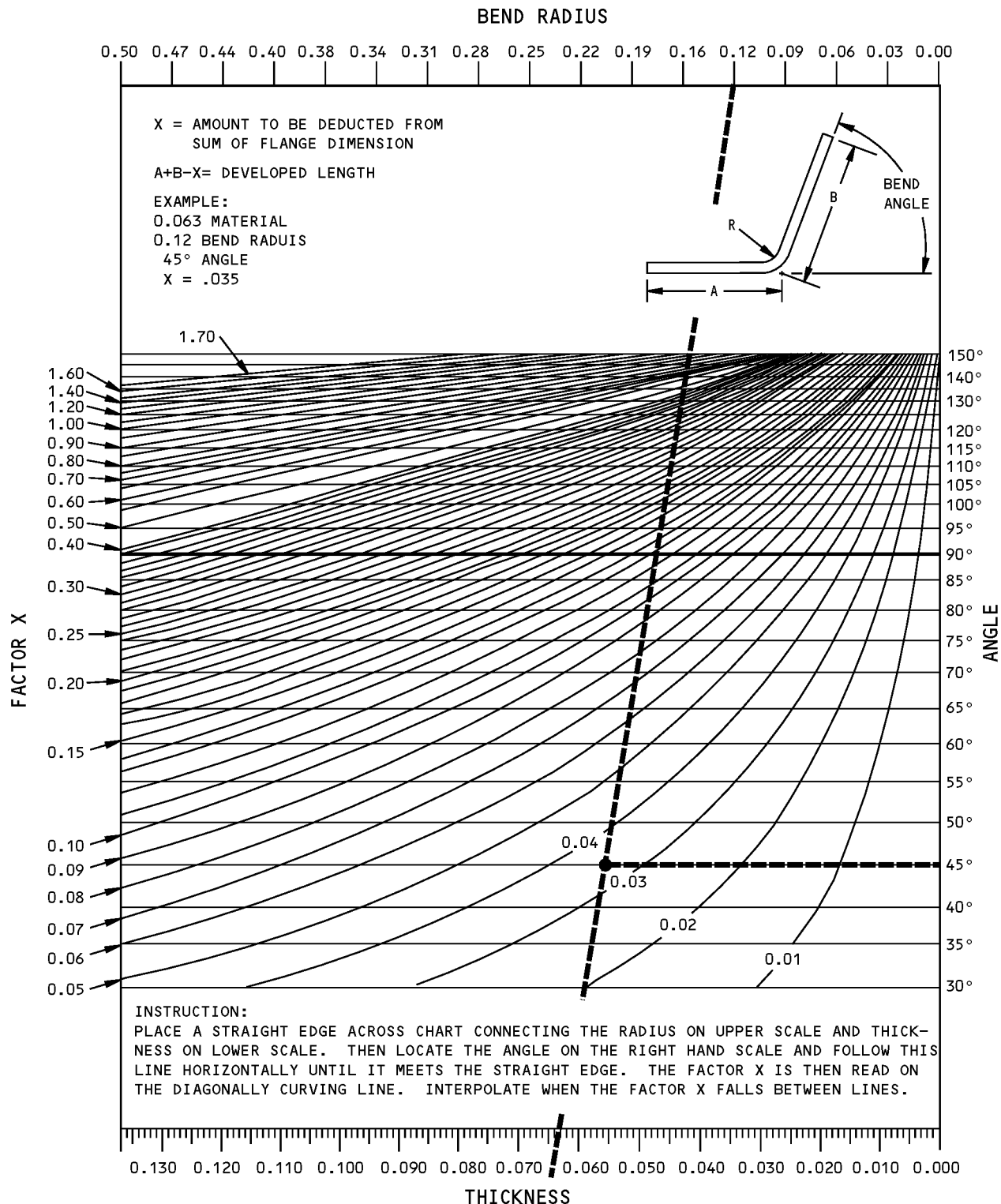
$$BA = 135^\circ$$

$$SET BACK = 0.453$$



Flat Pattern Set Back Graph
 Figure 8

757-200 STRUCTURAL REPAIR MANUAL



**Developed Length Graph
Figure 9**

757-200 STRUCTURAL REPAIR MANUAL

SHIM THICKNESS AS A PERCENTAGE OF THE FASTENER DIAMETER	FASTENER TYPE AND MATERIAL	NON-STRUCTURAL SHIM B	STRUCTURAL SHIM A C
LESS THAN 21%	RIVETS (ALUMINUM)	X	
21% AND GREATER			X
LESS THAN 34%	SHEAR LOCKBOLTS OR HEX-DRIVE (STEEL OR TITANIUM)	X	
34% AND GREATER			X
LESS THAN 41%	TENSION LOCKBOLTS, BOLTS, OR HEX-DRIVE (STEEL OR TITANIUM)	X	
41% AND GREATER			X

NOTES

- EXAMPLE CALCULATION:
FOR A 0.040-INCH THICK SHIM AND A 5/32
(0.1562) INCH DIAMETER ALUMINUM ALLOY RIVET,
THE SHIM THICKNESS AS A PERCENTAGE OF THE
FASTENER DIAMETER

$$\begin{aligned}
 &= \frac{\text{SHIM GAGE}}{\text{FASTENER DIAMETER}} \times 100 \\
 &= \frac{0.040 \text{ INCH}}{0.1562 \text{ INCH}} \times 100 \\
 &= 25.6\%
 \end{aligned}$$

THUS, A STRUCTURAL SHIM IS NECESSARY SINCE
THE MAXIMUM ALLOWABLE NON-STRUCTURAL SHIM
THICKNESS, AS A PERCENTAGE OF THE FASTENER
DIAMETER OF AN ALUMINUM ALLOY RIVET, IS LESS
THAN 21%.

- A** THE SHIM MUST BE FASTENED TO THE REPAIR
PART OR THE INITIAL PART. THE STRUCTURAL
SHIM IS USED TO PREVENT MOVEMENT THAT COULD
POSSIBLY BEND THE FASTENER. A STRUCTURAL
SHIM IS TO CONTAIN NO LAMINATES (SOLID
SHIMS ONLY).

- B** FOR CONVENIENCE OF INSTALLATION, THE SHIM
CAN BE BONDED TO THE REPAIR PART WITH
BMS 5-95 OR BAC5010, TYPE 70 ADHESIVE.

- C** MAKE SURE THAT THE STRUCTURAL SHIM MATERIAL
IS EQUIVALENT TO THE MATERIAL OF THE PART
TO BE FASTENED. APPLY ONE LAYER OF
BMS 10-11, TYPE I PRIMER TO THE SHIM AND
THE BARE SURFACES OF THE PART. REFER TO
SOPM 20-41-02.

Instructions for the Use of Shims Figure 10



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GENERAL - METALLIC MATERIALS

1. References

Reference	Title
51-20-05, GENERAL	Repair Sealing
51-30-03, GENERAL	Nonmetallic Materials

2. General

- A. This subject contains: Extrusions and formed sections which are specified in repair designs contained in this manual. These sections are arranged in numerical sequence by AND and BAC part numbers.
- B. Metallic materials used when making repairs contained within the 757 Structural Repair Manual and also lists sources of supply. These materials are also called out with the applicable repair information. The purpose of this list is to show which subject the materials are used in and if they are common to more than one subject. The materials listed are not only used in the actual repair, but also used for preparation and accomplishment of repairs.
- C. Refer to Figure 1/GENERAL for extruded sections.
- D. Refer to Figure 2/GENERAL for formed sections.
- E. Refer to Figure 3/GENERAL for metallic materials and their sources.
- F. For nonmetallic materials refer to 51-30-03, GENERAL.
- G. For sealant classifications and substitutions data, refer to 51-20-05, GENERAL.



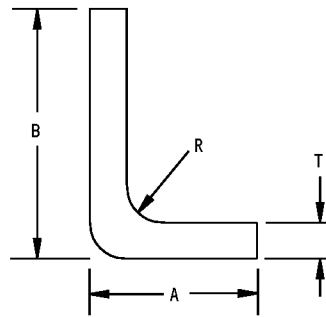
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STRUCTURAL REPAIR MANUAL

EXTRUSION NUMBER	TABLE NO.	REPAIR SUBJECT	EFFECTIVITY
BAC1503- 100122	I	53-00-52	
BAC1505- 100617	II	53-00-51	
BAC1506- 3212	III	54-11-02	
BAC1512- 3353 3396	IV	53-00-51	
BAC1520-792	V	53-00-52	

INDEX OF EXTRUSIONS USED FOR REPAIRS

Extrusions Used for Repairs
Figure 1 (Sheet 1 of 6)

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STRUCTURAL REPAIR MANUAL**



BAC1503

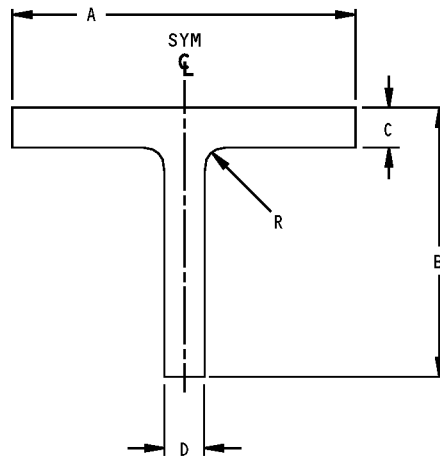
DASH NO.	A	B	T	R	AREA (in. ²)	DIE NUMBER
100122	0.92	1.60	0.08	0.125	0.2682	82517,80573

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

**BAC1503 EXTRUDED SECTIONS USED FOR REPAIRS
TABLE I**

**Extrusions Used for Repairs
Figure 1 (Sheet 2 of 6)**

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STRUCTURAL REPAIR MANUAL



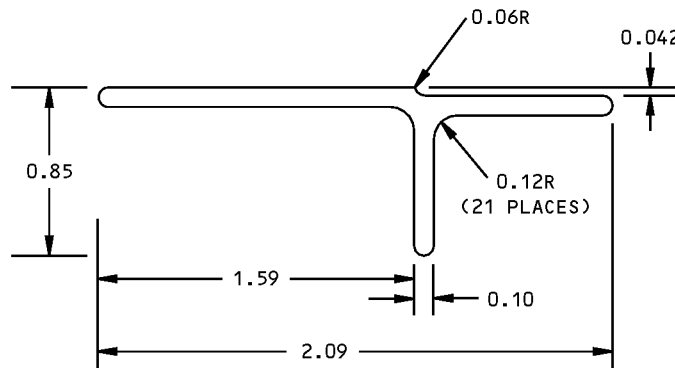
BAC1505

DASH NUMBER	A	B	C	D	E	R	DIE NUMBER	AREA
100617	3.31	2.00	0.125	0.095	1.61	0.12	53617	0.594

BAC1505 EXTRUSIONS USED FOR REPAIRS
TABLE II

Extrusions Used for Repairs
Figure 1 (Sheet 3 of 6)

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STRUCTURAL REPAIR MANUAL



BAC1506-3212

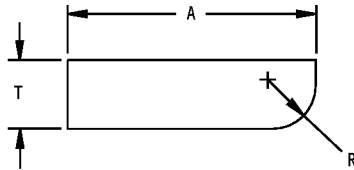
DASH NO.	AREA (in. ²)	DIE NO.
3212		

BAC1506 EXTRUSIONS USED FOR REPAIRS
 TABLE III

Extrusions Used for Repairs
Figure 1 (Sheet 4 of 6)



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STRUCTURAL REPAIR MANUAL



BAC1512

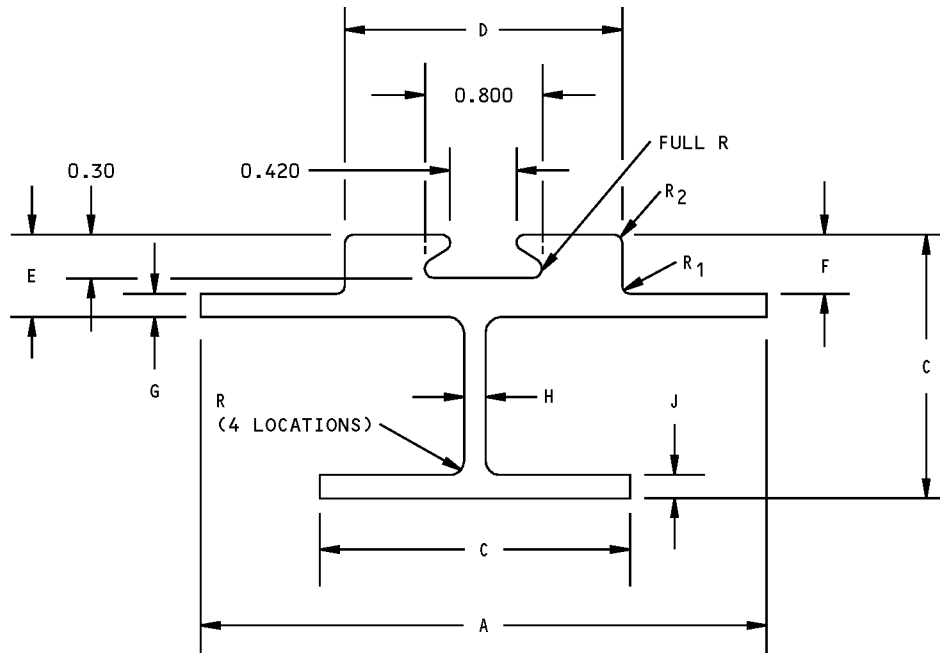
DASH NO.	A	T	R	AREA (in. ²)	DIE NO.
3353	0.95	0.051	0.09	0.048	71401
3396	1.40	0.08	0.19	0.108	42456

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

BAC1512 EXTRUSIONS USED FOR REPAIRS
TABLE IV

Extrusions Used for Repairs
Figure 1 (Sheet 5 of 6)

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BAC1520

DASH NO.	A	B	C	D	E	F	G	H	J	DIE NUMBER
792	3.30	1.75	2.00	1.36	0.53	0.46	0.07	0.08	0.14	71957

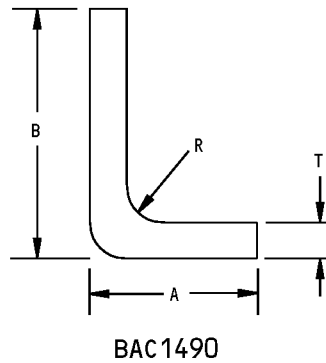
DASH NO.	R	R ₁	R ₂	AREA (in. ²)
792	0.125	0.125	0.090	1.065

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

BAC1520 EXTRUSIONS USED FOR REPAIRS
TABLE V

Extrusions Used for Repairs
Figure 1 (Sheet 6 of 6)

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STRUCTURAL REPAIR MANUAL



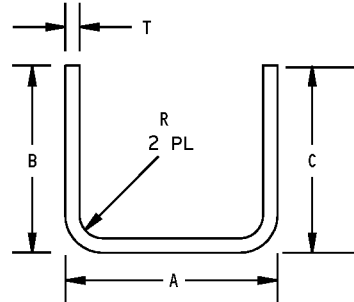
DASH NO.	A	B	T	R	AREA (in. ²)
64	1.00	2.31	0.064	0.13	0.203
2785	1.00	2.00	0.050	0.12	0.1443

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

BAC1490 FORMED SECTIONS USED FOR REPAIRS
TABLE I

Formed Sections Used for Repairs
Figure 2 (Sheet 1 of 6)

757-200 STRUCTURAL REPAIR MANUAL



BAC1493

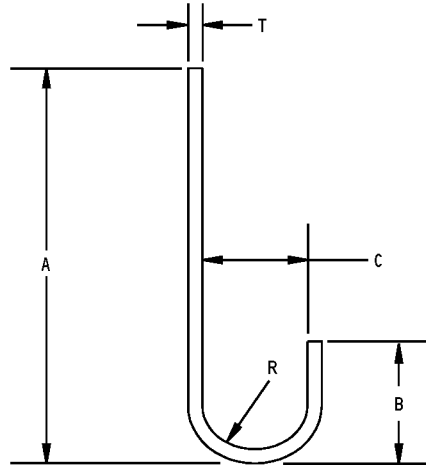
DASH NO.	AREA	A	B	C	T	R
782	0.1700	1.09	0.94	0.94	0.063	0.12
783	0.1816	1.09	0.88	0.88	0.071	0.12
784	0.1624	1.09	0.88	0.88	0.063	0.12
785	0.1529	0.94	0.88	0.88	0.063	0.12
786	0.1445	0.94	0.82	0.82	0.063	0.12
787	0.1536	0.93	0.81	0.81	0.071	0.12
788	0.1057	0.82	0.88	0.25	0.063	0.12
789	0.1148	0.78	0.88	0.25	0.071	0.12
790	0.0925	0.67	0.82	0.25	0.063	0.12
791	0.0986	0.62	0.81	0.25	0.071	0.12
792	0.0944	0.63	0.94	0.20	0.063	0.12
793	0.0812	0.48	0.88	0.20	0.063	0.12

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

BAC1493 FORMED SECTION USED FOR REPAIRS
TABLE I

Formed Sections Used for Repairs
Figure 2 (Sheet 2 of 6)

**757-200
STRUCTURAL REPAIR MANUAL**



BAC1496

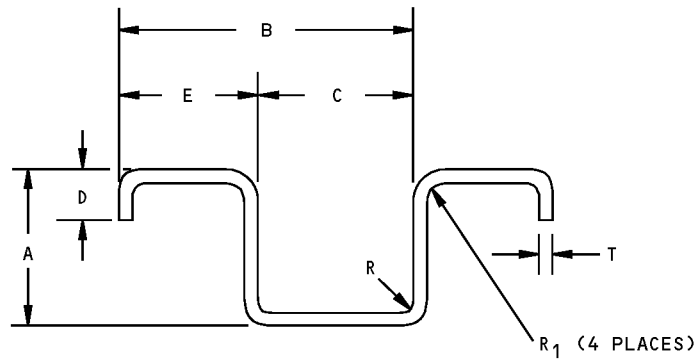
DASH NO.	A	B	C	T	AREA (in. ²)	R
356	0.08	0.25	0.25	0.032	0.038	0.125

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

**BAC1496 FORMED SECTION USED FOR REPAIRS
TABLE III**

**Formed Sections Used for Repairs
Figure 2 (Sheet 3 of 6)**

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STRUCTURAL REPAIR MANUAL



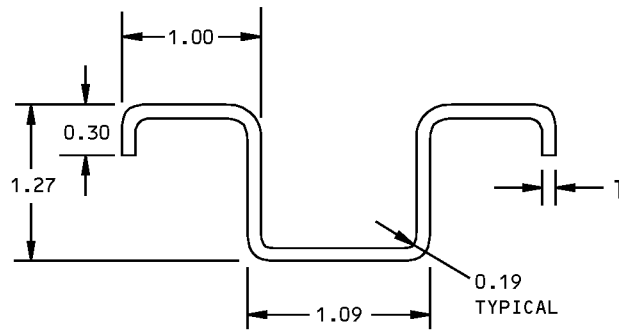
BAC1498

DASH NO.	A	B	C	D	E	R	R ₁	T
212	0.80	2.30	0.80	0.30	0.75	0.06	0.12	0.040

BAC1498 FORMED SECTION
TABLE IV

Formed Sections Used for Repairs
Figure 2 (Sheet 4 of 6)

757-200
STRUCTURAL REPAIR MANUAL



BAC1498

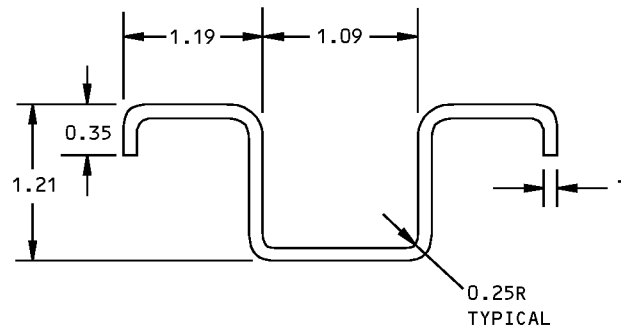
DASH NO.	T
200	0.036
201	0.040
202	0.050
203	0.063
204	0.090

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

BAC1498 FORMED SECTIONS USED FOR REPAIRS
TABLE V

Formed Sections Used for Repairs
Figure 2 (Sheet 5 of 6)

**757-200
STRUCTURAL REPAIR MANUAL**



BAC1498

DASH NO.	T	AREA (in. ²)
232	0.036	0.2092
233	0.040	0.2318
234	0.050	0.2879
235	0.063	0.3596
236	0.090	0.5045

ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED

**BAC1498 FORMED SECTIONS USED FOR REPAIRS
TABLE VI**

**Formed Sections Used for Repairs
Figure 2 (Sheet 6 of 6)**



757-200 STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT													SOURCE
	53-00-50	53-80-01	54-01-01	54-11-01	54-30-01	54-31-01	54-41-30	54-51-70	55-10-01	55-30-01	57-20-01	57-43-01	57-43-02	
ALUMINUM HONEYCOMB CORE														A
BMS 4-4 TYPE 3-10N		X							X			X	X	
BMS 4-4 TYPE 3-20N		X												
BMS 4-4 TYPE 3-60N						X								
BMS 4-4 TYPE 4-15N										X				
BMS 4-4 TYPE 4-25N								X						
BMS 4-4 TYPE 6-30N						X								
BMS 4-4 TYPE 6-40N						X								A
FLEXIBLE ALUMINUM HONEYCOMB CORE														
BMS 4-6 CLASS I, TYPE 4.1-25			X	X										
BMS 4-6 CLASS II, TYPE 6-37									X					B
CRES (PH15-7) HONEYCOMB CORE														
TRE33001A3/8C-15-7/ 15-7PX/1820-15-7/50/ 041							X							
TRE3200-1A-3/8XCN-15- 7/15-7/1818-15-7- 331025							X							
ALUMINUM HONEYCOMB CORE														
AL H/C (5052) 22.1- 1/8-60N MIL-C-7438E							X							

A HEXCEL CORP.
11711 DUBLIN BLVD.
DUBLIN, CALIFORNIA 94566

B ASTECH DIVISION
TRE CORPORATION
3030 SOUTH REDHILL AVE
SANTA ANA, CALIFORNIA 92711

**Metallic Materials Sources
Figure 3**



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - NONMETALLIC MATERIALS

1. References

Reference	Title
51-20-05, GENERAL	Repair Sealing

2. General

- A. This section lists materials used when making repairs contained within the 757 Structural Repair Manual and also lists sources of supply.
- (1) These materials are also called out with the applicable repair information. The purpose of this list is to show which subject the materials are used in and if they are common to more than one subject. The materials listed are not only used in the actual repair, but also are used for preparation and accomplishment of repairs.
- (2) If you have access to the Qualified Products List (QPL) for a Boeing Material Specification (BMS), it is possible to find suppliers and/or products for specified Classes, Types, Grades, etc., that are not listed in this section. You are permitted to use the products and suppliers listed in the QPL unless stated differently in the repair section where the BMS is used.
- B. Various materials, including resins and prepreg materials used for composite repairs, have a limited shelf life and require special storage conditions. This information is available from the material suppliers.
- C. Refer to Table 1/GENERAL for an index of figures for lists of materials:

Table 1: Materials Index

Material	Figure Location
Protective Coatings, Sealants, Adhesives and Cleaners	Figure 1/GENERAL
Fiberglass/Graphite/Aramid Fabrics, and Non-Metallic Honeycomb Core	Figure 2/GENERAL
Abrasives	Figure 3/GENERAL
Miscellaneous Materials	Figure 4/GENERAL

- D. For sealant classifications and substitution data, refer to 51-20-05, GENERAL.



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STRUCTURAL REPAIR MANUAL

NOTES

- [A] AMCHEM PRODUCTS INCORPORATED
300 BROOKSIDE AVE
AMBLER, PA 19002-3436
- [B] TURCO PRODUCTS INCORPORATED
24700 S MAIN ST
P.O. BOX 6200
CARSON, CA 90749
- [C] WITCO CHEMICAL CORPORATION
WITCO-ALLIED-KELITE DIVISION
400 MIDLAND AVE
HIGHLAND PARK, MI 48203-3734
- [D] SIKKENS AEROSPACE
20846 NORMANDIE AVE
TORRANCE, CA 90502
- [E] COURTAULDS AEROSPACE
1608 - 4TH ST
BERKELEY, CA 94710
- [F] MINNESOTA MINING AND MANUFACTURING
3M CENTER
ST. PAUL, MN 55144-1000
- [G] GIBSON CHEMICALS, LTD.
350 RESERVE ROAD
CHELTENHAM, VICTORIA
AUSTRALIA
- [H] DEFT CHEMICAL COATINGS
17451 VON KARMAN AVE
IRVINE, CA 92714
- [I] ESSEX CHEMICAL CORPORATION
COAST PRO-SEAL DIVISION
19451 SUSANA ROAD
COMPTON, CA 90221-5713
- [J] PRODUCTS RESEARCH AND CHEMICAL CORPORATION
5454 SAN FERNANDO ROAD
GLENDALE, CA 91209
- [K] D. AIRCRAFT PRODUCTS COMPANY
1191 HAWK CIRCLE
ANAHEIM, CA 92708
- [L] UNION OIL COMPANY OF CALIFORNIA
P.O. BOX 76
SEATTLE, WA 98111
- [M] UNION OIL 76 DIVISION WESTERN REGION
461 S BOYLSTON ST
P.O. BOX 7600
LOS ANGELES, CA 90017-1443
- [N] E.I. duPONT deNEMOURS
5500 UNION PACIFIC AVE
CITY OF COMMERCE
LOS ANGELES, CA 90022
- [O] FURANE AEROSPACE PRODUCTS
CIBA-GEIGY CORPORATION
5121 SAN FERNANDO ROAD W
LOS ANGELES, CA 90039
- [P] PERMACEL TAPE DIVISION
AN AVERY COMPANY
U.S. HWY 1
P.O. BOX 671
NEW BRUNSWICK, NJ 08903
- [Q] CYTEC INDUSTRIES
CYTEC ENGINEERED MATERIALS
HAVRE DE GRACE, MD 21078
- [R] FIBER-RESIN CORPORATION
170 W PROVIDENCIA AVE
P.O. BOX 4187
BURBANK, CA 91503
- [S] REN PLASTICS INCORPORATED
A CIBA-GEIGY COMPANY
BLDG D, FISHER INDUSTRIAL PARK
KENT, WA 98032
- [T] DEXTER AEROSPACE INCORPORATED
DEXTER CORPORATION
2850 WILLOW PASS ROAD
P.O. BOX 312
PITTSBURG, CA 94565-3237
- [U] UNION CARBIDE CORP.
CHEMICAL AND PLASTICS DIVISION
BOUND BROOK, NJ 08805
- [V] TRITON MANUFACTURING CO.
DIVISION OF TRITON INDUSTRIES, INC.
P.O. BOX 361
EAST HADDAM, CT 06423
- [W] OWENS CORNING FIBERGLASS CORP.
608 MADISON AVE
TOLEDO, OH 43604
- [X] CABOT CORPORATION
125 HIGH ST
BOSTON, MA 02110-2721
- [Y] TEMPO PAINT AND VARNISH COMPANY
205 FENMAR DRIVE
WESTON, ONTARIO
CANADA M9L2X4
- [Z] CROWN METRO INCORPORATED
ECHELON ROAD
DONALDSON CENTER
GREENVILLE, SC 29606
- [AA] BMS 5-79 IS SUPERSEDED BY BMS 5-95. SEE
SRM 51-20-05, FIG. 5 FOR SUBSTITUTE
SEALANTS
- [AB] FORMULATED SYSTEMS GROUP
CIBA-GEIGY CORPORATION
4917 DAWN AVE
EAST LANSING, MI 48823
- [AC] MAGNOLIA PLASTICS INCORPORATED
5547 PEACHTREE INDUSTRIAL BLVD
CHAMBLEE, GA 30341

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 1 of 12)

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NOTES (CONT)

- | | |
|---|--|
| <p>[AD] SOVEREIGN ENGINEERED
ADHESIVES
123 W. BARTGES ST
AKRON, OH 44311-1081</p> <p>[AE] McCANN MANUFACTURING
ADHESIVES AND PREPREGS
BOX 429, ROUTE 14A
ONECO, CT 06373</p> <p>[AF] DOW CORNING CORPORATION
3901 S. SAGINAW RD
MIDLAND, MI 48641-2721</p> <p>[AG] 3M/AEROSPACE MATERIALS DEPARTMENT
3211 E. CHESTNUT EXPRESSWAY
SPRINGFIELD, MO 65802</p> <p>[AH] BMS 5-51 IS SUPERSEDED BY
BMS 5-129 FOR COMPOSITES AND
BMS 5-101, TYPE II FOR METAL BOND.</p> <p>[AI] PARKER & AMCHEM
32100 STEPHENSON HIGHWAY
MADISON HEIGHTS, MI 48071</p> <p>[AJ] HOLT LLOYD CORPORATION
4647 HUGH HOWELL RD
TUCKER, GA 30084-5004</p> | <p>[AK] DINOL INTERNATIONAL, INC.
14021 E. TEN MILE RD
P.O. BOX 1065
WARREN, MI 48090-1065</p> <p>[AL] CYTEC INDUSTRIES
CYTEC ENGINEERED MATERIALS
1440 N. KRAEMER BLVD
ANAHEIM, CA 92806</p> <p>[AM] HEXCEL CORP.
LIVERMORE PLANT
10 TREVARNO RD
LIVERMORE, CA 94550</p> <p>[AN] DINOL INTERNATIONAL INC
20600 EUREKA RD, SUITE 414
TAYLOR, MI 48180-5306</p> <p>[AO] LPS LABORATORIES INC
4647 HUGH HOWELL RD
TUCKER, GA 30085-5052</p> <p>[AP] ZIP-CHEM PRPDUCTS
1860 DOBBIN DRIVE
SAN JOSE, CA 95133</p> |
|---|--|

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 2 of 12)



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																				SOURCE
	51-20-01	51-20-05	51-40-08	51-70-03	51-70-09																
<u>CORROSION INHIBITORS</u>																					
DESOTO 513-346 CIAP 513-707 CIAP					X																E
MIL-C-16173, GRADE 3	X																				ANY SOURCE
BMS 3-23	X																				G
BMS 3-23 TYPE I BOESHIELD T-9 BOESHIELD T-9HF	X																				G AI
BMS 3-23 TYPE II BOESHIELD T-9 BOESHIELD T-9HF LP-3 DINITROL AV8	X																				G AI AJ AK
BMS 3-29	X																				AN AO AP
BMS 5-89					X																F Q
BMS 10-20, TYPE II		X																			D
<u>ADHESIVES AND RESINS</u>																					
BMS 5-14			X																		I
BMS 5-25 GRADE 1, EA 901 PASTE				X																	T
EA 934NA PART A: 100PBW PART B: 33PBW				X																	T
BMS 5-92, TYPE I, GRADE 1				X																	F
PHENOLIC MICROBALLOONS, BJ0-0929				X																	U

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 3 of 12)



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MATERIAL	SUBJECT																				SOURCE
	51-20-01	51-70-03	51-70-04	51-70-05	51-70-09	51-70-14															
MATERIALS FOR PROTECTIVE TREATMENT																					
ALCOHOL - PHOSPHORIC SOLUTION TURCO PREPAINT	X X																				B
KELITE POLYLOTE	X																				C
PHOSPHORIC ACID	X																				ANY SOURCE
BUTYL CELLUSOLVE	X																				ANY SOURCE
TRITON X-100 WETTING AGENT	X																				V
BMS 10-11, TYPE I	(USED IN MANY SUBJECTS)																				D E Y H Z
BMS 10-21, TYPE I						X															D E Y
CAB-O-SIL GRADE M-5 GRADE PTG					X																X
EC-843 TOPCOAT SPRAY	X																				F
IRIDITE 14-2	X																				C
MIL-C-5541 ALODINE 1000	X																				A
MIL-C-5541 ALODINE 1200S	X																				A
MIL-C-5541 ALODINE 600	X																				A
MIL-C-11796, CLASS 3 CORROSION-PREVENTATIVE COMPOUND	X																				ANY SOURCE
MIL-P-8585 CHROMATE PRIMER	X																				ANY SOURCE
MYLAR TAPE		X	X	X																	ANY SOURCE
NITRIC ACID PHYDRION PAPERS NO. 60781	X																				ANY SOURCE
TURCOAT ALUMIGOLD	X																				B

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 4 of 12)



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																		SOURCE
	51-20-05	57-43-01																	
SEALANTS																			
SILICONE SEALING COMPOUND	X																	ANY SOURCE	
NONSILICONE (POLYURETHANE/POLYSULPHIDE)	X																	ANY SOURCE	
BMS 5-26 TYPE II, CLASS A-2, B-2,C-24 PRO-SEAL 890 A-2,B-2, C-24 PR1440 A-2,B-2	X																	I	
BMS 5-63, B-4	X																	K	
BMS 5-79 CLASS B-1/2,B-2,B-4 PRO-SEAL 898 B-1/2, 3C-414 B1/2 PRO-SEAL 898 B-2, 3C-414 B-2 PRO-SEAL 898 B-4, 3C-414 B-4	X																	AA	
BMS 5-95 CLASS B-1/2,B-2,B-4, C-20 PR1436G B-1/2 PR1436G B-2, PRO-SEAL 870 B-2 PR1436G TYPE I, PRO-SEAL 870 C-20	COMMON CHROMATE-LOADED REPAIR SEALANT																	J	
DOW CORNING 93-006		X																AF	

**Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 5 of 12)**



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																SOURCE
	51-20-01	51-20-05	51-40-02	51-40-08	51-70-03	51-70-04	51-70-05	51-70-06	51-70-07	51-70-08	51-70-17	54-00-30					
<u>SOLVENTS</u>																	
ACETONE					X	X	X	X	X	X	X						ANY SOURCE
NAPTHA	X																F
METHYL ETHYL KETONE (MEK)	X	X	X	X	X	X	X					X					ANY SOURCE
METHYL ISOBUTYL KETONE (MIBK)					X	X	X					X					ANY SOURCE
PERCHLOROETHYLENE, O-T-236	X																ANY SOURCE
TRICHLOROETHANE	X	X			X	X	X	X	X	X	X						ANY SOURCE
TRICHLOROETHYLENE	X																ANY SOURCE
BMS 3-2	X																L
BMS 11-7		X															M
<u>PARTING FILM</u>																	
FLOUROCARBON (FEP)					X	X	X										ANY SOURCE
PHENOLIC SHEET MIL-P-15035C TYPE FBM					X												ANY SOURCE
POLYVINYL FLUORIDE (PVF) TEDLAR NO. 240					X												ANY SOURCE

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 6 of 12)



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																SOURCE					
	52-40-02	52-80-02	53-10-72	54-10-01	54-20-01	54-21-01	54-31-01	54-31-02	54-50-70	54-51-70	55-10-01	55-10-30	55-10-71	55-20-01	55-30-01	55-30-30		55-30-71				
TAPES																						
3M-436	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X					F
PERMACEL P95 POLYESTER TAPE			X																			P
SCOTCHBRAND NO. 850,853			X																			F

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 7 of 12)



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																SOURCE
	55-40-01	55-40-02	55-40-30	57-30-01	57-41-01	57-41-09	57-41-70	57-43-01	57-43-02	57-51-01	57-53-01	57-53-70	57-60-01	57-60-02	57-70-01	57-70-02	
TAPES (CONT)																	
3M-Y436 (CONT)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	F

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 8 of 12)



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																	SOURCE					
	51-70-03	51-70-10	52-40-02	52-80-02	53-00-70	54-10-01	54-20-01	54-21-01	54-31-01	54-50-70	54-51-70	55-10-01	55-10-30	55-20-01	55-30-01	55-30-30	55-40-01		55-70-01	57-51-01			
POTTING COMPOUNDS AND RESINS																							
BMS 5-28 TYPE 3 EC 1511A WITH EC 1511B HARDENER		X																					
BMS 5-28 TYPE 7, CLASS 1 CG 1305 WITH CG 1305 HARDENER FR 7162A WITH FR 7162B HARDENER TYPE 7, CLASS 2 EC 89537A WITH EC 89537B HARDENER	(USED IN MANY SUBJECTS)																				AB		
	(USED IN MANY SUBJECTS)																						B
																							AB
BMS 5-28 TYPE 13 EC 938	X																					O	
BMS 5-28 TYPE 15 EC 1615A WITH EC 1615B HARDENER	X																					O	
BMS 5-28 TYPE 17 EC 1617A WITH EC 1617B HARDENER	X																					O	
BMS 5-28 TYPE 17 MAGNOBOND 91A WITH MAGNOBOND 91B HARDENER	X																					AC	

**Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 9 of 12)**



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																		SOURCE
	51-70-03	51-70-05	51-70-07	57-53-01	57-53-70	57-60-01	57-60-02	51-71-01											
POTTING COMPOUNDS AND RESINS (CONT)																			
BMS 5-28 TYPE 19 EC 1619A WITH EC 1619B HARDENER	X																		O
BMS 5-51 TYPE 2, CLASS I, GRADE 10,15, OR 30 AF-126		X																	AH
BMS 5-51 TYPE 2, CLASS II, GRADE 10,15, OR 30 AF-126-2		X																	
BMS 5-90 TYPE III, CLASS 250/350-10-10, ALL GRADES FM-490A MA-562 PL-685	X	X	X	X				X											Q AD AD
BMS 5-90 TYPE IV, CLASS 250/350-10-10, PL-460	X	X	X	X				X											AD

**Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 10 of 12)**



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MATERIAL	SUBJECT																SOURCE
	51-70-03	51-70-04	51-70-05	51-70-07	51-70-08	51-70-09	51-70-10	51-71-01									
<u>POTTING COMPOUNDS AND RESINS (CONT)</u>																	
BMS 5-101 TYPE II, GRADE 5 OR 10 FM-73M EA-9628NW AF-163-2 OST		X	X	X		X	X										Q T F AG
BMS 5-101 TYPE II, GRADE 15 FM-73M AF-163-2M		X	X	X		X	X										Q AG
BMS 5-101 TYPE III EC-3903				X		X	X										F AG
BMS 5-129 TYPE 2, CLASS IA AF-126			X	X													AG
BMS 5-129 TYPE 2, CLASS IIA AF-126-2			X	X													AG
BMS 5-129 TYPE 2, CLASS IIB FM-123-2			X	X													Q
BMS 5-129 TYPE 4, GRADE 10 AF-163-20ST EA-9628-NW			X	X													F T AG
BMS 5-154 TYPE II, CLASS 1, GRADE 03 METAL BOND 1515-3M O3 PSF ADH. FILM METAL BOND 1515-3M-HT O3 PSF ADH. FILM PL 795 O3 PSF ADH. FILM		X			X		X										AL AL AD
BMS 5-154 TYPE II, CLASS 1, GRADE 05 METAL BOND 1515-3M O5 PSF ADH. FILM METAL BOND 1515-3M-HT O5 PSF ADH. FILM PL 795 O5 PSF ADH. FILM							X										AL AL AD
BMS 5-154 TYPE II, CLASS 2, GRADE 03 PL 795 O3 PSF ADH. FILM							X										AD

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 11 of 12)



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																				SOURCE
	51-70-03	51-70-04	51-70-05	51-71-01	53-71-01	53-11-72															
<u>POTTING COMPOUNDS AND RESINS (CONT)</u>																					
BMS 5-154 TYPE II, CLASS 2, GRADE 05 PL 795 05 PSF ADH. FILM					X																AD
BMS 8-139 CLASS 2 STYLE 120: 120-F164-6-F50 STYLE 1581: 1581-F164-6-F50				X																	AM
BMS 8-207 TYPE I, CLASS I, EC 1838A: 50 PBW EC 1838B: 50 PBW	X	X	X																		
BMS 8-207 TYPE I, CLASS II, FR-40 BASE RESIN EC 156A, EC 156B EC 941, 5413C HARDENER FIBER-RESIN 5318S 5318C FIBER-RESIN 5318S 53180	X	X	X																		F S
BMS 8-218 STYLE 120: KEVLAR 49-120 F161-188 STYLE 285: KEVLAR 49-285 F161-188				X																	AM
EA9330 A/B						X															U

**Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 12 of 12)**



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NOTES

- [A] HEXCEL CORPORATION
VALLEY INDUSTRIAL PARK
1214 WEST HWY 84
CASA GRANDE, AZ 85222
OR
HEXCEL CORPORATION
338 N. PENNSYLVANIA
GRAHAM, TX 76046
- [B] CIBA-GEIGY CORPORATION
COMPOSITE MATERIALS DEPARTMENT
3550 NW 49TH STREET
MIAMI, FL 33142
- [C] CIBA-GEIGY (UK), LTD.
BONDED STRUCTURES DIVISION
DUXFORD, CAMBRIDGE CB24QD ENGLAND
- [D] GENERAL VENEER MFG CO.
8652 OTIS STREET
SOUTH GATE, CA 90280
- [E] CIBA-GEIGY CORPORATION
COMPOSITE MATERIALS DEPARTMENT
5115 EAST LA PALMA AVE.
ANAHEIM, CA 92807-2018
- [F] HEXCEL CORPORATION
STRUCTURAL PRODUCTS DIVISION
10 TREVARNO ROAD
LIVERMORE, CA 94550
- [G] FIBERITE WEST COAST CORP.
645 CYPRESS ST. N
ORANGE, CA 92667
- [H] CELANESE CORPORATION
NARMCO MATERIALS DIVISION
1440 NORTH KRAEMER BLVD.
ANAHEIM, CA 92806-1404
- [I] AMERICAN CYANAMID COMPANY
INDUSTRIAL CHEMICALS AND PLASTICS DIV.
BLOOMINGDALE DEPT.
OLD POST ROAD
HAVRE DE GRACE, MARYLAND 21078
OR
AMERICAN CYANAMID COMPANY
AEROSPACE PRODUCTS DIVISION
21444 GOLDEN TRIANGLE RD
SAUGUS, CA 91350
- [J] HEXCEL CORP.
11711 DUBLIN BLVD.
DUBLIN, CA 94566
- [K] CLARK-SCHWEBEL
FIBERGLASS CORPORATION
5 CORPORATE PARK DR
WHITE PLAINS, NY 10604
- [L] J.P. STEVENS AND COMPANY, INC.
STEVENS TOWER
1185 AVENUE OF THE AMERICAS
NEW YORK, NY 10036
- [M] FIBERITE CORPORATION
501-559 W. THIRD ST
WINONA, MN 55987
- [N] YOKOHAMA RUBBER CO., LTD.
AEROSPACE DIVISION
P.O. BOX 20, HIRATSUKA-SHI
KANAGAWA-KEN, 254 JAPAN
- [O] E.I. DU PONT DE NEMOURS & CO., INC.
1007 MARKET ST
WILMINGTON, DE 19898
- [P] NORDAM DIVISION
R. H. SIEGFRIED, INC.
510 SOUTH LANSING
P.O. BOX 3365
TULSA, OK 74120
- [Q] BURLINGTON INDUSTRIES
BURLINGTON GLASS FABRICS CO.
1245 AVENUE OF THE AMERICAS
NEW YORK, NY 10019
- [R] UNIGLASS INDUSTRIES
UNITED MERCHANTS
P.O. BOX 871
STATESVILLE, NC 28677
- [S] CLARK-SCHEBEL INTERNATIONAL S.A.
BATTICE, BELGIUM
- [T] KANEBO FIBER GLASS COMPANY LTD.
3-12 MOTO-AKASAKA 1-CHOME
MINATO-KU, TOKYO 107, JAPAN
- [U] ARISAWA MFG. CO., LTD.
5-5, 1-CHOME MINAMI HONCO
JOETSU-CITY, NIIGATA-PREFECTURE
JAPAN
- [V] AIR LOGISTICS CORPORATION
3600 E. FOOTHILL BLVD
PASADENA, CALIFORNIA 91109
- [W] PERMALI GLOUCESTER LIMITED
BRISTOL ROAD
GLOUCESTER
GL1 5TT
ENGLAND

Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 1 of 14)



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																SOURCE
	51-70-05	52-40-02	53-10-72	53-11-72	53-50-70	55-10-01	55-10-30	55-30-01	55-30-09	55-30-30	55-40-01	57-30-01	57-41-01	57-41-09			
<u>FIBERGLASS FABRIC</u>																	
BMS 8-79 TYPE 120, CLASS III, GRADE I 120-F155-5-F69 120-F255-1-F69 NARMCO-3203-120-Z6040 NARMCO-3203F-120- Z6040 MXB 7701-120-Z6040 120-F155-5-CS272 G120/F6986S03-S920NM	X	X		X	X	X	X				X		X	X			<div>A</div> <div>F</div> <div>G</div> <div>H</div> <div>N</div>
TYPE 1581, CLASS III, GRADE I 120-F155-5-F69 120-F255-1-F69 NARMCO-3203-120-Z6040 NARMCO-3203F-120- Z6040 MXB 7701-120-Z6040 120-F155-5-CS272 G120/F6986S03-S920NM	X		X	X		X	X	X	X	X		X					
TYPE 7781, CLASS III, GRADE I 120-F155-5-F69 120-F255-1-F69 NARMCO-3203-120-Z6040 NARMCO-3203F-120- Z6040 MXB 7701-120-Z6040 120-F155-5-CS272 G120/F6986S03-S920NM	X											X					

Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 2 of 14)



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																		SOURCE
	57-51-01	57-53-01	57-53-02	57-53-70	57-60-01	57-60-02													
<u>FIBERGLASS FABRIC (CONT)</u>																			
BMS 8-79 TYPE 120, CLASS III, GRADE I 120-F155-5-F69 120-F255-1-F69 NARMCO-3203-120-Z6040 NARMCO-3203F-120- Z6040 MXB 7701-120-Z6040 120-F155-5-CS272 G120/F6986S03-S920NM	X	X	X	X															<div>A</div> <div>F</div> <div>G</div> <div>H</div> <div>N</div>
TYPE 1581, CLASS III, GRADE I 120-F155-5-F69 120-F255-1-F69 NARMCO-3203-120-Z6040 NARMCO-3203F-120- Z6040 MXB 7701-120-Z6040 120-F155-5-CS272 G120/F6986S03-S920NM	X		X	X	X	X													
TYPE 7781, CLASS III, GRADE I 120-F155-5-F69 120-F255-1-F69 NARMCO-3203-120-Z6040 NARMCO-3203F-120- Z6040 MXB 7701-120-Z6040 120-F155-5-CS272 G120/F6986S03-S920NM																			

**Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 3 of 14)**



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																	SOURCE
	51-70-03	51-70-04	51-70-06	51-70-08	51-70-14	51-70-17	53-00-50	53-10-72	53-11-72									
<u>FIBERGLASS FABRIC</u> (CONT)																		
BMS 8-139 TYPE 120		X		X														A F H
BMS 9-3 TYPE D (ALL CLASSES EXCEPT CLASSES 1 AND 15)	X		X			X			X									J K L Q R S T
TYPE H (ALL CLASSES EXCEPT CLASSES 1 AND 15)					X			X	X									J K L Q R S
TYPE H-2 (ALL CLASSES EXCEPT CLASSES 1 AND 15)	X		X		X	X		X	X									J K L Q R S T
TYPE H-3 (ALL CLASSES EXCEPT CLASSES 1 AND 15)	X		X		X	X		X										J K L Q R S T U
PRECURED FIBERGLASS SHEET STRATOGLAS 700S-EAL PERMAGLASS XERTT6/9							X											V W

Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 4 of 14)



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																SOURCE
	51-70-03	51-70-05	52-40-02	52-80-02	53-30-70	53-50-70	53-60-70	53-60-71	55-10-01	55-30-01	57-51-01	57-53-70					
<u>GRAPHITE TAPE</u>																	
BMS 8-168 TYPE II, CLASS I, GRADE 95										X	X						<div>F</div> <div>K</div> <div>L</div> <div>M</div> <div>U</div>
TYPE II, CLASS I, GRADE 145									X		X						
TYPE II, CLASS I, GRADE 190											X	X					
<u>GRAPHITE FABRIC</u>																	
BMS 8-168 TYPE II, CLASS II, STYLE 3K-70-PW W3T-282-42-F155-76 W36-282-42-F155-76 HMF-322/7714 AC C3WPW/F6986S03	X	X	X	X	X	X	X	X			X	X					<div>F</div> <div>K</div> <div>L</div> <div>M</div>

**Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 5 of 14)**



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MATERIAL	SUBJECT																		SOURCE
	51-70-04																		
GRAPHITE FABRIC (CONT)																			
BMS 8-212 TYPE I, CLASS 2, STYLE 3K-70-PW RIGIDITE 5208 WOVEN T-300, STYLE 3K-70- PW-42% TYPE I, CLASS 2, STYLE 3K-135-8H RIGIDITE 5208 WOVEN T-300, STYLE 3K- 135-8H-42%	X																		H
TYPE II, CLASS 2 HMF-322/34C-II RIGIDITE 5208 WOVEN T-300, STYLE 3K-70- PW-35% RIGIDITE 5208F WOVEN T-300, STYLE 3K-70- PW-35% RIGIDITE 5208 WOVEN C3000, STYLE 3K-70- PW-35% T193-PW/3501-5A W3T-282-42-F263-2 F3T-584-42-F263-2 HMF-133/34-II RIGIDITE 5208 WOVEN T-300, STYLE 3K-135- 8H-35% RIGIDITE 5208F WOVEN T-300, STYLE 3K-135- 8H-35% RIGIDITE 5208 WOVEN C3000, STYLE 3K-135- 8H-35% T370-8H/3501-5A	X																		H

**Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 6 of 14)**



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																	SOURCE
	51-70-04	55-20-01	54-10-01	54-11-01	54-20-01	54-21-01	54-30-01	54-31-01	55-20-02	55-40-02	57-60-02							
<u>GRAPHITE FABRIC (CONT)</u>																		
BMS 8-212 TYPE III, CLASS I, GRADE 95		X																H
TYPE III, CLASS I, GRADE 145										X								H
TYPE III, CLASS I, GRADE 190									X									
TYPE III, CLASS II, STYLE 3K-135-8H F3C-584-42-F263-7 F3T-584-42-F263-7 HMF-133/34-III RIGIDITE 5208 WOVEN T-300, STYLE 3K-135- 8H-37% RIGIDITE 5208F WOVEN T-300, STYLE 3K-135- 8H-37% RIGIDITE 5208 WOVEN C3000, STYLE 3K-135- 8H-37%	X		X	X	X	X	X	X	X									H

Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 7 of 14)



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																SOURCE
	55-20-01	55-20-02	55-40-01	55-40-02	57-53-01	57-60-01	57-60-02	57-70-01	57-70-02								
GRAPHITE FABRIC (CONT)																	
BMS 8-212 TYPE IV, CLASS II, STYLE 3K-70-PW HMF-322/34C-IV HMF-1322/34C-IV RIGIDITE 5208 WOVEN T-300, STYLE 3K-70- PW-40% RIGIDITE 5208F WOVEN T-300, STYLE 3K-70- PW-40% RIGIDITE 5208 WOVEN C3000, STYLE 3K-70- PW-40% W3C-282-42-F263-8 W3T-282-42-F263-8	X	X	X	X	X	X	X	X	X								H

Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 8 of 14)



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																		SOURCE
	51-70-03	51-70-04	52-40-02	52-80-02	53-30-70	53-40-70	53-60-70												
GRAPHITE FABRIC (CONT)																			
BMS 8-256 TYPE I, CLASS 2, HMF-322/81C RIGIDITE 5240 WOVEN T-300, STYLE 3K-70-PW W3T-282-42-F593-1		X																	F H M
BMS 8-258 TYPE I, CLASS 2, STYLE 3K-70-PW				X															I
BMS 9-8 TYPE I, CLASS 2	X																		H M
ALUMINIZED FIBERGLASS FABRIC																			
BMS 8-278 TYPE I, CLASS 250 TYPE II, CLASS 250			X		X	X	X												F

Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 9 of 14)



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																	SOURCE
	51-70-03	51-70-04	51-70-05	54-10-01	54-20-01	54-21-01	54-30-01	54-31-01	54-50-70	54-51-70								
<u>ARAMID FABRIC</u>																		
AMS 3902 STYLE 120,285	X																	0
BMS 8-218 STYLE 120 120-F164-6-F50 1581-F164-6-F50 KEVLAR 49-120 F161-188	X	X	X	X	X	X	X	X										F
BMS 8-218 STYLE 285 KEVLAR 49-285 F161-188									X	X								F

**Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 10 of 14)**



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT															SOURCE
	52-40-02	52-80-02	53-30-70	53-40-70	53-60-70	53-60-71	55-10-01	55-10-30	55-30-01	55-30-30	57-51-01	57-53-02	57-53-04	57-53-70	57-60-01	
ARAMID FABRIC (CONT)																
BMS 8-219 STYLE 120 STYLE 285	X X	X	X X	X X	X X	X	X X	X X	X	X X	X X	X X	X X	X X	X	I

Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 11 of 14)



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MATERIAL	SUBJECT																SOURCE				
	52-40-02	52-80-02	53-10-72	53-30-70	53-40-70	53-60-70	53-60-71	54-10-01	54-11-01	54-20-01	54-30-01	54-31-01	54-40-02	54-50-70	54-51-70	55-10-01		55-10-30	55-20-01	55-20-02	55-30-01
<u>NON-METALLIC HONEYCOMB</u>																					
BMS 8-124 CLASS I, TYPE I, GRADE 4.0 AND/OR 12.0	X	X			X	X															
CLASS I, TYPE I, GRADE 5.5			X																		
CLASS I, TYPE I, GRADE 8.0					X								X								
CLASS I, TYPE IV, GRADE 4.5																					
CLASS IV, TYPE I, GRADE 4.0	X							X	X	X											A
CLASS IV, TYPE I, GRADE 9.0								X													B
CLASS IV, TYPE V, GRADE 3.0	X			X	X	X	X									X		X	X	X	
CLASS IV, TYPE V, GRADE 4.0															X						
CLASS IV, TYPE V, GRADE 5.0		X			X						X	X					X				
CLASS IV, TYPE V, GRADE 8.0													X	X							
CLASS IV, TYPE V, GRADE 9.0											X										
CLASS IV, TYPE VI, GRADE 3.0														X	X						

**Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 12 of 14)**



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																SOURCE
	55-30-09	55-40-01	55-40-02	57-30-01	57-41-01	57-41-09	57-41-70	57-51-01	57-53-01	57-53-02	57-53-70	57-60-01	57-60-02	57-70-01			
NON-METALLIC HONEYCOMB (CONT)																	
BMS 8-124 CLASS I, TYPE I, GRADE 4.0 AND/OR 12.0					X	X	X										A B
CLASS I, TYPE I, GRADE 5.5																	
CLASS I, TYPE I, GRADE 8.0								X									
CLASS I, TYPE IV, GRADE 4.5				X													
CLASS IV, TYPE I, GRADE 4.0																	
CLASS IV, TYPE I, GRADE 9.0																	
CLASS IV, TYPE V, GRADE 3.0	X	X	X					X	X	X	X	X	X	X			
CLASS IV, TYPE V, GRADE 4.0																	
CLASS IV, TYPE V, GRADE 5.0				X													
CLASS IV, TYPE V, GRADE 8.0																	
CLASS IV, TYPE V, GRADE 9.0																	
CLASS IV, TYPE VI, GRADE 3.0	X							X									

**Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 13 of 14)**



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STRUCTURAL REPAIR MANUAL**

MATERIAL	SUBJECT																				SOURCE
	53-00-50	53-10-72	53-40-70	54-50-70	54-51-70																
NON-METALLIC HONEYCOMB (CONT)																					
BMS 8-124 TAPE V, STYLE 285, GRADE 4.0				X	X																A B
HRH-F/50-10-5.0		X																			F
HRH-101F50-4.5			X																		F
<u>FLOOR PANEL STOCK</u>																					
BMS 4-17 TYPE I, LOW DENSITY	X																				C D E P
TYPE II, MED DENSITY																					C D E P
TYPE VII, DUAL DENSITY																					C D E P
TYPE VI, HIGH DENSITY (FORMERLY 69B15779 TYPE VI)	X																				E
BMS 4-23 TYPE II, HIGH DENSITY	X																				A

**Fiberglass/Graphite/Aramid Fabrics and Non-Metallic Honeycomb Cores
Figure 2 (Sheet 14 of 14)**



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STRUCTURAL REPAIR MANUAL

MATERIAL	SUBJECT																SOURCE
	51-10-00	51-20-01	51-20-05	51-70-01	51-70-03	51-70-04	51-70-05	54-00-30									
<u>ABRASIVES</u>																	
ALUMINUM OXIDE ABRASIVE PAPER NO. 80 GRIT	X			X	X	X	X										ANY SOURCE
NO. 150 GRIT				X	X	X	X										ANY SOURCE
NO. 320 GRIT		X	X														ANY SOURCE
NO. 400 GRIT		X															ANY SOURCE
SCOTCHBRITE PAD TYPE A NO. 150		X			X	X											A
NO. 240					X	X											A
SILICA SAND, NO. 1					X	X	X										ANY SOURCE
SILICONE CARBIDE PAPER NO. 240 GRIT								X									ANY SOURCE
SODA LIME GLASS BEADS NO. 60 GRIT					X	X	X										ANY SOURCE
STEEL SHOT, NO. 230 (VACUBLAST)					X	X	X										ANY SOURCE
TYCRO TYPE 3A, ALUMINUM OXIDE WHEELS		X															A

NOTE

A MINNESOTA MINING AND
MANUFACTURING CO.
3M CENTER ST.
ST. PAUL, MINNESOTA 55101

Abrasives
Figure 3



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STRUCTURAL REPAIR MANUAL

NOTES

- A** WEST COAST PAPER CO.
2203 FIRST AVE. SO.
SEATTLE, WASHINGTON 98134
- B** FISHER BAG CO.
1560 FIRST AVE. SO.
SEATTLE, WASHINGTON 98134
- C** THE ORELUBE CORPORATION
201 EAST BETHPAGE ROAD
PLAINVIEW, NEW YORK 11803
- D** E.I. DUPONT DE NEMOURS AND CO., INC.
1007 MARKET STREET
WILMINGTON, DELAWARE 19898
- E** AIRTECH INTERNATIONAL INC.
2542 E. DE LAMO BLVD
P.O. BOX 6207
CARSON, CALIFORNIA 90749
- F** HILL INDUSTRIES, INC.
1005 17TH STREET N.W.
PUYALLUP, WA 98371

Miscellaneous Materials
Figure 4 (Sheet 1 of 2)



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MATERIAL	SOURCE	SUBJECT															
		51-20-01	51-20-05	51-40-02	51-40-09	51-70-03	51-70-04	51-70-05	51-70-06	51-70-07	51-70-08	51-70-09	51-70-10	51-70-14	51-70-16	51-70-17	51-70-18
CHEESECLOTH	ANY SOURCE	X	X			X	X	X	X	X	X	X	X	X		X	X
BLEEDER CLOTH	A B					X	X	X	X	X	X	X	X	X		X	
OSNABURG CLOTH UNBLEACHED CCC-C-429																	X
GAUZE	ANY SOURCE					X	X	X	X	X	X	X	X	X		X	
CETYL ALCOHOL	ANY SOURCE			X	X												
LAURIC ACID	ANY SOURCE				X												
BOELUBE 100A	C			X											X		X
FREON TB-1	D			X													
SOLID FEP PARTING FILM	ANY SOURCE					X	X	X	X	X	X			X	X	X	X
PERFORATED FEP PARTING FILM	ANY SOURCE					X	X	X	X	X	X			X	X	X	X
VACUUM BAG MATERIAL	ANY SOURCE					X	X	X	X	X	X	X	X	X	X	X	X
TEFLON PARTING FILM	ANY SOURCE					X			X					X	X		X
AIRWEAVE SS	E					X	X	X	X	X	X				X	X	
EXTRUDED SEALING COMPOUND	ANY SOURCE					X	X	X	X	X	X			X	X	X	X
BMS 8-289 TYPE O/250/4/1100/002 FORM I C-CLAD H250/350 -002	F							X						X			
BMS 8-289 TYPE O/350/2/1100/002 FORM I C-CLAD H250/350 -002	F						X				X						
BMS 8-289 SPLICE TYPE O/250/4/1145/002 FORM II C-CLAD M250/350 -002	F							X						X			
BMS 8-289 SPLICE TYPE O/350/4/1145/002 FORM II C-CLAD M250/350 -002	F						X				X						

Miscellaneous Materials
Figure 4 (Sheet 2 of 2)



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GENERAL - HAZARDOUS MATERIALS

1. References

Reference	Title
51-10-02, GENERAL	Inspection and Removal of Damage
51-30-01, GENERAL	Sheet Metal Materials
SOPM 20-10-09	Machining of Copper Beryllium Alloys
SOPM 20-50-03	Bearing and Bushing Replacement

2. Beryllium Alloy

- A. Certain bushings used on this airplane are made from beryllium copper. The dust and fumes from this material when machined are toxic and work of this nature must only be undertaken where the appropriate facilities exist. Refer to SOPM 20-10-09 for practices and precautions when working with beryllium and beryllium alloys, and SOPM 20-50-03 for further information on bushings.

3. Magnesium Alloys

- A. Dust and particles of magnesium alloys present a fire hazard. For details of practices and precautions when working with magnesium refer to 51-10-02, GENERAL.

4. Titanium Alloys

- A. Dust and particles of titanium alloys present a fire hazard. For details of practices and precautions when working with titanium refer to 51-10-02, GENERAL and 51-30-01, GENERAL.



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GENERAL - EQUIPMENT AND TOOLS FOR REPAIRS

1. General

- A. This section gives a list of the equipment and hand tools that are used to make repairs. This section also gives the necessary vendor data.
- B. Refer to:
 - (1) Figure 1/GENERAL for a list of repair equipment
 - (2) Figure 2/GENERAL for a list of hand tools
- C. Some of the procedures in this manual identify tools or equipment. You can use alternative tools that are equivalent unless the procedure tells you the specified tool or equipment item is mandatory. If you use alternative tools or equipment, make sure they give the same results and are as safe to the parts and personnel as the tools or equipment specified in the procedure.



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STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
AIR-BLAST GUN	VACU-BLAST JR., #41303 OR EQUIVALENT	VACU-BLAST WOODSON HOUSE AJAX AVENUE SLOUGH BERKSHIRE, SL1 4DS ENGLAND -OR- P.O. BOX 286 HERINGTON, KANSAS 67449	CLEAN METAL SURFACES
ASPIRATOR, VACUUM	VACUUM MODEL TD-260 OR EQUIVALENT	AIR-VAC ENGINEERING P.O. BOX 215 30 PROGRESS AVE SEYMOUR CT 06483 AIRTRONICS 1940 124TH AVE NE BLDG. A-107 BELLEVUE, WA 98005	CONVERTS AIR PRESSURE TO VACUUM
BAGS, PRESSURE	10-LB SAND OR SHOT BAGS	COMMERCIAL-ANY SOURCE	USE AS A SUBSTITUTE PRESSURE MEDIUM
BLANKET, HEATING	5 WATTS/IN ² MINIMUM	ATACS PRODUCTS, INC. 14040 INTERURBAN AVE S TUKWILA, WA 98168 HEATCON COMPOSITE SYSTEMS 600 ANDOVER PARK E SEATTLE, WA 98188 -OR- UNIT 8, EDISON RD, ST. IVES, HUNTINGDON, CAMBRIDGE PE17 4LZ ENGLAND GMI 9 RUE BUFFAULT 75009 PARIS, FRANCE -OR- GMI/EMPTECH 5957 GLENDALE DRIVE CHILLIWACK, B.C., CANADA V2R 3A5 JR TECHNOLOGY LTD. 81 NORTH END, MELDRETH ROYSTON, HERTS, ENGLAND SG86NU PYROMETRIC SERVICE CORP. 1312 S. 96TH ST SEATTLE, WA 98108-5010 TAYCO ENGINEERING, INC. 10874 HOPE ST P.O. BOX 6034 CYPRESS, CA 90630 WICHITECH INDUSTRIES, INC. OAKLAND CENTER, 8990 RT. 108 COLUMBIA, MD 21045	TO PROVIDE HEAT FOR CURING ADHESIVE

Miscellaneous Equipment
Figure 1 (Sheet 1 of 5)

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TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
CLEANER, VACUUM B	INDUSTRIAL-TYPE MODEL #APN4423 (TORNADO); USE A 556AL BARREL AS A DUST RECEIVER	BREUER/TORNADO CORP. 7401 W. LAWRENCE AVE. CHICAGO, IL 60656	CLEAN UP SANDING DUST AND DEBRIS
CONTAINERS, 1 LITER BEAKER-TYPE, POLYETHYLENE	#13915-679 SHERWOOD OR EQUIV	V.W.R. SCIENTIFIC 355 TRECK DRIVE SEATTLE, WA 98188	MIXING RESINS AND POTTING COMPOUNDS
CONTAINERS, SAFETY, FOOT-LEVER-TYPE	METAL, EAGLE 906-FL OR EQUIV	V.W.R. SCIENTIFIC 355 TRECK DRIVE SEATTLE, WA 98188	HOLDING USED CLOTHES WITH TOXIC MATERIALS
CORK SHEET	0.125-IN.	COMMERCIAL - ANY SOURCE	
CAUL PLATE	FABRICATE LOCALLY USING 0.016 ALUMINUM SHEET		USE TO DISTRIBUTE PRESSURE OVER AREAS OF A REPAIR
COUNTERSINK, MICRO-STOP, 100° ADJUSTABLE DRIVE	#6300-LARGE, #6400-SMALL, OR EQUIVALENT	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMMASTER.COM	COUNTERSINKING HOLES FOR RIVETS, SCREWS, OR BOLTS
CUTTER, HONEYCOMB, VALVE STEM TYPE, TWO-PIECE	30-030-1 HOLDER D 30-030-2 CUTTER	ONSRUD CUTTER MFG CO. 800 LIBERTY DRIVE P.O. BOX 550 LIBERTYVILLE, IL 60048	ALUMINUM HONEYCOMB CUTTER
CUTTER, HONEYCOMB, VALVE STEM TYPE ONE-PIECE	31-010 0.50 DIA C 31-015 0.75 DIA C 31-020 1.0 DIA C 31-025 1.5 DIA D 31-030 2.0 DIA D	OR ANY OTHER COMMERCIAL SOURCE	ALUMINUM HONEYCOMB CUTTER
DRILL MOTOR B	ELECTRIC 600 RPM, MODEL 15C 1489 OR EQUIVALENT	AERO INDUSTRIAL TOOL 482 EAST MEADOW AVE. E. MEADOW, NY 11554	CONVENTIONAL DRILLING, SANDING, OR CIRCULAR SAWING
	PNEUMATIC, 1/4-IN. CHUCK, MODEL #3008-0 OR EQUIVALENT	CHICAGO PNEUMATIC 1800 OVERVIEW DR. ROCKHILL, SC 29730	
DRILL MOTOR, 90° ANGLE	PNEUMATIC, VARIABLE SPEED, MODEL #10L-1201B OR EQUIVALENT	AERO INDUSTRIAL TOOL 482 EAST MEADOW AVE. E. MEADOW, NY 11554	CONVENTIONAL DRILLING, SANDING, OR CIRCULAR SAWING
GAUGE, AIR PRESSURE	0 TO 100 PSI, MODEL J4654 OR EQUIVALENT	MARSH DISTRIBUTOR P.O. BOX 361 ANTIOCH, IL 60002	TO INDICATE AIR LINE PRESSURE
GAUGE, VACUUM	0 TO 32 IN. HG	MARSH DISTRIBUTOR P.O. BOX 361 ANTIOCH, IL 60002	TO INDICATE VACUUM LINE PRESSURE
GLOVES, COTTON	WHITE, UNTREATED, LINTLESS	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMMASTER.COM	USE FOR HANDLING CLEANED PARTS OR ADHESIVES
GLOVES, INSULATING	HEAT INSULATING	ANY SOURCE	USE FOR HANDLING HOT PARTS
HEATER ASSEMBLY B	HOT AIR, BF-400-10, OR EQUIVALENT	ENGINEERED AIR SYSTEMS 1270 N. PRICE RD. ST. LOUIS, MO 63132	HOT AIR BLOWER TO DUCT AIR TO AREA BEING CURED

Miscellaneous Equipment
Figure 1 (Sheet 2 of 5)

757-200 STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
HEATER, AIR B	1000 TO 2000 WATTS, MODEL HGS 50110J ALTERNATE	MASTER APPLIANCE CORP. 2420 18TH ST. RACINE, WI 53403 IDEAL INDUSTRIES, INC. 1006 PARK AVENUE SYCAMORE, IL 60178	FOR HEAT-TACKING ADHESIVES, HEAT-DRYING HONEYCOMB CORE OR ASSEMBLIES, WARMING COMPOUNDS AND/OR RESINS
LAMP, HEATING	250 TO 300 WATTS, EXPLOSIONPROOF, TUNGSTEN OR QUARTZ TUBE	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMASTER.COM	LOW-TEMPERATURE CURING OF ADHESIVES, POTTING COMPOUNDS, OR RESINS
LAMP, HEATING ASSEMBLY	25 OR 40/4 #375G30 OR EQUIVALENT	DELTROL CONTROLS CORP. 2740 SO. 20TH ST. MILWAUKEE, WI 53215	LOW-TEMPERATURE CURING OF ADHESIVES, POTTING COMPOUNDS, OR RESINS
MAT, FIBERGLASS	2 OZ FIBERGLASS OR 7500 TOOLING MAT	REN PLASTICS 5656 S. CEDAR ST. LANSING, MI 48909 DEXTER CORP. (HYSOL PRODUCTS) ONE DEXTER DRIVE SEABROOK, NH 03874	CAN BE USED FOR LAMINATED TOOLING, FIBERGLASS BLEEDER CLOTH, INSULATION MATERIAL, OR A SUBSTITUTE FOR OSNABURG BLEEDER CLOTH
MOTOR ASSEMBLY, PNEUMATIC	ARBOR SAW/MOTOR	AERO INDUSTRIAL TOOL 482 EAST MEADOW AVE. E. MEADOW, NY 11554	TO CUT AWAY DAMAGED MATERIAL
MULTITESTER	LOW CURRENT, LOW OHM, KELVIN-BRIDGE-TYPE	COMMERCIAL - ANY SOURCE	TAKING ELECTRONIC MEASUREMENTS
PEENING TOOL, POWER B	1/4-IN. STEM (DRILL ROD), SLOT END FOR FLAPPER STRIP MIL-B-1170, TYPE II, CLASS E, STYLE 1		USE FOR SHOT PEENING REQUIREMENTS
POWER SUPPLY, DC	REGAL LINE MODEL R2518 UNFILTERED BENCH MODEL R SERIES DC OR EQUIV.		USE AS POWER SOURCE FOR PHOSPHORIC ACID ANODIZING
RECORDER, TEMPERATURE, 24-POINT, AUTOMATIC CHART-TYPE	MODEL #15306836-24	HONEYWELL	MEASURING TEMPERATURE AT THE ADHESIVE CURE LINE BY THERMOCOUPLES; 1 THROUGH 24 POINTS AVAILABLE
RECORDER, TEMPERATURE, 1-POINT, INDIVIDUAL PRINTOUT, ROLLER CHART	MODEL #122 115-VOLT, 60-CYCLE	GULTON GRAPHIC INSTRUMENT 1900 S. COUNTRY TR. E. GREENWICH, RI 02818	MEASURING ONE THERMOCOUPLE ON A LINE CHART
REGULATOR, AIR PRESSURE	0 TO 125 PSI, MODEL 11-002-025 OR EQUIVALENT	C.A. NORGREN CO. 5400 S. DELEWARE ST. LITTLETON, CO 80120	MEASURE AND REGULATE AIR PRESSURE
REGULATOR, VACUUM	0- TO 30-INCH HG, OR EQUIVALENT	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMASTER.COM	MEASURING VACUUM AT THE ASSEMBLY

Miscellaneous Equipment
Figure 1 (Sheet 3 of 5)

757-200 STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
SAFETY FACE SHIELD	TRU-SAFE #199-1 OR SAFELINE #6799 (10 BY 18-1/4) OR EQUIV	COMMERCIAL - ANY SOURCE	FOR FACE AND EYE PROTECTION
SAFETY FACE SHIELD HOLDER	RICE HEAD SHIELD #707 OR EQUIVALENT		HOLDS REPLACEABLE FACE SHIELD
SAFETY GLASSES	5944D SMOKE CLEAR LENSES OR EQUIVALENT	H.L. BOUTON CO. INC. BUZZARD BAY, MA 02532 MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMASER.COM	FOR EYE PROTECTION
SCALE, BALANCE	1.0 GRAM ACCURACY, MULTIPLE MODELS	METTLER 1900 POLARIS PKWY COLUMBUS, OH 43240 OR OHAUS CORPORATION 29 HANOVER RD FLORHAM PARK, NJ 07932	WEIGHING COMPOUNDS AND RESIN MIXTURES
SEALANT GUN	AIR-OPERATED OR EQUIVALENT GLUE GUN	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMASER.COM	DISPENSING OF FILLERS AND SEALANTS
SHAVER, MICRO-RIVET- HEAD	MODEL 2T-405, ADJUSTABLE, OR EQUIVALENT	ADVANCED AIR TOOL CO., INC. 131 ALLEN BLVD. FARMINGDALE, NY 11735-5616	SHAVE PROTRUDING RIVET HEADS
SINE PLATE	0° TO 45° INCLINATION FROM HORIZONTAL POSITION	BROWN & SHARPE PRECISION PARK 200 FRENCHTOWN RD. N. KINGSTOWN, RI 02852	USE WITH CORE-SLICING EQUIPMENT
SPRAY UNIT	POWER UNIT, ATOMIZED W/GLASS 6 OZ CONTAINER	PRECISION VALVE CORP. P.O. BOX 309 YONKERS, NY 10702	USED TO APPLY SMALL AMOUNTS OF LIQUID PRIMER, ADHESIVE, OR RESINS
SURFACE BLEEDER, SURFACE BREATHER, AND INSULATION TEMPERATURE CONTROLLER CONSOLE, PORTABLE SELF- CONTAINED <div style="border: 1px solid black; display: inline-block; padding: 2px;">A</div> <div style="border: 1px solid black; display: inline-block; padding: 2px;">B</div>	BMS 9-3, TYPE D	SEE 51-20-03, FIG. 2 ATACS PRODUCTS, INC. 14040 INTERURBAN AVE. S. TUKWILA, WA 98168 HEATCON COMPOSITE SYSTEMS 600 ANDOVER PARK E. SEATTLE, WA 98188 JR TECHNOLOGY LTD. 81 NORTH END, MELDRETH ROYSTON, HERTS, ENGLAND SG86NU	USE WITH HEAT BLANKETS, THERMOCOUPLES, AND VACUUM UNIT FOR APPLICATION AND RECORDING OF HEAT AND PRESSURE

**Miscellaneous Equipment
Figure 1 (Sheet 4 of 5)**



757-200
STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
TRANSFORMER, PORTABLE B VACUUM UNIT B VACUUM PROBE, QUICK DISCONNECT	VARIABLE CONTROL 115-VOLT, 60-CYCLE ANY UNIT COMPATIBLE WITH TEMPERATURE CONTROL CONSOLE VACU-VALVE, #401 ROUND BASE, #401A RECTANGULAR BASE	PYROMETRIC SERVICE CORP. 1312 S. 96TH ST. SEATTLE, WA 98108-5010 TAYCO ENGINEERING, INC. 10874 HOPE ST. P.O. BOX 6034 CYPRESS, CA 90630 WICHITECH INDUSTRIES, INC. OAKLAND CENTER 8990 RT. 108 COLUMBIA, MD 21045 AIRTECH INTERNATIONAL, INC. 5700 SKYLAB ROAD HUNTINGTON BEACH, CA 92647	USE WITH HEATING BLANKETS AS A POWER SUPPLY INCLUDES VACUUM PUMP AND TRANSDUCER USE FOR EVACUATION OF AIR INSIDE BAG FILM

NOTES

- A** HOT BOND CONSOLES MUST HAVE THE FOLLOWING FEATURES:
- (1) CONTROL OF POWER INPUT TO HEAT BLANKETS
 - (2) PROVIDE FOR EVACUATION OF LAY-UP
 - (3) CONTROL VACUUM
 - (4) CONTINUOUSLY RECORD TEMPERATURE INPUT FROM AT LEAST 1 THERMOCOUPLE
 - (5) PROVIDE MANUAL MONITORING OF AT LEAST 3 THERMOCOUPLES
 - (6) SETTING OF CURE TIME
 - (7) AUTOMATIC SHUT-OFF AT END OF CURE TIME

- B** THE USE OF ELECTRICAL EQUIPMENT IS HAZARDOUS WHEN USED IN PROXIMITY OF FUEL AND OTHER VOLATILE MATERIALS. OBSERVE ALL SAFETY PRECAUTIONS
- C** 0.25 SHANK
- D** 0.50 SHANK

Miscellaneous Equipment
Figure 1 (Sheet 5 of 5)

757-200 STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
ANGLES, 90° ALUMINUM	ASSORTED SIZES, SHOP STOCK	COMMERCIAL - ANY SOURCE	USE WITH CLAMP WEDGE BLOCKS OR REPAIRS AT EDGE OF ASSEMBLIES
BLADE, SAW	RAZOR 3/4 IN., #34-C	X-ACTO ONE COMMERCE SQUARE 2005 MARKET ST. PHILADELPHIA, PA 17103	FINAL SAWING OF EXTRUSIONS AND SKINS
BLADE HANDLE, SAW	X-ACTO #5	X-ACTO ONE COMMERCE SQUARE 2005 MARKET ST. PHILADELPHIA, PA 17103	HANDLE FOR THE #34-C RAZOR SAW BLADE
BLOCK, SANDING	METAL OR WOOD	COMMERCIAL - ANY SOURCE OR IN-HOUSE FABRICATION	USE WITH SANDING PAPER TO ACHIEVE A FLAT FINISH SURFACE
BOTTLES, LIQUID DISPENSING, POLYETHYLENE	SQUEEZE-TYPE, 16 OZ., #16057-120 OR EQUIV USE SPOUT CAP, 28 MM, #H-16657 OR EQUIV	V.W.R. SCIENTIFIC 355 TRECK DRIVE SEATTLE, WA 98188	DISPENSING CLEANING SOLVENTS AND LIQUIDS
BRUSH, ACID		COMMERCIAL - ANY SOURCE	
BRUSH, PAINT	1.0 INCH WIDE, SHORT BRISTLE	COMMERCIAL - ANY SOURCE	FOR APPLICATION OF SOLVENTS, PASTE, SOLVENTS, OR ADHESIVES
BURNISHING TOOL	METAL, ASSORTED SIZES, SPOON TYPE	COMMERCIAL - ANY SOURCE	USE FOR BURNISHING SCRATCHES
BURNISHING TOOL	0.187 POLYETHYLENE	COMMERCIAL - ANY SOURCE	USE FOR BURNISHING SCRATCHES
CLAMPS, C-TYPE	ASSORTED SIZES	COMMERCIAL - ANY SOURCE	USE FOR MECHANICAL CLAMPING TO APPLY PRESSURE TO A REPAIR, OR TO WEDGE BLOCKS (IF USED)
DIVIDERS, METAL- MARKING	CAPACITY, 8 INCHES	COMMERCIAL - ANY SOURCE	USE FOR MARKING CUTOUTS ON ALUMINUM OR TITANIUM SURFACES AND DETAIL FABRICATION
DRILLS, HI-SPEED STEEL	NUMBER OR LETTER DRILL SET, 90°/108° POINT ANGLE	COMMERCIAL - ANY SOURCE	FOR DRILLING ALUMINUM
DRILLS, COBALT	NUMBER OR LETTER DRILL SET, 135° POINT ANGLE	COMMERCIAL - ANY SOURCE	FOR DRILLING TITANIUM
DRILL STOP, SPRING- LOADED	WEDGELOCK DS-10 WEDGELOCK DS-20 WEDGELOCK DS-30 WEDGELOCK DS-40	MONOGRAM AEROSPACE FASTENERS 2343 SO. GARFIELD AVE. LOS ANGELES, CA 90040	FOR SETTING DRILL DEPTH
FILE, HAND, FLAT MILL	6-, 8-, 10-, OR 12-IN.	COMMERCIAL - ANY SOURCE	USE FOR DEBURRING AND SIZING DETAILS
FILE, HAND, ROUND (RAT-TAIL)	1/8-, 1/4-, 3/8-, OR 1/2-IN.	COMMERCIAL - ANY SOURCE	USE FOR DEBURRING AND FILING HOLES
FILE, HAND, ROTARY	1/2-, 3/4-, OR 1-IN. DIA ROUND END	COMMERCIAL - ANY SOURCE	USE FOR REMOVING METAL AND HONEYCOMB CORE
FILE, HAND, FLAT VIXON	12- OR 14-IN.	COMMERCIAL - ANY SOURCE	USE FOR HEAVY ROUGH CUT IN METAL REMOVAL

Hand Tools
Figure 2 (Sheet 1 of 5)

757-200 STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
FUNNELS, POLY-ETHYLENE, 28 MM OPENING, SHORT STEM	3-IN. DIA # 3-2050-040 6-IN. DIA # 3-2050-084 6-IN. DIA # 3-0255-088	V.W.R. SCIENTIFIC 355 TRECK DRIVE SEATTLE, WA 98188 OR LOCAL SUPPLIER OF LABORATORY SUPPLIES	USE FOR DISPENSING CHEMICALS, SOLVENTS, OR ACIDS
HAMMER, MACHINISTS BALL PEEN	FED. GGG-H-86, TYPE II, CLASS 1, STYLE A, 8 OZ	COMMERCIAL - ANY SOURCE	HAND WORK
HAMMER, TAPPING, INSPECTION		IN-HOUSE FABRICATION	INSPECTION TOOL
KNIFE, RETRACTABLE BLADE	MECHANICAL, RAZOR BLADE	COMMERCIAL - ANY SOURCE	THIN CORE SLICING, ADHESIVE CUTTING, FILM CUTTING, TAPE CUTTING, MISC CUTTING OR TRIMMING
MICROMETERS, GAP- TYPE, CERTIFIED	0.0 TO 1.0 INCH, ADJUST- ABLE STEM	COMMERCIAL - ANY SOURCE	USE FOR THICKNESS MEASUREMENTS OF SHEET METAL AND FOR INSPEC- TION OPERATIONS
MICROMETERS, DEPTH, CERTIFIED	0.0 TO 2.0 INCHES	COMMERCIAL - ANY SOURCE	USE FOR MEASURING DEPTH OF HONEYCOMB CORE OR ASSEMBLY THICKNESS
NEEDLE, HYPODERMIC	18 GAGE, 2 INCHES LONG, #BD-1098 BECTON/DICKSON	V.W.R. SCIENTIFIC 355 TRECK DRIVE SEATTLE, WA 98188	CUT STEM TO LENGTH DESIRED. USE FOR RESIN INJECTIONS TO FILL VOIDS
PRESSURE PLATES	0.125 AND 0.250 ALUMINUM PLATE, VARIOUS SIZES 6061-T4 ALUM ALLOY PLATE OR EQUIV	COMMERCIAL - ANY SOURCE	USE FOR PRESSURE APPLICATION DURING THE CURE CYCLE
PHENOLIC SHEET	0.125 TEMPLATE STOCK MIL-P-15035 OR EQUIV	COMMERCIAL - ANY SOURCE	USE FOR ROUTER TEMPLATES
PIPET, STRAIGHT TIP MEDICINE DROPPER	#52950-002 OR EQUIV	V.W.R. SCIENTIFIC 355 TRECK DRIVE SEATTLE, WA 98188	USE FOR INJECTION OF LIQUID ADHESIVE
PLASTIC SHEET, ACRYLIC	0.187 DRILL TEMPLATE STOCK OR EQUIV MIL-P-5425A	COMMERCIAL - ANY SOURCE	USE FOR DRILL TEMPLATES
PLASTIC SHEET, MYLAR	0.0075 IN. WIDE, 650-FT ROLL	DUPONT	USE FOR MAKING OUTLINE TEM- PLATES FOR HONEYCOMB CORE DETAILS
PLASTIC APPLICATOR	P.A-1 PLASTIC	3M	USE FOR SPREADING, SCREEDING, AND SMOOTHING OF ADHESIVES, RESINS, OR COMPOUNDS
PLATE, MIXING	0.125 OR 0.250 ALUMINUM PLATE	COMMERCIAL-ANY SOURCE, IN-HOUSE SHOP STOCK	MYLAR SHEET CAN BE USED AS A SUBSTITUTE FOR MIXING COM- POUNDS, RESINS, OR ADHESIVE PASTES
PLIERS, ANGLE NOSE, MULTIPLE HOLE	FED. GGG-P-00471, TYPE II, STYLE B, CLASS 1	COMMERCIAL-ANY SOURCE	MANUAL USE
PLIERS, DUCKBILL, 6-INCH	FED. GGG-P-471	COMMERCIAL-ANY SOURCE	MANUAL USE


Hand Tools
Figure 2 (Sheet 2 of 5)

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TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
PLIERS, NEEDLE NOSE STRAIGHT	FED. GGG-P-471	COMMERCIAL-ANY SOURCE	MANUAL USE
PLIERS, STRAIGHT NOSE SLIP-JOINT W/CUTTER	FED. GGG-P-471	COMMERCIAL-ANY SOURCE	MANUAL USE
PLYWOOD, INDOOR	0.250 TEMPLATE STOCK OR EQUIV	COMMERCIAL-ANY SOURCE	USE FOR ROUTER TEMPLATES
ROD, STIRRING	0.125 THRU 0.375-IN. DIA STEEL, GLASS, OR POLY-ETHYLENE	COMMERCIAL-ANY SOURCE	USE FOR MIXING OR STIRRING LIQUIDS AND COMPOUNDS
ROLLER	WOOD OR HARD RUBBER, 6 INCHES LONG, 2-IN. DIA	COMMERCIAL-ANY SOURCE	ROLL OUT COMPOUNDS, LIQUID ADHESIVES, OR TRAPPED AIR UNDER FILMS OR CLOTH
ROUTER ATTACHMENT	MODEL QRC-3C OR QRC-3D COLLET, 9003 NOSE, 9013, 9022 BEARING, 9015 RET. RING, 9016; #881390 COMPLETE, USE WITH MODEL 11GLF-230/250 ROUTER MOTORS OR EQUIVALENT	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMMASTER.COM COOPER POWER TOOLS 2000 SO. STA. CRUZ ST. ANAHEIM, CA 92805	HAND-ROUTING OF DAMAGED MATERIAL WITH ROUTER BIT GUIDE THAT INCLUDES SET-BACK DIMENSIONAL
ROUTER BUSHING	#SP-310-31J OR EQUIVALENT	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMMASTER.COM	USE WITH QRC-3C AND -3D ROUTER MOTORS
ROUTER, MOTOR	PNEUMATIC, HI-SPEED, 20,000 RPM, QRC-3C OR 3D OR EQUIVALENT	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMMASTER.COM COOPER POWER TOOLS 2000 SO. STA. CRUZ ST. ANAHEIM, CA 92805	USE FOR DAMAGE REMOVAL; SEE "ROUTER ATTACHMENT" FOR QRC ROUTERS
ROUTER, BITS	PNEUMATIC, HI-SPEED, MODEL 11GLF-230 RPM 25,000, WITH ACCESSORIES OR EQUIVALENT 1/4-IN. DIA, 2-FLUTE LH SPIRAL, HI-SPEED STEEL FOR ALUMINUM; 1/4-IN. DIA, 3-FLUTE LH SPIRAL, CARBIDE FOR TITANIUM OR EQUIVALENT	MC MASTER-CARR P.O. BOX 740100 ATLANTA, GA 30374-0100 WWW.MCMMASTER.COM COOPER POWER TOOLS 2000 SO. STA. CRUZ ST. ANAHEIM, CA 92805 COMMERCIAL-ANY SOURCE	USE #881390 ROUTER ATTACHMENT INCLUDES SETBACK BUSHING USE WITH ANY ROUTER MOTOR

Hand Tools
Figure 2 (Sheet 3 of 5)

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TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
SAFETY FACE SHIELD	TRU-SAFE #119-1 OR SAFELINE #6799 (10 BY 18-1/4) OR EQUIV	COMMERCIAL - ANY SOURCE	FOR FACE AND EYE PROTECTION
SAFETY FACE SHIELD HOLDER	RICE HEAD SHIELD #707 OR EQUIV	COMMERCIAL - ANY SOURCE	HOLDS REPLACEABLE FACE SHIELD
SAFETY GLASSES	5944D SMOKE CLEAR LENSES	H.L. BOUTON CO. INC. BUZZARD BAY, MA 02532	FOR EYE PROTECTION
SANDER, POWER 	BELT, FLEXIBLE DISC, ORBITAL, OR ROTATING PAD TYPES	COMMERCIAL - ANY SOURCE	USE FOR TAPER SANDING REPAIR AREA, PAINT REMOVAL, SMOOTHING CURED REPAIRS
SAW, ARBOR	1/4-IN. DIA EXPANDABLE END, ALLEN SCREW LOCK	IN-HOUSE FABRICATION (SEE FIG. 8-12)	HOLDING ARBOR FOR SLOTTING SAW BLADES
SAW, BLADE	HACKSAW, 12-INCH, ASSORTED TEETH, 18,24,28 AND 32 PER INCH	COMMERCIAL - ANY SOURCE	USE FOR REMOVAL OR DAMAGED MATERIAL
SAW BLADE HOLDER		COMMERCIAL - ANY SOURCE	HOLDER FOR HACKSAW BLADES
SAW, CIRCULAR WITH ADAPTER AND BLADE	CP-3017-OKS-1000-3 OR EQUIVALENT	CHICAGO PNEUMATIC 1800 OVERVIEW DR. ROCKHILL, SC 29730	USE TO SAW SLOTS IN PANEL
SAW, CUTTER	5/8 INCH	COMMERCIAL - ANY SOURCE	CUTTER FOR ARBOR SAW
SAW, HOLE	1/2-,1-,2-,3-, AND 4-IN.	COMMERCIAL - ANY SOURCE	USE FOR REMOVAL OF DAMAGED MATERIAL
SAW, RECIPROCATING WITH BLADES	FOR ALUMINUM OR TI SKINS, CP-3017-FO OR EQUIVALENT	CHICAGO PNEUMATIC 1800 OVERVIEW DR. ROCKHILL, SC 29730	USE TO REMOVE DAMAGED MATERIAL-FROM BONDED PANELS
SAW, SLOTTING	1/4-IN. DIA ARBOR HOLE, 2-IN. BLADE	COMMERCIAL - ANY SOURCE	USE FOR REMOVAL OF DAMAGED MATERIAL
SCALE, FLEXIBLE	12-IN. #338R TEMPERED OR EQUIV	COMMERCIAL - ANY SOURCE	DETERMINING SIZES
SCREEN WIRE	#16 MESH 0.018 DIA WIRE CRS TYPE 304	PACIFIC NORTHWEST WIRE 18623 89TH PLACE S. KENT, WA 98032	USE FOR PHOSPHORIC ACID ANODIZING
SCRIBE	REVERSIBLE POINT	COMMERCIAL - ANY SOURCE	MAKING DETAIL LAYOUT OUTLINES ON MYLAR OR TEMPLATE STOCK
SHEARS, METAL CUTTING	10-IN. FED. GGG-5-291 TYPE II, CLASS 1, STYLE B	COMMERCIAL - ANY SOURCE	CUTTING METAL DETAILS, PREFIT TRIMMING OF DETAILS
SPATULA, MIXING	WOOD OR METAL	COMMERCIAL - ANY SOURCE	MIXING COMPOUNDS, SLICING LIGHT DENSITY CORE, SPREADING COMPOUNDS AND ADHESIVES
SQUARE, COMBINATION	12-IN. GROOVED BLADE, STYLE "BP"	COMMERCIAL - ANY SOURCE	MARKING DETAILS
SQUEEGE, FLAT	SYNTHETIC RUBBER, PHENOLIC LAMINATE, OR PLEXIGLASS	COMMERCIAL - ANY SOURCE	USE FOR SMOOTHING RESINS OR COMPOUNDS

Hand Tools
Figure 2 (Sheet 4 of 5)



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STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
TONGUE DEPRESSORS	WOOD	COMMERCIAL - ANY SOURCE	MIXING AND SPREADING COMPOUNDS AND ADHESIVES

NOTE

- A** THE USE OF ELECTRICAL EQUIPMENT IS HAZARDOUS WHEN USED IN PROXIMITY OF FUEL AND OTHER VOLATILE MATERIALS. OBSERVE ALL SAFETY PRECAUTIONS

Hand Tools
Figure 2 (Sheet 5 of 5)



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - ORDER DATA FOR COMPOSITE REPAIR MATERIALS

1. Applicability

- A. This general section contains the necessary data to order composite repair materials from The Boeing Company.

2. General

- A. This section gives a list of materials that are used to make the composite repairs given in the 757 Structural Repair Manual (SRM).
- B. The data given here includes the order numbers and the units of measure for materials that are available in small quantities through Boeing Spares. Refer to Paragraph 4./GENERAL for the order information. If you need a material that is not included in this section, you can still order it through Boeing Spares. It is possible that Boeing Spares will have to purchase the material from a vendor with a minimum buy limit. Also, the vendor source information for nonmetallic materials is given in 51-30-03, GENERAL.
- C. The shelf life of some materials is limited and special procedures for the storage and shipment of some materials is necessary. You can get the applicable data from the supply source.
- D. If you need the materials immediately, call the Boeing Airplane-On-Ground (AOG) Spares office at 1-206-544-9000. For other orders, call the Boeing Regional Spares Manager who works with your airline or repair facility.

3. References

Reference	Title
51-30-03, GENERAL	Nonmetallic Materials

4. Order Information

- A. Table 1/GENERAL gives the necessary order information for the composite repair materials.
- B. Order the repair materials by their order number as given in Table 1/GENERAL.
- C. Include the data that follows in the order noteline:
- 757 SRM 51-30-06.
- D. Order all of the preimpregnated materials as AOG or Critical.

Table 1: Composite Repair Materials

MATERIAL	ORDER NUMBER	UNIT OF MEASURE	REMARKS
BMS 5-28, Type 6 (Potting Compound)	BMS5-28TY6	1 quart kit	
	BMS5-28TYPE6	1 pint kit	
	5522360051	1 gallon each	
BMS 5-28, Type 7, Class 1 (Potting Compound)	BMS5-28TY7CL1	1 quart kit	
	5522360052	1 gallon each	
BMS 5-28, Type 7, Class 2 (Potting Compound)	BMS5-28TY7CL2	1 quart kit	
	5522360053	1 gallon each	
BMS 5-28, Type 17 (Potting Compound)	BMS5-28TY17	1 quart kit	
	BMS5-28TYPE17	1 pint kit	
	5522360050	6 pound kit	



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Table 1: Composite Repair Materials (Continued)

BMS 5-90, Type III, Class 250, Grade 50 (Foaming Film Adhesive)	BMS5-90TY3CL250GR50	2 square foot sheet	Ship and store frozen
BMS 5-90, Type III, Class 350, Grade 50 (Foaming Film Adhesive)	BMS5-90TY3CL350GR50	10-inch by 24-inch sheet	Ship and store frozen
BMS 5-90, Type IV, Class 350, Grade 50 (Foaming Extrudable Adhesive)	BMS5-90TY4CL350GR50	6 ounce cartridge	Ship and store frozen
MATERIAL	ORDER NUMBER	UNIT OF MEASURE	REMARKS
BMS 5-92, Type I - EC2216 A/B (Adhesive)	BMS5-92TY1	1 quart kit	
	BMS5-92TYPE1	6 ounces each	
BMS 5-101, Type II, Grade 10 (Adhesive)	BMS5-101TY2GR10	Length by the yard (36 inches wide)	Ship and store frozen
BMS 5-129, Type 2, Class IA, Grade 10 (Adhesive)	BMS5-129TY2CL1AGR10	Length by the yard (36 inches wide)	Ship and store frozen
BMS 5-129, Type 4, Grade 5 (Adhesive)	BMS5-129TY4GR5	Length by the yard (36 inches wide)	Ship and store frozen
BMS 5-141 (Adhesive)	BMS5-141	1 quart kit	
BMS 5-154, Grade 05 (Adhesive)	BMS5-154TY2CL2GR5	Length and width by the foot (maximum width of 3 feet)	Ship and store frozen
BMS 5-154, Grade 03 (Adhesive)	BMS5-154TY2CL2GR3	Length and width by the foot (maximum width of 3 feet)	Ship and store frozen
BMS 8-79, Class III, Style 120 (Glass Fiber Reinforced Plastic (GFRP) Fabric)	BMS8-79CL3GRATY220	Length by the yard (38 inches wide)	Ship and store frozen
BMS 8-79, Class III, Style 7781 (GFRP Fabric)	BMS8-79CL3GRATY7781	Length by the yard (38 inches wide)	Ship and store frozen
BMS 8-139, Class I, Style 120 (GFRP Fabric)	BMS8-139TY120CL1	Length by the yard (38 inches wide)	Ship and store frozen
BMS 8-139, Class I, Style 7781 (GFRP Fabric)	BMS8-139CL1TY7781	Length by the yard (38 inches wide)	Ship and store frozen
BMS 8-145, Type I (Adhesive Film)	BMS8-145TYPE1	Length by the yard (40 inches wide)	Ship and store frozen
BMS 8-168, Class 1, Type II, Grade 145 (Carbon Fiber Reinforced Plastic (CFRP) Tape)	BMS8-168T2C1GR145	Length by the yard (12 inches wide)	Ship and store frozen
BMS 8-168, Class 1, Type II, Grade 190 (CFRP Tape)	BMS8-168T2C1GR190	Length by the yard (12 inches wide)	Ship and store frozen
BMS 8-168, Class 2, Type II, Style 3K-70-PW (CFRP Fabric)	BMS8-168T2C2ST3K70PW	Length by the yard (42 inches wide)	Ship and store frozen
BMS 8-212, Type II, Class 1, Grade 95 (CFRP Tape)	BMS8-212TY2CL1GR95	Length by the yard (12 inches wide)	Ship and store frozen
BMS 8-212, Type II, Class 1, Grade 190 (CFRP Tape)	BMS8-212TY2CL1GR190	Length by the yard (12 inches wide)	Ship and store frozen
BMS 8-212, Type III, Class 1, Grade 145 (CFRP Tape)	BMS8-212TY3CL1GR145	Length by the yard (12 inches wide)	Ship and store frozen
BMS 8-212, Type III, Class 1, Grade 190 (CFRP Tape)	BMS8-212TY3CL1GR190	Length by the yard (12 inches wide)	Ship and store frozen

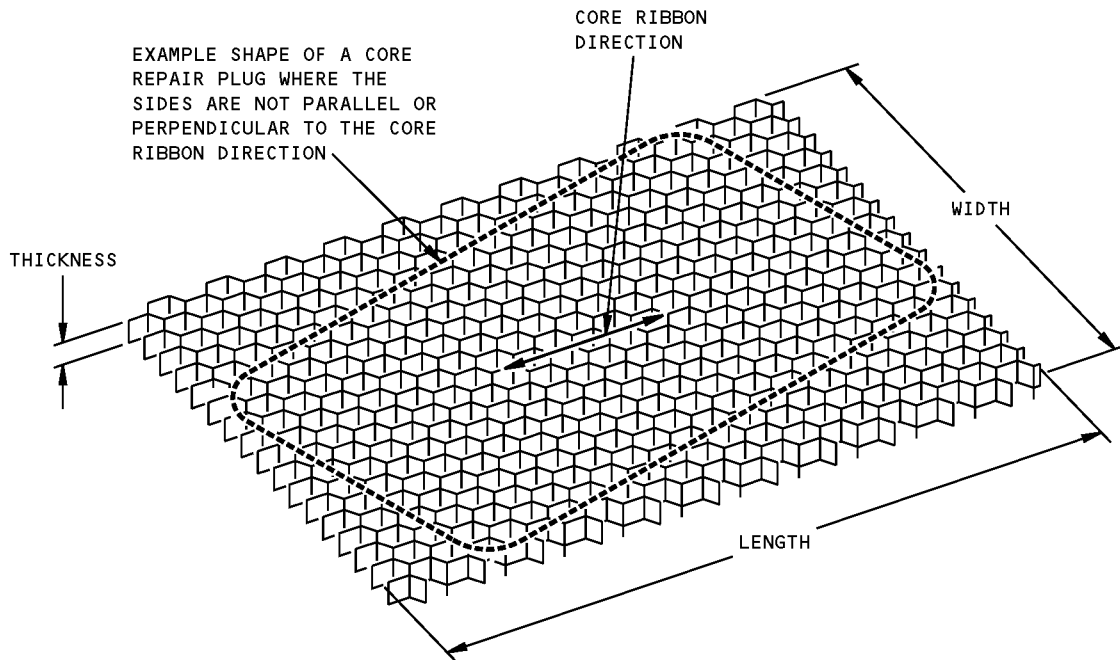


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Table 1: Composite Repair Materials (Continued)

BMS 8-212, Type II, Class 2, Style 3K-135-8H (CFRP Fabric)	BMS8-212T2C2-3K1358H	Length by the yard (42 inches wide)	Ship and store frozen
BMS 8-212, Type IV, Class 2, Style 3K-70-PW (CFRP Fabric)	BMS8-212T4C2ST3K70PW	Length by the yard (42 inches wide)	Ship and store frozen
BMS 8-256, Type II, Class 1, Grade 190 (CFRP Tape)	BMS8-256TY2CL1GR190 (This material is not always available at Boeing)	Length by the foot (12 inches wide)	Ship and store frozen
BMS 8-256, Type IV, Class 2, Style 3K-70-PW (CFRP Fabric)	BMS8-256T4C2ST3K70PW	Length by the yard (42 inches wide)	Ship and store frozen
BMS 8-276, Class 1, Type 35, Form 1 (Toughened-epoxy CFRP Tape)	BMS8-276C1FR1T35X12	Length by the foot (12 inches wide)	Ship and store frozen
BMS 8-297, Type 4, Class 2, Style 3K-70-PW (CFRP Fabric)	BMS 8-297T4C2S3K70PW	Length by the yard (42 inches wide)	Ship and store frozen
BMS 8-301, Class 1 (Adhesive)	BMS8-301CL1	1 quart each	Ship and store frozen
BMS 8-301, Class 2 (Adhesive)	BMS8-301CL2	1 quart each	Ship and store frozen
BMS 8-339, Class 1 (Pitch based CFRP Honeycomb Core)	BMS8-339CL1 (See Fig. 1 for the types of dimensions that are needed when you order the core)	Length and width by the foot. Many thicknesses are available	
BMS 8-342, Class 2 Type 3, Grade 15 (Polyacrylonitrile (PAN) based CFRP Honeycomb Core)	BMS8-342CL2TY3GR15 (See Fig. 1 for the types of dimensions that are needed when you order the core)	Length and width by the foot. Many thicknesses are available	
BMS 9-3, Type D, Class 7, Style 120 (Glass Fiber Fabric)	BMS9-3TYDCL7	125 yards minimum (38 inches wide)	
BMS 9-3, Type H-2, Class 7, Style 181 (Glass Fiber Fabric)	BMS9-3TYHCL7STYLE181	125 yards minimum (5.5 inches wide)	
BMS 9-8, Type I, Class 2, Style 3K-70-P (Carbon Fiber Fabric)	BMS9-8T1C2S3K70P	Length by the yard (42 inches wide)	
CAB-O-SIL (Filler)	CABOSILGRADEM5	10 pounds minimum	
EPIBOND 156 A/B (Surfacer)	EPIBOND156AB	1 quart kit	
Milled Glass Fibers (Filler)	MILLEDGLASSFIBER	By the pound (1/16 inch long milled fibers)	
Phenolic Microballoons (Filler)	BJ0-0930	1 bag each (17-pound bag)	

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NOTE: WHEN YOU ORDER THE CORE, GIVE:

- THE LENGTH THAT IS NEEDED IN THE CORE RIBBON DIRECTION
- THE WIDTH THAT IS NEEDED PERPENDICULAR TO THE CORE RIBBON DIRECTION
- THE THICKNESS THAT IS NEEDED.

Necessary Dimensions for Ordering the Core
Figure 1

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GENERAL - SHEET METAL MATERIALS - RB211-535 ENGINE NACELLE

1. General

- A. Most of the sheet metal materials used in the RB211-535 nacelles are aluminium alloy. In addition, commercially pure titanium sheet is used.

Figure 1/GENERAL shows approximate equivalent materials.

2. Aluminium alloys

WARNING: USE CARE WHEN YOU WORK WITH TITANIUM. SMALL PARTICLES OF TITANIUM ARE FLAMMABLE. IN A SUFFICIENT CONCENTRATION, AN EXPLOSION CAN OCCUR. EXTINGUISH ALL FIRES OF TITANIUM WITH FULLY DRY TALC, CALCIUM CARBONATE, SAND OR GRAPHITE. APPLY THE POWDER TO A DEPTH OF 0.50 INCH (12.7MM) OR MORE ON THE AREA THAT IS ON FIRE. DO NOT USE FOAM, WATER, CARBON TETRACHLORIDE, OR CARBON DIOXIDE. WHEN WATER TOUCHES MOLTEN TITANIUM, A STEAM EXPLOSION CAN OCCUR.

- A. Whenever the word 'clad' precedes material description, it indicates that material is coated with pure aluminum. The 'T' number that follows material description indicates heat treatment condition.

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MATERIAL		DOMESTIC DESIGNATION (USA) (Acceptable Alternative)		UNITED KINGDOM DESIGNATION
		MATERIAL	SPECIFICATION	SPECIFICATION
ALUMINUM ALLOY	SHEET	CLAD 2024-T3 OR CLAD 2024-T42	QQ-A-250/5	L163
		CLAD 2014-T6	QQ-A-250/3	L164
		2219-T81		L165
				DTD5070
	PLATE	2024-T351	QQ-A-250/4	DTD5010
	BARS EXTRUS			DTD5014
ALUMINUM ALLOY	CASTING PREMIUM	A357.0 T61	MIL-A-21180 CLASS II	L92
ALUMINUM	DIE FORGING	2014-T6	QQ-A-367	L77
TITANIUM	SHEET	COMPURE - 70	MIL-T-9046, TYPE 1 COMP B	TA6
		COMPURE - 60	MIL-T-9046, TYPE 1 COMP C	DTD5023
	BAR FORGING	COMPURE - 70	MIL-T-9047, COMP 1	TA9
ALLOY STEEL	SHEET	347 ANNEALED	QQ-S-766	BSS527
	FORGING	4340 (QUENCH AND TEMP - HT 125-145 KSI)	MIL-S-5000B, COMP F	BSS154

Approximately Equivalent Strength Materials, All RB211-535 Engines
Figure 1

STRUCTURAL REPAIR MANUAL**GENERAL - NONMETALLIC MATERIALS - RB211-535 ENGINE NACELLE****1. Applicability**

- A. The purpose of this section is to provide a list of repair materials used during the repair of composite nonmetallic components. Also included are the handling instructions for the various materials.

2. List of Repair Materials

- A. Refer to Figure 1/GENERAL for list of materials and sources.

3. General Requirements for Composite Material Handling

- A. Adhesive Primer (HYSOL EA-9205)

(1) Use requirements

- (a) Shelf life is 6 months when stored at a temperature of -18°C (0°F).
- (b) Designated to be used with adhesive (EA-9689) and to be spray applied.
- (c) To cure, primer EA-9205 should be flashed by exposing surfaces to ambient conditions for 30 minutes followed by 93°C (200°F) for 30 minutes in a forced air oven.

(2) Health hazards

WARNING: DANGER! EXTREMELY FLAMMABLE! KEEP AWAY FROM HEAT, SPARKS AND OPEN FLAME! THIS MATERIAL HAS A FLASH POINT OF 13°C (55°F), THEREFORE MUST BE CONSIDERED VERY FLAMMABLE. KEEP CONTAINER CLOSED. USE WITH ADEQUATE VENTILATION! AVOID PROLONGED OR REPEATED CONTACT WITH SKIN!

- (a) EA-9205 primer carries ANSI Classification 2. As sold, it contains both M.E.K. (2-butaone) and tetrahydrofuran, both flammable solvents.

- B. Adhesive Thermofoam 3050

(1) Use Requirements

- (a) Thermofoam 3050 has a limited life of 5 days at 32°C (90°F); 7 days at 24°C (75°F); 30 days at 0°C (32°F); and a minimum of 6 months at -18°C (0°F) or below.
- (b) This product can be cured at either:
 - 1) At 121°C (250°F) for 1 hour.
 - 2) At 177°C (350°F) for 30 minutes using a heat-up rate of 8 to 17°C (46° to 62°F) per minute. Thermofoam 3050 will cure at temperatures as low as 107°C (225°F) in 90 minutes.

(2) Health hazards

WARNING: THIS PRODUCT CONTAINS ASBESTOS FIBERS. AVOID CREATING DUST. BREATHING IT CAN CAUSE SERIOUS BODILY HARM. WHEN SANDING, USE REGULATORY AGENCY APPROVED FACE MASK. USE GOOD VENTILATION. PREVENT ALL CONTACT WITH SKIN; IF CONTACT OCCURS, WASH IMMEDIATELY WITH SOAP AND WATER.

- C. Epoxy Adhesive Film (HYSOL Adhesive EA-9689)

(1) Use requirements

- (a) Storage life is 6 months when stored at a temperature of -18°C (0°F).
- (b) Cure for 1 hour at 176°C (350°F). Heatup rate between 2°C (4°F) and 4°C (7°F) per minute. Pressure to be applied before heating.

(2) Health hazards

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WARNING: THIS PRODUCT CAN CAUSE SKIN SENSITIZATION OR OTHER ALLERGIC RESPONSES. AVOID INHALATION OF VAPOR. GOOD VENTILATION MUST BE USED WHEN HEATED OR SPRAYED. PREVENT ALL CONTACT WITH SKIN; IF CONTACT OCCURS, WASH IMMEDIATELY WITH SOAP AND WATER. THIS PRODUCT CARRIES ANSI CLASSIFICATION 4, CLASSIFIED ACCORDING TO "GUIDES FOR CLASSIFYING AND LABELING EPOXY PRODUCTS ACCORDING TO THEIR HAZARDOUS POTENTIALITIES" PREPARED AND PUBLISHED BY THE AMERICAN STANDARDS INSTITUTE, INC.

(3) Environmental requirements of working area.

- (a) Temperature and humidity controls are not critical.
- (b) Work area and other surfaces can be cleaned of uncured adhesive material by wiping with a cloth saturated in a solution of denatured alcohol.
- (c) Once removed from cold storage the adhesive must be used within 10 days when temperature is 25°C (77°F) or 7 days at 32°C (90°F).

D. Laminating Resin Adhesive (HYSOL Adhesive EA-956)

(1) Use requirements

- (a) The pot life is 30 minutes at 24°C (75°F), for 454 grams (one pound).
- (b) Shelf life - Refer to Table 1/GENERAL.

Table 1: Shelf Life

TEMPERATURE	TIME	
	Part A	Part B
38°C (100°F)	3 months	over 2 years
27°C (80°F)	3 months	over 2 years
4°C (40°F)	1 year	over 2 years
-18°C (0°F)	2 years	over 2 years

- (c) Cure at 24°C (75°F) for 5 to 7 days to obtain full strength, or at 82°C (180°F) to 93°C (200°F) for one hour. 75 percent strength is obtained at 24°C (75°F) in 24 hours. Heatup time for higher temperature cure is not critical.

CAUTION: MATERIAL TEMPERATURE BEFORE AND DURING MIXING MUST BE AT ROOM TEMPERATURE.

- (d) Combine by weight, 100 parts A with 58 parts B, and mix thoroughly. Temperatures before and during mixing must be at room temperature.

(2) Health hazards

WARNING: THIS PRODUCT CAN CAUSE SKIN SENSITIZATION OR OTHER ALLERGIC RESPONSES. AVOID INHALATION OF VAPOR. GOOD VENTILATION MUST BE USED WHEN HEATED OR SPRAYED. PREVENT ALL CONTACT WITH SKIN; IF CONTACT OCCURS, WASH IMMEDIATELY WITH SOAP AND WATER. THIS PRODUCT CARRIES ANSI CLASSIFICATION 4, CLASSIFIED ACCORDING TO "GUIDES FOR CLASSIFYING AND LABELING EPOXY PRODUCTS ACCORDING TO THEIR HAZARDOUS POTENTIALITIES" PREPARED AND PUBLISHED BY THE AMERICAN STANDARDS INSTITUTE, INC.

(3) Environmental requirements of working area.

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- (a) Temperature and humidity controls are not critical.
 - (b) Work area and other surfaces can be cleaned of uncured adhesive material by wiping with a cloth saturated in a solution of denatured alcohol.
- E. Potting compound (EPOCAST H-1843-A/B, Type 4, Grade B)
- (1) Use requirements
 - (a) The storage life is 12 months at 5° to 27°C (40° to 80°F) in unopened containers.
 - (b) Cure at room temperature for 3 hours, at 77°C (170°F) for 30 minutes, or at 121°C (250°F) for one hour.
 - (c) To 100 parts by weight of Part A, add 15 parts by weight of part B.
NOTE: Before blending Parts A and B, stir contents of each container to ensure uniformity. Blend resin (Part A) with hardener (Part B) thoroughly in required ratio.
 - (2) Health hazards
- WARNING:** AVOID CONTACT OF RESIN OR HARDENER WITH SKIN. APPLY UNDER CONDITIONS OF GOOD VENTILATION.
- F. Potting Compound (HYSOL Adhesive EA-934NA)
- (1) Use requirements
 - (a) Combine by weight, 100 parts A with 33 parts B, and mix thoroughly. Thinners must not be used. Temperatures prior to and during mixing are not critical but should be close to 24°C (75°F).
 - (b) Pot life at 24°C (75°F) is 40 minutes for 454 grams (one pound).
 - (c) Cure at 24°C (75°F) for 5 to 7 days or at 93°C (200°F) for one hour to obtain full strength. 75 percent full strength cure is obtained at 24°C (75°F) in 24 hours. Heat-up time for higher temperature is not critical.
 - (2) Health hazards
- WARNING:** THIS PRODUCT CAN CAUSE SKIN SENSITIZATION OF OTHER ALLERGIC RESPONSES. AVOID INHALATION OF VAPOR. GOOD VENTILATION MUST BE USED WHEN HEATED OR SPRAYED. PREVENT ALL CONTACT WITH SKIN. IF CONTACT OCCURS, WASH IMMEDIATELY WITH SOAP AND WATER.
- (3) Environmental requirements of working areas.
 - (a) Temperature and humidity controls are not critical.
 - (b) Work area and other surfaces can be cleaned of uncured adhesive material by wiping with a cloth saturated in a solution of denatured alcohol.
- G. Pre-Impregnated Graphite Fabric (A320-5H/3501-5A)
- (1) Facility Requirements
 - (a) The ambient temperature and applicable working surfaces must be maintained at 18° to 32°C (65° to 90°F), and maximum relative humidity must be 70 percent.
 - (b) The lay-up must be maintained in an orderly and clean condition.
 - (c) Unapproved agents such as silicone base release agents, lubricants, hand creams, talcum powder, waxes, oils, or other materials which could affect laminating process or bondability of laminate, must not be permitted in lay-up area for any purpose.

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(2) Use Requirements

- (a) Shelf life of graphite fabric is 6 months when stored at a temperature designated by manufacturer.
- (b) Working life of material is 10 days, from storage removal until initiation of cure, when exposed to 16° to 27°C (60 to 80°F) at a relative humidity of 65 percent or less, under a protective dust cover or when vacuum bagged for 48 hours of that period.
- (c) Pre-impregnated graphite fabric removed from cold storage must be warmed to ambient temperature before removal from protective cover.
- (d) Lay-up is performed in a clean and orderly environment maintained at 18 to 27°C (65 to 80°F) and 70 percent maximum relative humidity.

(3) Health Hazards

- (a) Persons having a sensitivity to epoxy polymers and their associated curing agents, modifiers, etc., must not be certified as operators to this process.

H. Blue Filler EC3524 B/A

(1) General

- (a) EC3524 is a two part low density void filling compound. Part A is a white heavy consistency paste and Part B is a blue heavy consistency paste.
- (b) Weight out 100 parts of Part B and 94 parts of Part A.
- (c) Mix the materials by kneading until a uniform blue color, without streaks, is obtained. This provides a working life of approximately one hour at 22°C (72°F).

NOTE: Operators should wear plastic gloves during preparation and application and avoid skin contact.

(2) Blue filler EC3524 B/A

- (a) Refer to (1) for mixing instructions.
- (b) Apply the filler

NOTE: Operators should wear plastic gloves during preparation and application and avoid skin contact.

- 1) Use a spatula, pallet knife, small trowel or pressure gun to apply the material.
- 2) If the material tends to adhere to the tool it is permissible to very slightly moisten the blade with cold water when finally smoothing air washed surfaces.

NOTE: Avoid using too much water as it reacts with the filler as a plasticiser.

- 3) Remove excess material as soon as it is hard to the touch. Use tool blade in a burnishing action.

- (c) Cure the filler for the time and temperature shown in Table 2/GENERAL.

NOTE: 1. The minimum cure time is 1/2 hour.

2. The material will not cure before 12°C (54°F).

3. Maximum temperature which may be applied to filler is 150°C (302°F). Above this temperature surface scorching and exothermic heat reaction may occur.

4. Remove scorching by hand abrading.

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STRUCTURAL REPAIR MANUAL**Table 2:** Blue Filler Cure Data Chart

Time - Hours	96	72	36	24	16	8	4	2	1	1/2
Temp. deg.C.	12	15	20	22	25	30	35	45	60	100
Temp. deg.F.	54	59	68	72	77	86	95	113	140	212

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MATERIAL	SOURCE	SUBJECT															
		51-21-01	51-21-05	51-31-03	54-10-01	54-20-01	54-20-03	54-30-01	54-30-70								
PRIMERS EA9205 20%	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D			X													
ADHESIVES EA956 PARTS A AND B EA934NA EA969 EPOCAST H-1843 (TYPE 4 GRADE B) PARTS A AND B	<input type="checkbox"/> A <input type="checkbox"/> A <input type="checkbox"/> R <input type="checkbox"/> A <input type="checkbox"/> B			X	X				X								
REPAIR MATERIALS BREATHER FABRIC OSNABURG MYLAR, TEDLAR F.E.P. NYLON VACUUM FILM HF800 SEALANT TAPE 9151 THERMOFOAM 3050 DOUBLE-BACK TAPE GLASS CLOTH 181, 1581 or 7781 VOLAN A GRAPHITE FABRIC A320-5H/3501 5A GRAPHITE FABRIC A370-5H/3501-5A GRAPHITE FABRIC A310-5H/3501-5A SPEED TAPE TEFLON TAPE NO. 61 (BLUE)	<input type="checkbox"/> H -- <input type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> A -- <input type="checkbox"/> C <input type="checkbox"/> F <input type="checkbox"/> F <input type="checkbox"/> F -- <input type="checkbox"/> J <input type="checkbox"/> K			X		X		X									
CLEANERS METHYL-ETHYL KETONE M.E.K. H-N-95 AND TT-M-261 INHIBITED TRICHLOROETHANE	<input type="checkbox"/> J <input type="checkbox"/> S OR ANY SOURCE -- ANY SOURCE			X		X			X								
SEALANT PR1431G HYLOMAR PL 32M	<input type="checkbox"/> G <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> N <input type="checkbox"/> O	X		X	X				X								

Non-Metallic Repair Material Sources
Figure 1 (Sheet 1 of 3)

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MATERIAL	SOURCE	SUBJECT															
		51-21-01	51-21-05	51-31-03	54-10-01	54-20-01	54-20-03	54-30-01	54-30-70								
MISCELLANEOUS ITEMS																	
ACETONE	--			X		X											
ABRASIVE PAPER 120 TO 400	--			X													
DENATURED ALCOHOL	--			X													
WEIGHTS OR SANDBAGS	--			X													
GARNET PAPER 60 TO 80					X		X										
CLEAN COTTON CLOTH	ANY SOURCE				X												
CLEAN COTTON GLOVES	ANY SOURCE				X												
TEFLON TAPE - TYGAFLOR	<input type="checkbox"/> J <input type="checkbox"/> T				X												
COATED GLASS FABRIC																	
FILLER																	
RESIN FILLER EC3524BA	<input type="checkbox"/> J <input type="checkbox"/> K			X	X												
MATERIALS FOR PROTECTIVE TREATMENT																	
TWO PACK EPOXY CLEAR ENAMEL BASE, SL5459 PJP9110C 8000 CATALYST, CSH5538, PJP2000.2.0538		X			X												
SURFACE PRETREATMENT																	
ALODINE 1200 DTD 900/4413		X			X												
ALODINE 1200S DTD 900/4413		X			X												
ALODINE 600 DTD 900/4413		X			X												
IRIDITE 14-2		X			X												
TURCOAT ALUMIGOLD		X			X												

Non-Metallic Repair Material Sources
Figure 1 (Sheet 2 of 3)

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STRUCTURAL REPAIR MANUAL**NOTES**

- | | |
|--|---|
| <p>[A] HYSOL DIV, DEXTER CORP
15051 EAST DON JULIAN ROAD
INDUSTRY, CA 91744
U.S.A.</p> <p>[B] M AND T CHEMICALS, INC
5121 SAN FERNANDO ROAD WEST
LOS ANGELES, CA 90039
U.S.A.</p> <p>[C] J.P. STEVENS CO
16040 STEPHENS STREET
INDUSTRY, CA 91749
U.S.A.</p> <p>[D] RICO PLASTICS
P.O. BOX 8677
SAN DIEGO, CA 92138
U.S.A.</p> <p>[E] SCHNEE - MOREHEAD CHEMICALS INC
8835 SOUTH DICE
SANTA FE SPRINGS, CA 90241
U.S.A.</p> <p>[F] HERCULES INC
BACCHUS WORKS
MAGNA, UT 84044
U.S.A.</p> <p>[G] PRODUCTS RESEARCH AND CHEMICAL CO
5454 SAN FERNANDO ROAD
GLENDALE, CA 91203
U.S.A.</p> <p>[H] WEST COAST PAPER CO
2203 FIRST AVENUE SOUTH
SEATTLE, WA 98134
U.S.A.</p> <p>[J] MED-LAB LIMITED
2-6 AGARD STREET,
DERBY, DE1 1DZ
ENGLAND</p> <p>[K] 3M UK PLC
3M HOUSE
28 GREAT JACKSON STREET
MANCHESTER M15 4PA
ENGLAND</p> <p>OR</p> <p>3M COMPANY
3M CENTER
ST PAUL, MN 55101
U.S.A.</p> | <p>[L] INDESTRUCTABLE PAINT CO. LTD.
25 PENTOS DRIVE
BIRMINGHAM B11 3TA
ENGLAND</p> <p>[M] MARSTON BENTLEY LTD.
HYLO HOUSE, COLE LANE
NEW SPRINGS, WIGAN WN2 1JR
ENGLAND</p> <p>[N] MARSTON BENTLEY
1848 STAR BATT DRIVE
ROCHESTER HILLS, MI 48309
U.S.A.</p> <p>[O] VAN DUSSEN AIRCRAFT SUPPLIES
TETERBORO AIRPORT
500 INDUSTRIAL AVENUE
TETERBORO, NJ 07608
U.S.A.</p> <p>[P] INTERNATIONAL PAINT COMPANY, INC.
21 WEST STREET
NEW YORK CITY, NY 10006
U.S.A.</p> <p>[Q] IMPERIAL CHEMICAL INDUSTRIES LTD
NEW YORK LTD
444 MADISON AVENUE
NEW YORK CITY, NY 10022
U.S.A.</p> <p>[R] AERO CONSULTANTS LTD
P.O. BOX 2117
8600 DUBENDORF
ZURICH
SWITZERLAND</p> <p>[S] THE BRITISH DRUG HOUSES LTD
BDH LABORATORY CHEMICAL DIVISION
POOLE, DORSET, OR BIRKBECK STREET
LONDON
E2 SJW</p> <p>[T] FOTHERGILL ENGINEERED FABRICS
P.O. BOX 1
SUMMIT
LITTLEBOROUGH
LANCASHIRE O15 9QT</p> |
|--|---|

Non-Metallic Repair Material Sources
Figure 1 (Sheet 3 of 3)



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GENERAL - FASTENERS

1. Applicability

- A. This section gives general information about Boeing approved fasteners used on this airplane. It also gives information about inspecting for loose fasteners.

2. General

A. Fastener Codes and Symbols

- (1) The Boeing Drawing system for the airplane model in this Structural Repair Manual uses a fastener symbol system as specified in NAS523 and Boeing Design Detail Standard BACD2074. Figure 1/GENERAL shows some examples of fastener symbols used in Boeing engineer drawings.
- (2) Boeing approved fasteners and fastener/mating part combinations have specific fastener codes. Fastener codes are not used in this manual, but are used on the Boeing engineer drawings. Fastener codes are cross referenced to the fastener part numbers on the drawings and in Boeing Design Detail Standard BACD2074.

B. Suppliers of Boeing approved fasteners.

- (1) Suppliers for Boeing approved fasteners can be found in the Qualified Products List (QPL) of each Boeing Fastener Specification.

C. Loose Fasteners

- (1) Refer to 51-10-05, GENERAL if you find loose or missing fasteners. Loose fasteners can be identified by the following situations:
 - (a) The fastener moves in relation to the material that it holds.
 - (b) Tipped fastener heads can show looseness or slippage of the material. The edges of a rivet head that are rolled upward also show looseness.
 - (c) A black or dark gray colored stain adjacent to or around the fastener head can show a loose rivet. A streak of dirt or oil aft of a loose rivet is usually apparent.
 - (d) Fasteners can be loose if the paint around the fastener head is cracked.
- (2) You can also examine the structure for loose fasteners as shown in Figure 2/GENERAL.

3. References

Reference	Title
51-10-05, GENERAL	Instructions to Make it Possible to Operate Airplanes with Missing Fasteners in Secondary Structure
51-40-02, GENERAL	Fastener Installation and Removal
51-40-03, GENERAL	Fastener Substitution
51-40-04, GENERAL	Torque Values
51-40-05, GENERAL	Fastener Hole Sizes
51-40-06, GENERAL	Fastener Edge Margins
51-40-07, GENERAL	Strength of Fasteners
51-40-08, GENERAL	Countersinking
51-40-09, GENERAL	Coldworking of Holes for Fatigue Improvement

STRUCTURAL REPAIR MANUAL**4. Fastener Types**

A. This section gives some general data about the usual types of mechanical fasteners found on this airplane.

B. Fasteners can be grouped as either permanent or removable as follows:

- (1) Permanent fasteners are used in the assembly of structure that is not disassembled during usual service. Most permanent fasteners become unserviceable after they are removed and must be discarded. Some hex-drive bolts continue to be serviceable after they are removed.

Inspect removed hex-drive bolts to see if they continue to be serviceable as specified in 51-40-02, GENERAL. These types of fasteners are permanent:

- solid rivets
- lockbolts
- hex-drive bolts
- radius lead-in bolts
- blind rivets
- blind bolts
- sandwich panel inserts

- (2) Removable fasteners are used in the assembly of structure that can or must be disassembled during usual service. These types of fasteners are removable fasteners:

- bolts
- screws
- set-screws
- nuts
- nutplates
- threaded inserts
- washers
- pins

C. Solid Rivets

- (1) Most of the fasteners used on this airplane are solid-shank rivets made from specified aluminum alloys. Solid rivets are permanent fasteners that are used where rivets must have sufficient shear strength and where complete hole-filling is important.
- (2) You can use softer alloy rivets as alternative fasteners for the usual rivets in some locations. Although softer alloy rivets are permitted in some locations, a larger number of fasteners or a larger diameter of fastener can be necessary to get the same structural strength. Make sure the material edge margin and fastener spacing are correct when you use softer alloy rivets as alternative fasteners. Refer to 51-40-03, GENERAL for data about approved fastener substitutions and to see if there are limitations on their use.

D. Lockbolts and Hex-Drive Bolts

- (1) Lockbolts are permanent fasteners that have a collar that is swaged onto the serrated end of the bolt. Lockbolts have a higher shear strength and a higher clamp-up force than solid rivets.



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- (2) Hex-drive bolts are almost the same as lockbolts but use a threaded shank together with a threaded collar or nut. Some special hex-drive bolts use a fluted, threaded shank together with swage-locking collar. You can use hex-drive bolts as alternative fasteners to lockbolts if you do not have access to the lockbolt installation tools. Refer to 51-40-03, GENERAL for approved alternatives.

E. Radius Lead-In Bolts

- (1) You can use radius lead-in bolts in highly-stressed aluminum alloy structure where durability (resistance to fatigue) is necessary.

Radius lead-in bolts are different from hex-drive bolts because they:

- (a) Have a shank with a radius lead-in area under the head.
- (b) Have a 0.006-inch diameter oversize shank.
- (c) Are driven into high interference-fit holes during installation.

F. Blind Rivets and Blind Bolts

CAUTION: DO NOT USE BLIND FASTENERS AT THESE LOCATIONS:

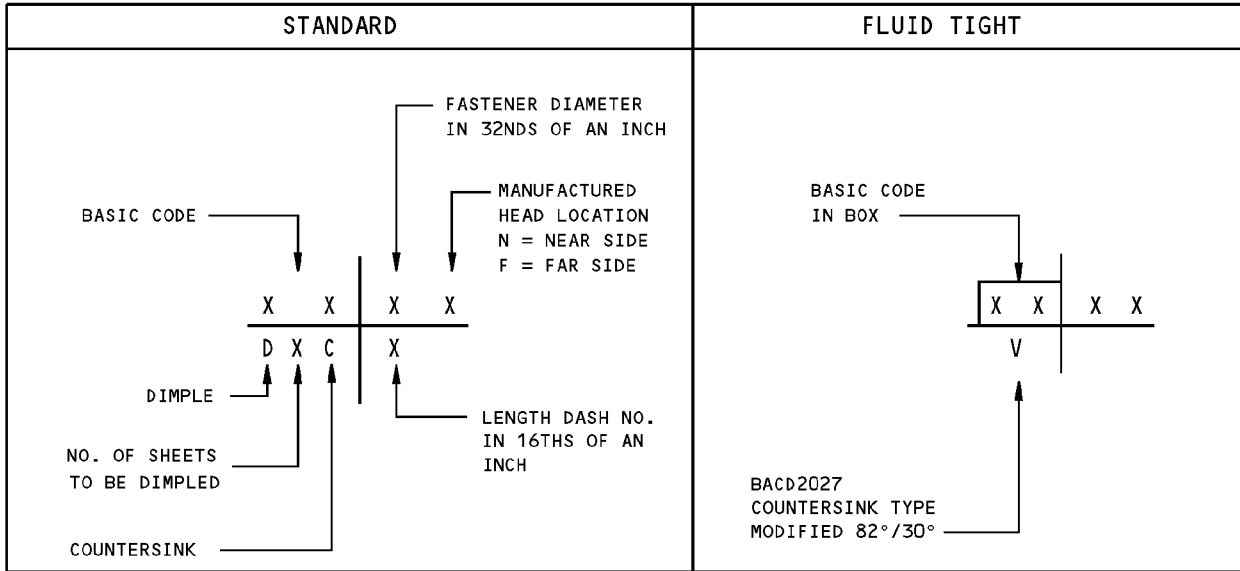
- WHERE THE HEADS CAN BE PRIED
- FLUID-TIGHT JOINTS
- WING ATTACHMENT FITTINGS
- PYLON ATTACH FITTINGS
- LANDING GEAR FITTINGS
- CONTROL SURFACE HINGE BRACKETS
- CONTROL SURFACE ATTACHMENT FITTINGS
- FIXED TAIL SURFACE ATTACHMENT FITTINGS
- OTHER TENSION OR HIGHLY STRESSED LOCATIONS

BLIND FASTENERS CAN FAIL IF YOU USE THEM IN THESE LOCATIONS.

- (1) Blind fasteners are fasteners that you can install when you have access to only one side of the structure. In some locations, you can use blind rivets where access is not available to make the upset head of a solid rivet. Blind bolts have larger manufactured heads and higher tension and shear strengths than the usual blind rivets.

NOTE: Blind fasteners are permanent only when they replace the initial blind fasteners specified in the drawing for the component or if specified as permanent in an FAA approved repair. Although blind fasteners are permitted in some conditions as alternatives to solid fasteners, a larger number of fasteners or a larger diameter of fastener can be necessary to get the same structural strength. Make sure that the material edge margin and fastener spacing are sufficient when you use blind fasteners as alternative fasteners. Refer to 51-40-03, GENERAL for approved alternatives. In some repairs there will be specified time-limits for replacement with permanent fasteners, or inspections, or both.

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YNE	6N
C	

BACR15FV6KE RIVET
120° MODIFIED SHEAR HEAD
3/16 DIAMETER
7050-T73
COUNTERSINK, NEAR SIDE

XCZ	8

BACB30FM HEX-DRIVE BOLT
1/4 DIAMETER
STEEL, WITH BACC30M COLLAR

RL	5

NAS1398D BLIND RIVET
5/32 DIAMETER
2017-T4

YKJ	4N
C	12

BACB30PT4K12L BOLT
70° RADIUS LEAD-IN HEAD
EXTENDED THREAD LENGTH
1/8 DIAMETER
3/4 GRIP LENGTH
6AL-4V TITANIUM
WITH BACN10WM ALUMINUM COATED NUT
COUNTERSINK, NEAR SIDE

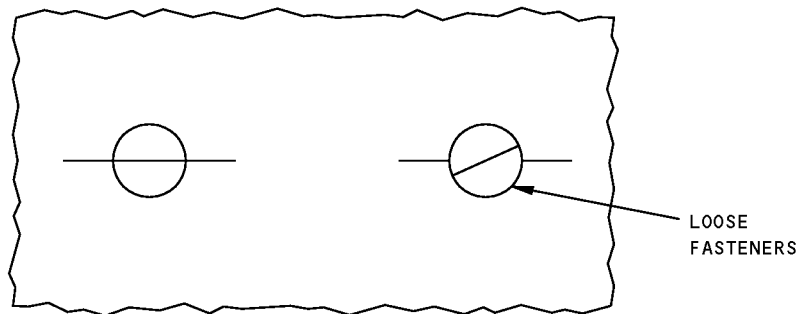
XFV	8
DC	

BACB30GY LOCKBOLT
100° SHEAR HEAD
1/4 DIAMETER
STEEL, WITH BACC30K COLLAR
DIMPLED SKIN
COUNTERSINK STRUCTURE

EXAMPLES

**Fastener Symbols
Figure 1**
































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MARK A RED LINE ACROSS THE FASTENER
HEAD AND THE ADJACENT MATERIAL.
CHECK THE LINE AT THE NEXT INSPECTION.
ANY LOOSENING OF THE FASTENER WILL
BREAK THE LINE AS INDICATED.

Red Lining of Fasteners
Figure 2

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RIVET IDENTIFICATION		UNIVERSAL	MODIFIED UNIVERSAL	100° CSK	100° SHEAR HEAD	82° CSK	120° CSK/CB
		STANDARD RIVET NO.					
MATERIAL	MARKS	BACR15BB	BACR15FT	BACR15BA	BACR15CE	BACR15FH	BACR15FV
2117(AD)	 DIMPLED						
2017(D)	 RAISED DOT EXCEPT [**]				 * NO MARKING		
2024(DD)	 RAISED DOUBLE DASH						
5056(B)	 RAISED CROSS						
1100(A)	 PLAIN						
7050(KE)	 RAISED CIRCLE EXCEPT [**]						 * INDENTED CIRCLE
MONEL (M) NICKEL – COPPER	 PLAIN						

Identification Marks on Boeing Standard Rivets
Figure 3



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GENERAL - FASTENER INSTALLATION AND REMOVAL

1. Applicability

- A. This section gives procedures for the removal and installation of structural fasteners in metallic and non-metallic structure.

2. General

- A. Some of the information in this subject can be found in Boeing Process Specifications BAC5004-1, BAC5004-2, BAC5004-3, BAC5009, BAC5047, and BAC5060.
- B. Hole Finder
- (1) You can use a hole finder to find the position of the initial fastener holes. Use a hole finder if the position of the hole is blocked by the repair parts, or if access is a problem.
 - (2) Refer to Figure 1/GENERAL for an example of this tool. Use a tool with a rivet peg that has the same diameter as the applicable hole.

CAUTION: USE SUFFICIENT PRECAUTIONS TO MAKE SURE THAT SYSTEM COMPONENTS, AIRPLANE ELECTRICAL WIRES AND STRUCTURES, ARE NOT DAMAGED BY DRILLS, METAL SHAVINGS AND OTHER CONTAMINATION WHILE YOU DO WORK. METAL SHAVINGS OR CONTAMINATION LEFT IN THE AIRPLANE CAN TOUCH WIRE BUNDLES AND CAUSE CHAFING DAMAGE TO ELECTRICAL WIRES. CHAFFED WIRES CAN CAUSE ARCING DAMAGE.

- C. Refer to 51-30-01, GENERAL for the procedure to drill in metal structures. Refer to 51-70-16, GENERAL for the procedure to drill in advanced composite structures.
- D. Refer to 51-40-05, GENERAL for hole size dimensions and hole quality specifications.
- E. When you install flush head fasteners, refer to Figure 2/GENERAL for fastener flushness specifications. Refer to 51-40-08, GENERAL for countersinking and counterbore procedures.
- F. Refer to 51-40-09, GENERAL if it is necessary to cold work fastener holes.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-05, GENERAL	Repair Sealing
51-20-07, GENERAL	Freeze Plug Installation
51-30-01, GENERAL	Sheet Metal Materials
51-40-01, GENERAL	Fasteners
51-40-04, GENERAL	Torque Values
51-40-05, GENERAL	Fastener Hole Sizes
51-40-06, GENERAL	Fastener Edge Margins
51-40-08, GENERAL	Countersinking
51-40-09, GENERAL	Coldworking of Holes for Fatigue Improvement
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
AMM 20-30-92/201	Aircraft Maintenance Manual
SOPM 20-30-92	Final Cleaning Prior to General Sealing (Series 92)
SOPM 20-50-19	General Sealing

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4. Solid Shank Rivets

A. General

- (1) The solid shank rivets in general use on this airplane are made from 7050, 2017 or 2117 aluminum alloy. In some locations, rivets made from 5056 or 2024 aluminum alloy, or nickel-copper alloy are used.
 - (a) 2017, 2117, 5056, and 7050 aluminum alloy rivets and nickel-copper rivets may be stored and used at room temperature.
 - (b) Rivets made from 2024 aluminum alloy must be heat-treated and then stored at a temperature of -10°F (-23°C), or lower. After removal from cold storage the rivets must be completely driven within 15 minutes. These rivets must not be returned to cold storage once they have been removed.
- (2) Machine-driven rivets are frequently used during the initial airplane assembly. Some machine-driven rivets have a formed head on each end of the rivet (slug rivet). Slug rivets can be installed with hand tools, but manufactured head rivets are usually installed as an alternative to slug rivets.
- (3) Refer to 51-20-05, GENERAL for replacement of rivets in the integral fuel tank.

B. Installation of Solid Rivets

- (1) Solid rivets can be installed with a rivet gun and bucking bar or an applicable squeeze riveting tool. Some rivets (for example, the BACR15FT rivet) are installed with tools that can be different than tools for most rivets. Make sure that you have the proper tools for each type of rivet that you install.
 - (a) Rivet guns and bucking bars must be large enough to drive the rivets quickly. Three to four seconds duration is best. Seven seconds is the maximum.
 - (b) Do not over-drive rivets as this can cause diagonal cracks. It is recommended that bucking bars be very smooth when you install all types of rivets. But, smooth bucking bars are very important when you drive 7050 and 2017 aluminum alloy rivets.
 - (c) Use heavy, slow speed rivet guns and heavier bucking bars for nickel-copper alloy rivets.
- (2) Install 5056 rivets wet with sealant if the rivets are installed in aluminum structure. Install 5056 rivets dry if installed in magnesium structure. Install all other rivets dry, unless told to do differently in a specific repair procedure.
- (3) Figure 3/GENERAL shows the grip ranges and the driven head sizes for solid shank rivets used in non-fluid-tight applications.
- (4) Figure 4/GENERAL shows the grip ranges and the driven head sizes for solid shank rivets used in fluid-tight applications.

NOTE: The driven head for fluid-tight universal rivets is always formed on the seal plane of the integral fuel tank.

- (5) Make sure that BACR15FV and MS14218 rivet heads are seated correctly in the counterbores before you drive the rivets.

NOTE: When seated in the counterbore, the rivet head will protrude above the skin surface. After driving, the rivet head will continue to protrude. See Figure 2/GENERAL for flushness specifications.

C. Do the inspections that follow after you install the rivets:

- (1) Measure the button dimensions as shown in Figure 3/GENERAL or Figure 4/GENERAL, as applicable.

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- (2) Inspect the heads and buttons for cracks as shown in Figure 6/GENERAL.
 - (3) Inspect the gaps under the heads of installed rivets as shown in Figure 7/GENERAL.
- D. Rework of rivet holes.
- (1) Rework is necessary when a rivet will be installed in a hole that was filled before by a rivet. Rework can also be necessary if a new hole does not comply with the quality specifications in 51-40-05, GENERAL, 51-40-08, GENERAL, or 51-70-16, GENERAL. Reworked holes must comply with the same quality specifications as the initial hole.
 - (2) It is permitted to rework holes to 1/32 inch oversize for rivets other than BACR15FV and MS14218 rivets.
 - (3) It is permitted to rework holes to 1/32 inch oversize for BACR15FV and MS14218 rivets if:
 - (a) The edge margin is twice the diameter of the initial fastener, or greater. Refer to 51-40-06, GENERAL.
 - (b) The replacement rivet complies with the specifications shown in one of the steps that follow:
 - 1) If the skin is thin (where the next larger diameter rivet does not meet the requirements shown in Figure 5/GENERAL), install the next larger diameter rivet. Drill the hole to the diameter necessary for the larger diameter rivet.
Countersink the hole to the same depth as the original rivet. See Figure 5/GENERAL, Detail I and 51-40-08, GENERAL. Drive the rivet only until it is tight in the hole. Microshave the head as specified in Figure 5/GENERAL. Complete driving of the rivet. No additional microshaving is required.
 - 2) If the skin is thick (where the next larger diameter rivet still meets the requirements shown in Figure 5/GENERAL, Table I), install the next larger diameter rivet in accordance with Figure 5/GENERAL, Detail II and 51-40-08, GENERAL.
- E. Refer to Figure 8/GENERAL for the procedures to remove solid shank rivets.

5. Blind Rivets**A. General**

- (1) Blind rivets are intended for use where access is limited to one side of the work.
- (2) Refer to 51-40-01, GENERAL for limitations on the use of blind rivets.

B. Installation

- (1) Blind rivets are installed with special tools, usually supplied by the fastener manufacturer.

NOTE: Blind rivets are supplied with different spindle configurations, full serrations, and partial serrations. Rivets having different spindle configurations cannot be installed with the same pulling head of the tool.

- (2) Check for correct installation as follows:
 - (a) The heads of protruding type must be seated so that a 0.002 inch thick shim cannot contact the rivet shank.
 - (b) The heads of flush type must be seated so that a 0.002 inch thick shim cannot be inserted between the head of the rivet and the countersink for more than 40% of the circumference of the head and does not contact the rivet shank.
 - (c) Check that stem and collar protrusions are within limits shown in Figure 9/GENERAL Table I.

C. Removal



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- (1) If the removal of blind rivets is necessary, refer to Figure 10/GENERAL.

6. Blind Bolts

A. General

- (1) MS21140 flush head, and MS21141 protruding head, blind bolts are approved for use on this airplane.
- (2) Refer to 51-40-01, GENERAL for limitations on the use of blind bolts.

B. Installation

- (1) Blind bolts are installed with special tools, usually supplied by the fastener manufacturer.
- (2) Check for correct installation as follows:
 - (a) Check for correct seating of boltheads as shown in Figure 9/GENERAL.
 - (b) Check that stem and collar protrusions are within limits shown in Figure 9/GENERAL.

C. Removal

- (1) Remove blind bolts using the steps shown in Figure 11/GENERAL.

NOTE: Special removal kits are available from the fastener manufacturers.

7. Lockbolts and Hex-Drive Bolts

A. General

- (1) The recommended fasteners in aluminum structure are aluminum coated titanium, aluminum coated A-286, or cadmium-plated A-286. Cadmium-plated alloy-steel fasteners are a structurally acceptable alternative. But, the cadmium plating is a sacrificial coating, and in a corrosive environment can come off of the fastener. This can cause the alloy-steel fastener to corrode. This can then cause streaks of rust and/or the start of corrosion on adjacent aluminum structure.
- (2) Collars for lockbolts and hex-drive bolts come from the manufacturer with a layer of lubrication. Do not remove the lubrication and do not add more lubrication.
- (3) Hex-drive bolts must be replaced with new hex-drive bolts when removed collars or nuts are Alloy Steel, CRES or Titanium.
- (4) Make sure that the joint is tightly clamped while the bolt is installed.
- (5) Fasteners are installed wet with sealant.

NOTE: Refer to 51-40-05, GENERAL and SOPM 20-50-19 to install fasteners in the integral fuel tank and other procedures to apply sealant.

- (6) All lockbolts and hex-drive bolts must have the manufactured head fully seated to the structure before you install the collar.

NOTE: Push on the manufactured head to seat the fastener. Do not pull on the pin to seat the head.

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B. Use of Washers (Figure 13)

NOTE: The total number of washers that can be used for fillet relief, grip length adjustment, or corrosion protection is two plus the permitted number of counterbore substitution washers (that can be used with Hex-drive bolts). Too many washers can cause unwanted eccentricity and can cause fasteners to become loose. But, if you cannot get a good grip length adjustment, have an engineer do an analysis. An engineer can make a decision to add another washer. Washer material must be similar to the fastener and structure materials. Refer to 51-20-01, GENERAL for the classification of dissimilar materials. The correct washer material and part number numbers to use are given in Figure 13/GENERAL.

(1) Fillet Relief Washers Under Protruding Head Fasteners.

- (a) A head-to-shank relief is necessary for all types of lockbolts and hex-drive bolts. As an alternative to making a fillet relief in the structure, you can put a fillet relief washer under protruding head fasteners.
- (b) One washer, maximum, can be used for fillet relief.
- (c) Only use washers that have a side with a fillet relief or countersink.
- (d) Put the fillet relief (or countersunk) side of the washer under the head of the fastener.

(2) Corrosion Protection and Grip Length Adjustment Washers

NOTE: The maximum number of these types of washer that can be used is two, with a maximum thickness of 1/16 inches (1.6 mm).

- (a) Only use standard washers (no countersunk washers) unless the grip adjustment washer is put directly under a protruding head (then a fillet relief or countersunk washer is necessary).
- (b) Install the washer(s) as follows:
 - 1) You can put one or two washers between a standard collar (or nut) and the structure.
 - 2) You can put one or two washers between a standard collar (or nut) and a self-aligning washer (BACW10CA).
 - 3) You can put one grip adjustment washer under a fastener head when:
 - both a self-aligning nut and a self-aligning washer are used (BACN10MT with a BACW10AU), or
 - a self-sealing collar is used (BACC30BP), or
 - a self-sealing nut is used (BACN10WM), or
 - a self-aligning collar-washer assembly is used (BACC30BQ or BACC30AG).
 - the structure is not magnesium.

NOTE: If a grip adjustment washer is necessary, put the washer between the fillet relief washer and the structure.

STRUCTURAL REPAIR MANUAL

(3) Counterbore Substitution Washers

NOTE: When non-counterbored, self-locking nuts (BACN10GW, BACN10JC, BACN10YR, MS21042, MS21043, NAS679, NAS1291, NAS1804, and NAS1805) are used as an alternative to mating collars on hex-drive bolts, use counterbore substitution washers. When non-counterbored nuts are used with self-aligning washers (BACW10CA), use counterbore substitution washers. See Figure 13/GENERAL for washer selection. Counterbore substitution washers can be used as corrosion protection washers. You are permitted to use counterbore washers plus the permitted number of fillet relief, grip length adjustment, and corrosion protection washers.

Counterbore substitution washers are not required for counterbored nuts (BACN10MT, BACN10TN, BACN10WM, BACN10XJ, BACN10YT, BACN10YZ, BACN10ZV, BACN10ZZ, BACN11E, KFN305, KFN511, KFN609, H600).

- (a) Make sure that all of the threads on the nut touch the threads on the bolt.
- (b) Use a 1/16 inch (1.6 mm) thick washer and a 1/32 inch (0.8 mm) thick washer with lightweight hex-drive bolts (BACB30VT, BACB30VU and BACB30YP). Put the 1/16 inch (1.6 mm) thick washer against the structure.

NOTE: If the chamfer on the end of the bolt is not fully above the end of the nut, only use a 1/16 inch (1.6 mm) thick washer.

- (c) With standard hex-drive bolts (BACB30FM, BACB30FN, BACB30JC, BACB30MB, BACB30MY, BACB30ND, BACB30NW, BACB30NX, BACB30NY, BACB30YK, BACB30YL, BACB30YM, BACB30YN, HLT420, HLT421, HLT422, and HLT423) do the applicable step that follows:

- 1) For bolt sizes that are 1/4 inch diameter or less, use two 1/16 inch (1.6 mm) thick washers. This is also applicable to first, second, and third oversize fasteners for these bolt diameters.

NOTE: If the chamfer on the end of the bolt is not fully above the end of the nut, only use a 1/16 inch (1.6 mm) thick washer.

- 2) For bolt sizes that are 5/16 inch through 5/8 inch diameter (and for these size bolts that are first and second oversize), use two 1/16 inch (1.6 mm) thick washers. For these size bolts that are third oversize, use three 1/16 inch (1.6 mm) washers.

NOTE: If the chamfer on the end of a third oversize bolt is not fully above the end of the nut, only use two 1/16 inch (1.6 mm) thick washers.

- 3) For bolt sizes that are 3/4 inch or larger diameter, use three 1/16 inch (1.6 mm) thick washers. This is also applicable to first, second, and third oversize bolts.

NOTE: If the chamfer on the end of the bolt is not fully above the end of the nut, only use two 1/16 inch (1.6 mm) thick washers.

C. Lockbolt Installation and Removal

- (1) The "pull type" lockbolt is installed with a type of pneumatic pulling gun. The gun pulls on the end of the shank, known as the pintail, and at the same time, swages a collar on to the shank. The pintail, breaks off at the correct load.

STRUCTURAL REPAIR MANUAL

- (2) Before you install the lockbolt collar, remove the sealant and/or contamination from the grooves of the lockbolt pintail. Very small quantities of sealant can stay on the pintail after it is cleaned.

NOTE: Sealant on the surface of the structure that has flowed from under a swaged collar is not usually permitted. Sealant is only permitted to flow from under a swaged collar if the lockbolt has a sealant escape groove.

- (3) Grip length adjustment can be made as given in Paragraph 7.B./GENERAL
- (4) Lockbolts can be driven out after collar removal. Collars can be removed by splitting them from one side with a chisel. Put a bucking bar on the opposite side of the collar during this operation, to prevent elongation of the holes. As an alternative the collars can be milled off.

D. Hex-Drive Bolt Installation and Removal

- (1) Hex-drive bolts are a threaded fastener usually installed with a type of nut that has a one-piece collar with a hexagonal torquing device. The hexagonal torquing device breaks off at the correct load. This removes the need to measure torque.
- (2) The bolts can be installed with power or hand tools. Hand tools can be used as follows:
 - (a) Insert the bolt into the hole until the head is seated.
 - (b) Install the collar and turn it until it is finger-tight.
 - (c) Put a hexagonal key in the hexagonal recess and make sure that the bolt does not turn. Turn the collar with a modified ratchet and socket or a box wrench until the wrenching device is torqued off (Figure 12/GENERAL).
- (3) Where access is not available for the installation of the special collar, it is permissible to use locknuts. This special collar is manufactured with a counterbore which allows for the bolt to fit into the recess in the collar. Counterbore substitution washers are necessary with non-counterbored locknuts. Refer to Paragraph 7.B./GENERAL and Figure 13/GENERAL for locknut selection and washer requirements. Refer to Paragraph 7.D.(5)/GENERAL for torque procedure.
- (4) After the collar is installed, inspect the bolt as follows:
 - (a) Examine the pin protrusion as given in Figure 14/GENERAL.
 - (b) Examine the gaps under the bolt head and collar as given in Figure 12/GENERAL.
 - (c) Examine head dishing in flush head fasteners as given in Figure 12/GENERAL.
- (5) Torque Procedure
 - (a) When the engineering drawing specifies an installation of multiple hex-drive bolts with locknuts (and the sequence to tighten the nuts is not specified), do not tighten adjacent bolts in a sequence.
 - 1) If the bolts are in a circle: first hand-tighten opposite bolts in a sequence. Then torque all bolts in an alternating pattern, all around the circle, first one bolt, then its opposite.
 - 2) If five or more bolts are in a row: first hand-tighten the end bolts, then the bolts that remain. Then torque all bolts in an alternating pattern, all along the row.
 - (b) Torque nuts to the values given in 51-40-04, GENERAL.
- (6) Hex-drive bolts are removed by inserting a hexagonal key in the pin and gripping and turning the collar with locking pliers.

8. Radius Lead-In Bolts**A. General**

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- (1) Radius lead-in bolts are used in this airplane for their good fatigue properties. These fasteners have a shank diameter larger than hex-drive bolts and lockbolts and are installed to give an interference fit. There are two oversizes available for each nominal size, that you can use in repair work.

B. Hole Preparation

(1) New Holes

- (a) New holes may be produced using either of the following methods:

- 1) Hole produced in one operation with the specified size ST7044 precision drill. Drill the hole at 2000 rpm with a feed rate at 8 to 12 seconds for 2.0 inch free travel.
- 2) Hole produced from pilot hole.
 - a) Drill pilot hole 1/64 inch under the size of the ST1219Y-1RCA reamer pilot. Maintain perpendicularity of pilot hole to part surface within $\pm 1/2^\circ$.
 - b) Ream the pilot to the size of the ST1219Y-1RCA reamer pilot.
 - c) With the required size of ST1219Y-1RCA reamer/countersink installed in the ST1219X-Y tripod, adjust the depth setting for proper countersink depth.
 - d) Attach a hand feed drill motor to the tripod unit and ream hole using a steady hand feed at 500 rpm.

NOTE: Apply enough pressure to fully countersink the hole in one operation. The pressure exerted must be constant from hole to hole to maintain countersink depth control.

- (b) Use a cutting and lubricating medium when drilling and reaming holes. A recommended cutting and lubricating medium is Cetyl Alcohol or BOELUBE, which comes in liquid, solid, paste or spray form.
- (c) Before producing holes in the airplane structure drill and ream a minimum of 5 holes to the requirements of par. (d) (below).
- (d) Before you install the fastener, inspect the hole to make sure that it agrees with the specifications in 51-40-05, GENERAL.

NOTE: Inspect the hole diameter before you inspect for straightness.

(2) Oversize Holes

NOTE: When a fastener is removed, the hole must be oversized unless the hole is inspected and the hole condition is permitted as specified in 51-40-05, GENERAL.

- (a) With the next oversize ST1219Y-1RCA reamer/countersink tool installed in the ST1219X-Y tripod, oversize the hole as specified in 51-40-05, GENERAL.

C. Installation

- (1) Select a bolt with the required grip length and thread protrusion as given in Figure 15/GENERAL.
- (2) If the thread protrusion requirements of Figure 15/GENERAL are not as specified, a grip adjustment washer can be used as shown in Figure 15/GENERAL.
- (3) Apply an applicable sealant to the underside of the bolt head. If the bolt has a flush head, you can apply sealant to the countersink as an alternative. Refer to 51-20-05, GENERAL for seals and sealing.

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- (4) Drive or press the bolt into the hole. The parts must be clamped together and the structure supported with a suitable bucking bar during this operation.

NOTE: A maximum interface separation of 0.004 inch is permissible at the bolt shank in fay seal areas, and in non faying seal areas a separation of less than 0.002 inch is permissible. To facilitate installation, holes may also be lubricated with cetyl alcohol.

- (5) Install nuts and washers as given in Paragraph 9.D./GENERAL and Figure 15/GENERAL.

(6) Torque Procedure

- (a) When the engineering drawing specifies a multiple bolt installation (and the sequence to tighten the nuts is not specified), do not tighten adjacent bolts in a sequence.

- 1) If the bolts are in a circle: first hand-tighten opposite bolts in a sequence. Then torque all bolts, in an alternating pattern, all around the circle, first one bolt, then its opposite.
- 2) If the bolts are five or more in a row: first hand-tighten the end bolts, then the bolts that remain. Then torque all bolts in an alternating pattern, all along the row.

- (b) Torque nuts to the values given in 51-40-04, GENERAL.

- (7) Clean the threads of sealant or any other residue and install the nut to the torque wrench values specified in 51-40-04, GENERAL. The installation of all bolts through parts assembled with faying surface seals should be completed with at least 60 minutes of the sealant application life left. After at least 20 minutes from the initial torque application, retorque the nuts to the maximum torque value +00 to -20 pound-inches (+00 to -2.26 Newton-Meters). Complete the retorquing before the sealant application life expires. Refer to SOPM 20-50-19 for the application life of sealant materials.

- (8) Make sure that the dish on the head of the installed fastener is smooth and does not have a raised ring.

- (9) Make sure that the bolt head is flush as given in 51-10-01, GENERAL, (unless specified differently in an engineering drawing).

NOTE: Additional driving of the bolt to get correct flushness is permitted. Make sure that the nut is retightened as given in 51-40-04, GENERAL.

- (10) Make sure that the shank protrusion is in the specified limits given in Figure 15/GENERAL.

- (11) Examine the gaps under the bolt head and nut as given in Figure 15/GENERAL.

D. Use of Washers

NOTE: See Figure 15/GENERAL for washer sizes and types.

(1) Seal Nuts

NOTE: Do not use a washer between a seal nut and the structure.

(2) Fillet Relief Washers Under Protruding Head Fasteners

- (a) A head-to-shank relief is necessary for radius lead-in bolts. As an alternative to making a fillet relief in the structure, you can put a fillet relief washer under protruding head fasteners.
- (b) A maximum of one washer is permitted for fillet relief.
- (c) Only use washers that have a side with a fillet relief or a countersink.
- (d) Put the fillet relief (or countersink) side of the washer under the head of the fastener.

(3) Grip Adjustment Washers

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- (a) A maximum of one washer is permitted for grip adjustment. Only use standard washers (no countersink washers) unless the grip adjustment washer is put directly under the head of a BACB30WR fastener (then a fillet relief washer or countersunk washer is necessary).
 - (b) You can use a grip adjustment washer with a counterbore substitution washer and/or a fillet relief washer. If a grip adjustment washer will be installed with a counterbore substitution washer: Put a standard grip adjustment washer between the counterbore substitution washer and the structure.
- (4) Counterbore Substitution Washers
- (a) One 1/16 inch (1.6 mm) thick washer can be used under a nominal size BACN10HY or BACN10SZ non-sealing nut for counterbore substitution.
 - (b) One 1/16 inch (1.6 mm) thick washer can be used when the BACN10MT self-aligning nut and BACW10AU self-aligning washer are used. Put the counterbore substitution washer under the BACW10AU self-aligning washer.

E. Removal

- (1) Remove the fastener by removing the nut and driving out the bolt. Due to the interference fit of the bolt this may require some sharp blows initially; therefore, the structure must be supported by a bucking bar recessed to accept the bolt during removal. A washer must be placed over the protruding threaded end of the bolt to protect the structure.

NOTE: As an alternative, a hole can be drilled through the bolt.

9. Bolts**A. General**

- (1) The recommended fasteners in aluminum structure are aluminum coated titanium, aluminum coated A-286, or cadmium-plated A-286. Cadmium-plated alloy-steel fasteners are a structurally acceptable alternative. But, the cadmium plating is a sacrificial coating, and in a corrosive environment can come off of the fastener. This can cause the alloy-steel fastener to corrode. This can then cause streaks of rust and/or the start of corrosion on adjacent aluminum structure.
- (2) Fasteners are installed wet with sealant.

NOTE: Refer to 51-20-05, GENERAL to install fasteners in the integral fuel tank and other procedures to apply sealant.

B. Installation

- (1) All threads of the nut must be completely engaged and the complete chamfered portion of the end of the bolt must protrude beyond the outer surface of the nut. Flat ended bolts must protrude at least 1/32 inch (0.8 mm) beyond the outer surface of the nut.
- (2) Nuts must not engage any incomplete threads next to the shank of the bolt.
- (3) No lubricants other than which is on the nuts or bolts, as purchased are to be used unless otherwise specified.
- (4) Boltheads must be installed with heads up or forward, when possible, unless otherwise specified.

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C. Use of Washers

NOTE: The total number of washers that can be used for fillet relief, grip length adjustment, corrosion protection or counterbore substitution is three. Too many washers can cause unwanted eccentricity and can cause fasteners to become loose. But, if you cannot get a good grip length adjustment, have an engineer do an analysis. An engineer can make a decision to add another washer.

Washer material must be similar to the fastener and structure materials. Refer to 51-20-01, GENERAL for the classification of dissimilar materials. The correct washer material and part number numbers to use are given in Figure 16/GENERAL.

(1) Fillet Relief Washers Under Protruding Head Fasteners.

- (a) A head-to-shank relief is necessary for all types of protruding head bolts. As an alternative to making a fillet relief in the structure, you can put a fillet relief washer under protruding head bolts.
- (b) A maximum of one washer can be used for fillet relief.
- (c) Only use washers that have a side with a fillet relief or countersink.
- (d) Put the fillet relief (or countersunk) side of the washer under the head of the fastener.

(2) Corrosion Protection and Grip Length Adjustment Washers

NOTE: The maximum number of these types of washer that can be used is two.

- (a) Only use standard washers (no countersunk washers) unless the grip adjustment washer is put directly under a protruding head (then a fillet relief or countersunk washer is necessary).
- (b) Install the washer(s) as follows:
 - 1) You can put one or two washers between a standard nut and the structure.
 - 2) You can put one or two washers between a standard nut and a self-aligning washer (BACW10CA).
 - 3) You can put one grip adjustment washer under a fastener head when both a self-aligning nut and a self-aligning washer are used (BACN10MT with a BACW10AU).

NOTE: If a grip adjustment washer is necessary, put the washer between the fillet relief washer and the structure.

D. Torque Procedure

- (1) When the engineering drawing specifies a installation of multiple bolts or screws (and the sequence to tighten the nuts is not specified), do not tighten adjacent bolts in a sequence.
 - (a) If the bolts are in a circle: first hand-tighten opposite bolts in a sequence. Then torque all bolts, in an alternating pattern, all around the circle.
 - (b) If the bolts are five or more in a row: first hand-tighten the end bolts, then the bolts that remain. Then torque all bolts in an alternating pattern, all along the row.
- (2) Torque nuts to the values given in 51-40-04, GENERAL.

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- (3) Clean the threads of sealant or any other residue and install the nut to the torque wrench values specified in 51-40-04, GENERAL. The installation of all bolts through parts assembled with faying surface seals should be completed with at least 60 minutes of the sealant application life left. After at least 20 minutes from the initial torque application, retorque the nuts to the maximum torque value +00 to -20 pound-inches (+00 to -2.26 Newton-Meters). Complete the retorquing before the sealant application life expires. Refer to SOPM 20-50-19 for the application life of sealant materials.

E. Evaluate gaps under the bolthead and nut as given in Figure 16/GENERAL.

10. Installation of Fasteners in Composites

- A. Refer to 51-70-16, GENERAL for drilling, countersinking, and machining of composites, treatment of fastener holes, and fastener hole quality.
- B. Refer to par. 11 for installation of BACR15GA rivets in composites.
- C. Carbon Fiber Reinforced Plastic (CFRP) panel installed on CFRP panel or CFRP structure.
 - (1) Remove all loose fasteners.
 - (2) Drill holes, if necessary, as given in the specified repair instructions.
 - (3) Install CRES or titanium fasteners dry. Use of aluminum fasteners in CFRP or hybrid aramid/CFRP structures is not recommended; corrosion may result.
- D. Aramid or Fiberglass Reinforced Plastic (AFRP or GFRP) panels
 - (1) Remove any loose fasteners.
 - (2) Drill holes, if necessary, as given in the specified repair instructions.
 - (3) Install fasteners wet with BMS 5-95 sealant.

11. Hollow-Ended Rivets (BACR15GA)

- A. General
 - (1) BACR15GA hollow-ended rivets are used in composite structural applications.
 - (2) Refer to par. 10. for installation of fasteners in composites.
- B. Hole Preparation
 - (1) Clamp components together before drilling so that no gap exists between components at the hole location during hole preparation.

CAUTION: THE USE OF LUBRICANTS OTHER THAN THOSE SPECIFIED AS FOLLOWS, CAN CAUSE DAMAGE TO RESIN SYSTEMS.

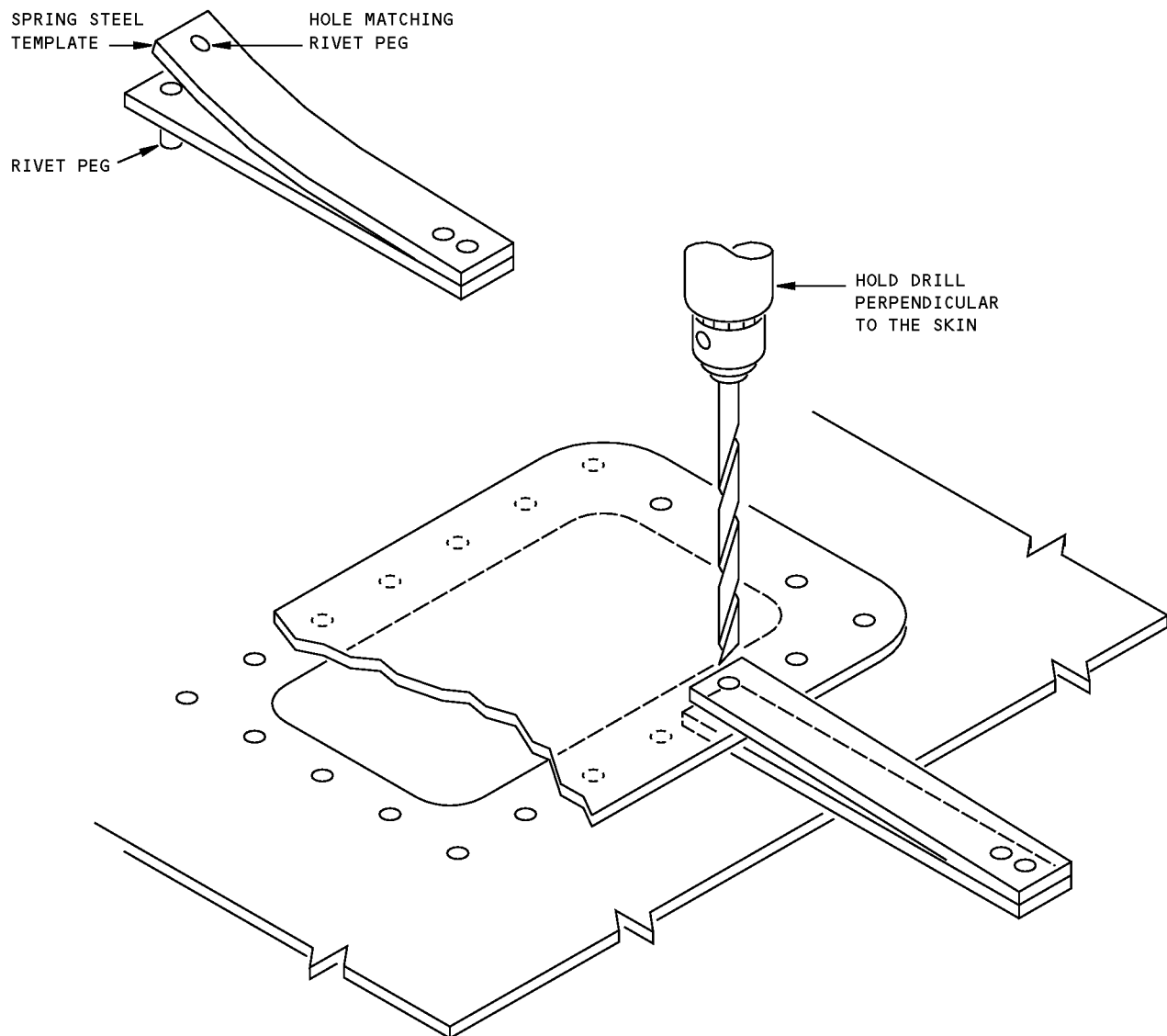
- (2) Filtered air, CO₂, non-oil containing freon, BOELUBE, or cetyl alcohol can be used as drilling lubricants.
- (3) A good backup is required on the exit side of the panel to prevent breakout damage. Refer to 51-70-16, GENERAL for breakout limits.
- (4) Countersink holes as specified in 51-70-16, GENERAL. Refer to 51-40-08, GENERAL for BACR15GA rivet countersink dimensions.
- C. Installation (Figure 17/GENERAL)
 - (1) Installation of BACR15GA rivets can be done with either of the following rivet squeeze tools:
 - (a) CP-0214 rivet squeezer or equivalent (preferred tool).
 - (b) ST-1010-399-3 rivet squeezer coupled to a CP505A hydraulic rivet gun and a EQE 1555 hydraulic power unit (alternate tool). Refer to Figure 17/GENERAL for squeeze force settings.



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- (c) The following forming dies shall be used for flaring the hollow end of the rivet into the countersink:
 - 1) Single-stage installations use ST1157G flaring tool. (preferred method)
 - 2) Double-stage installations use ST1157A flaring tool for 140° initial angle and 160° final angle or 120° initial angle and 140° final angle (alternate method).
- (2) Inspect rivets after installation for the following:
 - (a) Visible cracks in the flared end of the rivet are not allowed.
 - (b) Rivets must be flush within 0.000 to +0.015 for both ends of rivet.
 - 1) Flared end of rivet may be shaved to not less than +0.010 protrusion.
 - 2) Shaving of more than 25% of rivets in a single component is not allowed.
 - (c) Flared end of rivet must not be off center by more than 0.04.
- D. Removal of BACR15GA rivets can be accomplished by procedures used for solid shank rivets. See Figure 8/GENERAL.

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Hole Finder
Figure 1

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NOTES

- SEE DETAIL I FOR INSPECTION OF FLUSHNESS.

FASTENER	HEAD HEIGHT SPECIFICATIONS FOR FLUSH HEAD FASTENERS
RIVETS	<ul style="list-style-type: none"> • UNLESS SEPCIFIED DIFFERENTLY ON THE ENGINEER DRAWING, FLUSH HEAD RIVETS ON NONAERODYNAMIC SURFACES MUST BE FLUSH TO THE SPECIFICATIONS THAT FOLLOW: <ul style="list-style-type: none"> (1) BACR15GF, BACR15CE AND NAS1097 RIVETS MUST BE FLUSH -0.000 TO +0.005 INCH. (2) BACR15FV AND MS14218 RIVETS MUST BE FLUSH -0.001 TO +0.006 INCH. (3) ALL OTHER COUNTERSUNK RIVETS MUST BE FLUSH -0.000 TO +0.010 INCH. • UNLESS SPECIFIED DIFFERENTLY IN SRM 51-10-01 OR ON THE ENGINEERING DRAWING, FLUSH RIVET HEADS ON AERODYNAMIC SURFACES MUST BE FLUSH TO THE SPECIFICATIONS THAT FOLLOW: <ul style="list-style-type: none"> (1) BACR15GF RIVETS MUST BE FLUSH TO +0.001 TO +0.007 INCH. (2) BACR15FV AND MS14218 RIVETS MUST BE FLUSH +0.001 TO +0.006 INCH. (3) ALL OTHER FLUSH HEAD RIVETS MUST BE FLUSH -0.001 TO +0.002 INCH. • BACR15FV, MS14218, BACR15GF, NAS1097, AND BACR15CE RIVET HEADS MUST NOT BE SHAVED OR MODIFIED TO AGREE WITH FLUSHNESS SPECIFICATIONS (UNLESS PERMITTED FOR REWORK OF BACR15FV AND MS14218 RIVETS AS SPECIFIED IN FIGURE 5). • RIVETS OTHER THAN BACR15FV, NAS1097, BACR15GF, BACR15CE AND MS14218 RIVETS CAN BE SHAVED AS SPECIFIED IN SRM 51-10-01 TO AGREE WITH FLUSHNESS SPECIFICATIONS.
BLIND FASTENERS	<ul style="list-style-type: none"> • FLUSHNESS SPECIFICATION FOR FLUSH-HEAD FASTENERS SHALL BE -0.005 TO +0.010 INCH UNLESS SPECIFIED DIFFERENTLY ON THE ENGINEERING DRAWING. <ul style="list-style-type: none"> (1) MAKE SURE THE LOCKING RING AND STEM ARE IN THE POSITIONS SPECIFIED IN FIGURE 9 BEFORE YOU SHAVE A BLIND RIVET. THE LOCKING RINGS AND/OR STEMS OF NAS1398, NAS1399, NAS1738, NAS1739, BACR15FP, AND BACR15FR RIVETS CAN BE SHAVED A MAXIMUM OF 0.010 INCH TO AGREE WITH THE FLUSHNESS SPECIFICATION. SHAVING OF THE RIVET HEAD IS NOT PERMITTED. (2) THE STEMS OF BACB30AY, BACB30CC, BACB30JG BOLTS CAN BE SHAVED TO AGREE WITH THE FLUSHNESS SPECIFICATION. QUALITY CONTROL INSPECTION AND APPROVAL OF STEM POSITION PRIOR TO SHAVING IS REQUIRED. SHAVING OF THE BOLT HEAD IS NOT ALLOWED. • THE LOCKING RINGS AND/OR STEMS OF MS90353, MS90354, MS21140 AND MS21141 BOLTS MAY BE SHAVED TO MEET FLUSHNESS REQUIREMENTS. QUALITY CONTROL INSPECTION AND APPROVAL OF LOCKING RING AND STEM POSITION PRIOR TO SHAVING IS REQUIRED. SHAVING OF THE BOLT HEAD IS NOT ALLOWED.

TABLE I

Fastener Flushness Specifications
Figure 2 (Sheet 1 of 3)

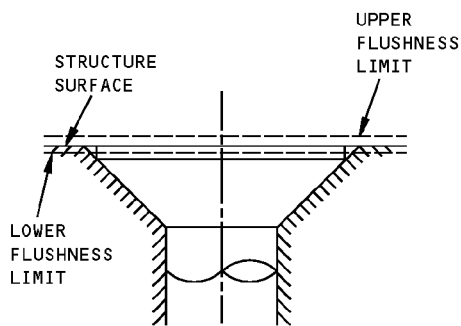
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FASTENER	HEAD HEIGHT SPECIFICATIONS FOR FLUSH HEAD FASTENERS
LOCKBOLTS AND HEX-DRIVE BOLTS	<ul style="list-style-type: none"> FLUSH HEAD FASTENERS MUST BE FLUSH -0.005 TO $+0.010$ INCH UNLESS SPECIFIED DIFFERENTLY IN SRM 51-10-01 OR ON THE ENGINEER DRAWING. DOMED HEAD FASTENERS (BACB30XT, BACB30XU AND BACB30YP) MUST BE FLUSH $+0.0025$ TO $+0.0085$ INCH UNLESS SPECIFIED DIFFERENTLY IN SRM 51-10-01 OR ON THE ENGINEER DRAWING. FLUSH HEAD FASTENERS THAT ARE TO BE COATED WITH BMS 5-62, BMS 8-70, BMS 8-78, OR BMS 8-103, MUST BE FLUSH -0.005 TO $+0.015$ INCH. IT IS NOT PERMITTED TO SHAVE THE HEADS OF LOCKBOLTS AND HEX-DRIVE BOLTS TO AGREE WITH THE FLUSHNESS SPECIFICATION. IF THE FASTENER HEAD IS NOT FLUSH TO SPECIFICATION: <ol style="list-style-type: none"> (1) MORE DRIVING OF THE PIN IS PERMITTED FOR HEX-DRIVE BOLTS IF THE COLLAR IS REPLACED OR THE NUT IS RE-TIGHTENED AS SPECIFIED IN SRM 51-40-04. <ol style="list-style-type: none"> (a) HEX-DRIVE BOLTS MUST BE REPLACED WITH NEW FASTENERS WHEN THE REMOVED COLLARS OR NUTS ARE ALLOY STEEL, CRES OR TITATNIUM. (b) WHEN ALUMINUM COLLARS OR NUTS ARE REMOVED FROM COMPLETED ASSEMBLIES OR INSTALLATION: EXAMINE THE HEX-DRIVE BOLT FOR THREAD DAMAGE BEFORE YOU INSTALL A NEW COLLAR OR NUT. IF THE THREAD IS DAMAGED, THE HEX-DRIVE BOLT MUST BE REPLACED WITH A NEW HEX-DRIVE BOLT. (2) FOR LOCKBOLTS, MORE DRIVING IS NOT PERMITTED. THE FASTENER MUST BE REPLACED.
BOLTS	<ul style="list-style-type: none"> FLUSH HEAD FASTENERS MUST BE FLUSH -0.005 TO $+0.010$ INCH UNLESS SPECIFIED DIFFERENTLY IN SRM 51-10-01 OR ON THE ENGINEER DRAWING. FLUSH HEAD FASTENERS THAT ARE TO BE COATED WITH BMS 5-62, BMS 8-70, BMS 8-78, OR BMS 8-103, MUST BE FLUSH -0.005 TO $+0.015$ INCH. IT IS NOT PERMITTED TO SHAVE THE HEADS OF BOLTS TO AGREE WITH THE FLUSHNESS SPECIFICATION.
RADIUS LEAD-IN BOLTS	<ul style="list-style-type: none"> BACB30PT BOLTS MUST BE FLUSH $+0.000$ TO $+0.006$, UNLESS SPECIFIED DIFFERENTLY IN SRM 51-10-01 OR ON THE ENGINEER DRAWING. BACB30WQ BOLTS MUST BE FLUSH AS SPECIFIED IN SRM 51-10-01 OR ON THE ENGINEER DRAWING. IT IS NOT PERMITTED TO SHAVE THE HEADS OF BOLTS TO AGREE WITH THE FLUSHNESS SPECIFICATION.

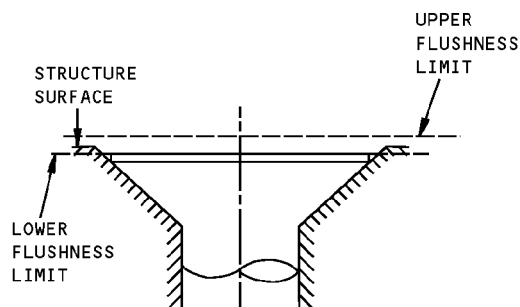
TABLE I (CONT)

**Fastener Flushness Specifications
Figure 2 (Sheet 2 of 3)**

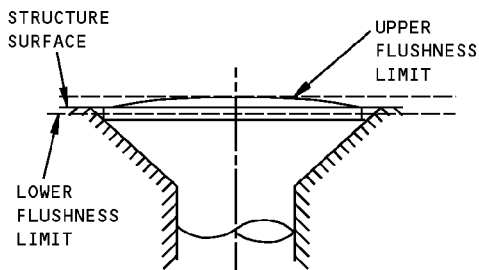
STRUCTURAL REPAIR MANUAL



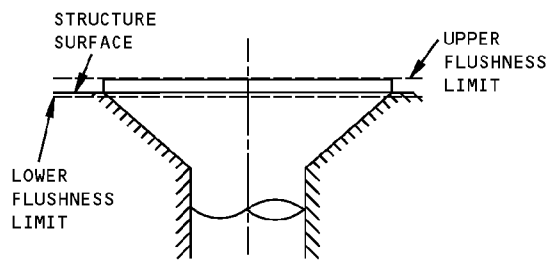
FASTENER HEAD HAS A CONTINUOUS SURFACE WITH THE STRUCTURE (ZERO VALUE)



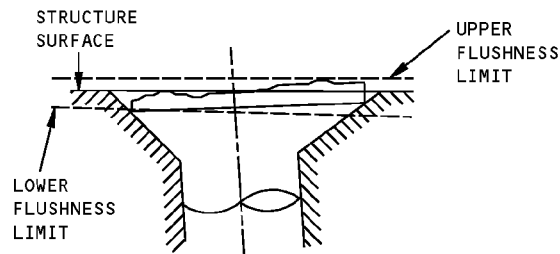
FASTENER EXACTLY AT LOWER FLUSHNESS LIMIT (NEGATIVE VALUE)



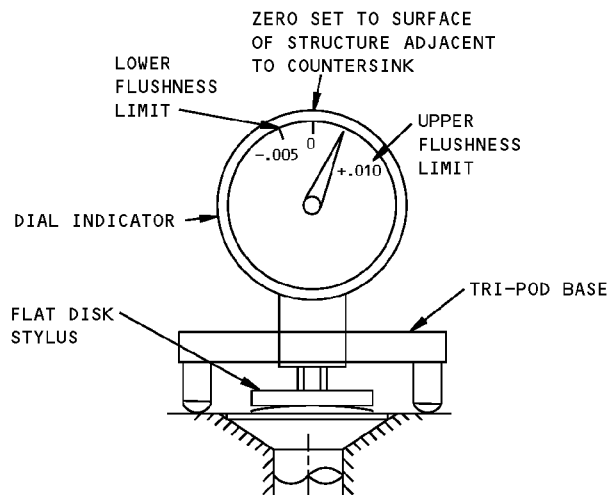
FASTENER WITH CROWN (OR DOME) ON TOP OF HEAD. FASTENER FLUSHNESS JUST MEETS FLUSHNESS LIMITS



FASTENER HEAD IS AT UPPER FLUSHNESS LIMIT (POSITIVE VALUE)



FASTENER HOLE NOT PERPENDICULAR TO STRUCTURE SURFACE. TOP OF FASTENER HEAD NOT PERPENDICULAR TO SHANK. TOP OF FASTENER HEAD NOT FLAT. ALL EDGES ARE AT OR IN BETWEEN THE UPPER AND LOWER FLUSHNESS LIMITS.

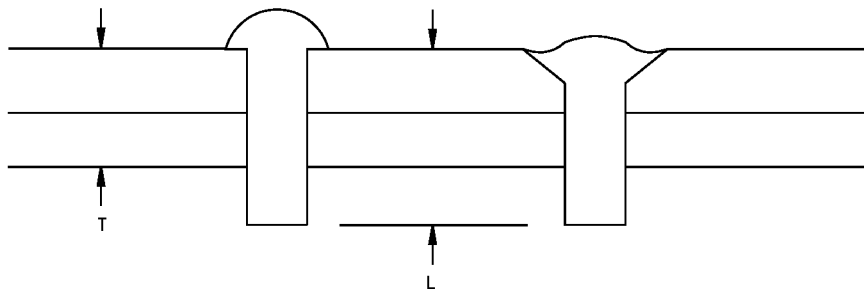


DIAL INDICATOR AND FLAT DISK STYLUS FOR FINDING PERMITTED FLUSHNESS VALUES (THIS METHOD ALSO APPLIES TO FLUSH HEAD FASTENERS WITHOUT A CROWN OR DOME)

HOW TO MEASURE FLUSHNESS
DETAIL I

Fastener Flushness Specifications
Figure 2 (Sheet 3 of 3)

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RIVET LENGTH (L) AND GRIP (T) DIMENSIONS FOR STANDARD ALUMINUM SOLID RIVETS
DETAIL I

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-1
- SEE TABLE I FOR GRIP RANGES AND RIVET LENGTHS.
- SEE TABLES II AND III FOR BUTTON DIMENSIONS.
- REFER TO FIGURES 6 AND 7 FOR ANALYSIS OF THE RIVET HEAD AND BUTTON AFTER INSTALLATION

A THESE RIVET LENGTHS ARE FOR NEW HOLES AND OVERSIZED HOLES ONLY. IF A HOLE THAT WAS FILLED BEFORE IS NOT OVERSIZED, USE A RIVET LENGTH ONE SIZE HIGHER.

B FOR RIVETS WITH A SPECIFIED 1.4X DIAMETER DRIVEN HEAD THE NEXT HALF-SIZED (R5 SUFFIX TO PART NUMBER) LENGTH MAY BE REQUIRED. FOR RIVETS WITH A SPECIFIED 1.5X DIAMETER DRIVEN HEAD, THE NEXT WHOLE DASH NUMBER MAY BE REQUIRED.

IN THICK STACKUPS, FOR RIVETS INSTALLED IN HOLES THAT ARE THE MAXIMUM ALLOWED DIAMETER, THE NEXT HALF-SIZED (R5) LENGTH CAN BE NECESSARY.

IN MINIMUM STACKUPS, A HALF-SIZE (R5 SUFFIX TO PART NUMBER) SHORTER LENGTH CAN BE USED FOR WEIGHT SAVINGS.

C 1/32 OVERSIZE REPLACEMENTS

D WHEN NORMAL HAND DRIVING STANDARDS ARE SPECIFIED.

E WHEN OVER-DRIVING IS SPECIFIED.

F 1/64 OVERSIZE REPLACEMENTS.

Dimensions for Driving Non-Fluid-Tight Solid Shank Rivets
Figure 3 (Sheet 1 of 3)



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STRUCTURAL REPAIR MANUAL

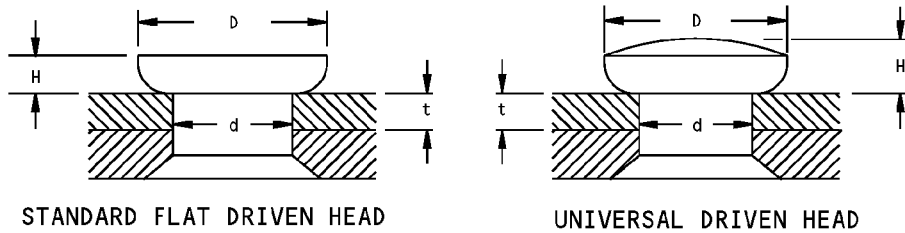
RIVET LENGTH L A		GRIP (T) RANGES FOR RIVET LENGTHS AND DIAMETERS B								
SIZE	DASH NO.	3/32 OR 3 DIA	1/8 OR 4 DIA	5/32 OR 5 DIA	3/16 OR 6 DIA	7/32 OR 7 DIA	1/4 OR 8 DIA	9/32 OR 9 DIA	5/16 OR 10 DIA	3/8 OR 12 DIA
3/16	-3	0.084	0.058	0.035						
1/4	-4	0.085 0.142	0.059 0.117	0.036 0.093	0.068					
5/16	-5	0.143 0.201	0.118 0.176	0.094 0.152	0.069 0.127	0.107	0.078	0.058		
3/8	-6	0.202 0.260	0.177 0.234	0.153 0.211	0.128 0.185	0.108 0.166	0.079 0.136	0.059 0.117	0.087	0.038
7/16	-7	0.261 0.319	0.235 0.293	0.212 0.270	0.186 0.244	0.167 0.225	0.137 0.195	0.118 0.176	0.088 0.146	0.039 0.097
1/2	-8	0.320 0.377	0.294 0.352	0.271 0.327	0.245 0.303	0.226 0.283	0.196 0.254	0.177 0.234	0.146 0.205	0.098 0.156
9/16	-9	0.378 0.436	0.353 0.411	0.328 0.387	0.304 0.362	0.284 0.342	0.255 0.313	0.235 0.293	0.206 0.264	0.157 0.215
5/8	-10	0.437 0.495	0.412 0.469	0.388 0.446	0.363 0.420	0.343 0.401	0.314 0.371	0.294 0.352	0.265 0.322	0.216 0.273
11/16	-11	----	0.470 0.528	0.447 0.505	0.421 0.479	0.402 0.460	0.372 0.430	0.353 0.411	0.323 0.381	0.274 0.332
3/4	-12	----	0.529 0.587	0.506 0.563	0.480 0.538	0.461 0.518	0.431 0.489	0.412 0.469	0.382 0.440	0.333 0.391
13/16	-13	----	0.588 0.646	0.564 0.622	0.539 0.597	0.519 0.577	0.490 0.548	0.470 0.528	0.441 0.499	0.392 0.450
7/8	-14	----	----	0.623 0.681	0.598 0.655	0.578 0.636	0.549 0.606	0.529 0.587	0.500 0.557	0.451 0.508
15/16	-15	----	----	0.682 0.740	0.656 0.714	0.634 0.695	0.607 0.665	0.588 0.646	0.558 0.616	0.509 0.567
1	-16	----	----	0.741 0.798	0.715 0.773	0.696 0.753	0.666 0.724	0.647 0.704	0.617 0.675	0.568 0.626
17/16	-17	----	----	----	0.774 0.832	0.754 0.812	0.725 0.783	0.705 0.763	0.676 0.734	0.627 0.685
9/8	-18	----	----	----	0.833 0.890	0.813 0.871	0.784 0.841	0.764 0.822	0.735 0.792	0.686 0.743
19/16	-19	----	----	----	0.891 0.949	0.872 0.930	0.842 0.900	0.823 0.881	0.793 0.851	0.744 0.802
5/4	-20	----	----	----	0.950 1.008	0.931 0.988	0.901 0.959	0.882 0.939	0.852 0.910	0.803 0.861
21/16	-21	----	----	----	----	0.989 1.047	0.960 1.018	0.940 0.998	0.911 0.969	0.862 0.920
11/8	-22	----	----	----	----	----	1.019 1.076	0.999 1.057	0.970 1.027	0.921 0.978

GRIP RANGES AND RECOMMENDED RIVET LENGTHS FOR STANDARD ALUMINUM SOLID RIVETS

TABLE I

Dimensions for Driving Non-Fluid-Tight Solid Shank Rivets
Figure 3 (Sheet 2 of 3)

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NOMINAL RIVET DIAMETER	D MINIMUM DRIVEN RIVET BUTTON DIAMETER				H DRIVEN RIVET BUTTON THICKNESS OR HEIGHT		
	ALL RIVETS EXCEPT AS NOTED		BACR15GF AND 7050 ALUMINUM ALLOY RIVETS		BACR15GF BACR15CE BACR15DS BACR15FV MS14218 NAS1097	ALL OTHER RIVETS	ALL RIVETS
	1.3d D	1.4d E	1.4d D	1.5d E	MINIMUM	MINIMUM	MAXIMUM RECOMMENDED
1/16	0.081	0.088	0.088	0.094	0.025	0.025	0.040
3/32	0.122	0.131	0.131	0.141	0.038	0.038	0.060
1/8	0.165	0.175	0.175	0.188	0.050	0.050	0.080
5/32	0.203	0.219	0.219	0.234	0.050	0.062	0.100
3/16	0.245	0.264	0.264	0.282	0.060	0.075	0.120
13/64 F					0.065		0.130
7/32 C	0.285	0.311	0.311	0.333	0.070	0.085	0.140
1/4	0.325	0.350	0.350	0.375	0.080	0.100	0.160
17/64 F					0.085		0.070
9/32 C	0.365	0.397	0.397	0.425	0.090	0.110	0.180
5/16	0.406	0.438	0.438	0.465	0.125	0.125	0.200
11/32 C	0.450	0.481	0.481	0.515	0.135	0.135	0.210
3/8	0.488	0.525	0.525	0.562	0.150	0.150	0.210
13/32 C	0.530	0.569	0.569	0.609	0.165	0.165	0.215

TABLE II

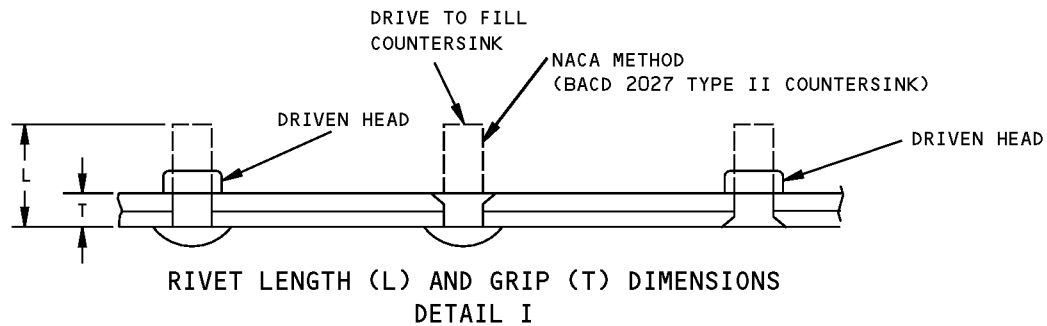
NOMINAL RIVET DIAMETER	THICKNESS (t) OF SHEET ADJACENT TO RIVET BUTTON	BUTTON THICKNESS MINIMUM	BUTTON DIAMETER MINIMUM
3/32	0.016-0.050 0.051 AND ABOVE	0.023 0.038	0.113 0.122
1/8	0.016-0.050 0.051 AND ABOVE	0.030 0.050	0.150 0.163
5/32	0.016-0.050 0.051 AND ABOVE	0.035 0.062	0.180 0.203
3/16	0.016-0.050 0.051 AND ABOVE	0.040 0.075	0.222 0.244
1/4	0.016-0.050 0.051 AND ABOVE	0.050 0.087	0.275 0.325

CRES AND NICKEL-COPPER RIVETS

TABLE III

Dimensions for Driving Non-Fluid-Tight Solid Shank Rivets Figure 3 (Sheet 3 of 3)

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NOMINAL RIVET LENGTH L			APPROXIMATE GRIP T-INCHES						
DECIMAL	FRACTION	DASH NO.	3/32 DIA	1/8 DIA	5/32 DIA	3/16 DIA	1/4 DIA	5/16 DIA	3/8 DIA
0.1875 0.2500 0.3125 0.3750	3/16 1/4 5/16 3/8	-3 -4 -5 -6	0.086 0.142 0.199 0.235	0.117 0.174 0.232	0.087 0.146 0.205	0.119 0.178			
0.4375 0.5000 0.5625 0.6250	7/16 1/2 9/16 5/8	-7 -8 -9 -10	0.312 0.368 0.424 0.480	0.290 0.348 0.406 0.464	0.263 0.322 0.381 0.439	0.237 0.295 0.356 0.416	0.180 0.240 0.300 0.360	0.120 0.181 0.242 0.302	0.183 0.244
0.6875 0.7500 0.8125 0.8750	11/16 3/4 13/16 7/8	-11 -12 -13 -14		0.522 0.579 0.637	0.498 0.557 0.617 0.675	0.475 0.534 0.594 0.654	0.420 0.480 0.540 0.600	0.362 0.423 0.484 0.544	0.307 0.366 0.427 0.488
0.9375 1.0000 1.0625 1.1250	15/16 1 1 1/16 1 1/8	-15 -16 -17 -18			0.732 0.782	0.712 0.773 0.832 0.890	0.660 0.720 0.780 0.840	0.605 0.665 0.726 0.787	0.549 0.610 0.671 0.732
1.1875 1.2500 1.3125 1.3750 1.4375 1.5000	1 3/16 1 1/4 1 5/16 1 3/8 1 7/16 1 1/2	-19 -20 -21 -22 -23 -24					0.901 0.961 1.021	0.847 0.908 0.968 1.029 1.090 1.150	0.793 0.854 0.915 0.976 1.037 1.098

NOMINAL RIVET LENGTH L AND APPROXIMATE GRIP T-INCHES
TABLE I

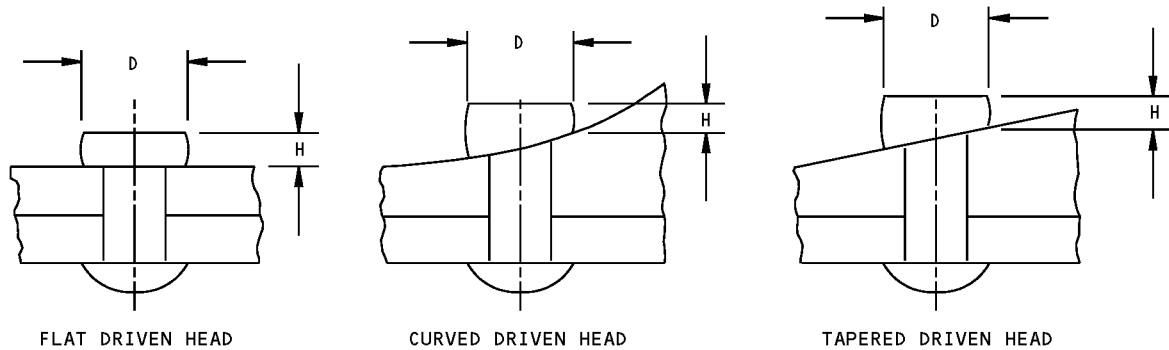
NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5047
- REFER TO FIGURES 6 AND 7 FOR ANALYSIS OF THE RIVET HEAD AND BUTTON AFTER INSTALLATION

A OVERSIZE REPLACEMENT

Dimensions for Driving Fluid-Tight Solid Shank Rivets
Figure 4 (Sheet 1 of 2)

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STRUCTURAL REPAIR MANUAL



DRIVEN RIVET BUTTON DIMENSIONS
DETAIL II

NOMINAL RIVET DIA		D MINIMUM BUTTON DIAMETER		H BUTTON THICKNESS	
		ALL RIVETS EXCEPT AS NOTED	7050 ALUMINUM ALLOY RIVETS	MINIMUM	MAXIMUM (RECOMMENDED)
0.1250	1/8	0.165	-- --	0.050	0.080
0.1560	5/32	0.203	0.219	0.062	0.100
0.1875	3/16	0.245	0.264	0.075	0.120
0.2190	7/32 [A]	0.285	0.311	0.085	0.140
0.2500	1/4	0.325	0.350	0.100	0.160
0.2810	9/32 [A]	0.365	0.397	0.110	0.180
0.3125	5/16	0.406	0.438	0.125	0.200
0.3440	11/32 [A]	0.450	0.482	0.135	0.210
0.3750	3/8	0.488	0.525	0.150	0.210
0.4060	13/32 [A]	0.530	-- --	0.165	0.215
0.4370	7/16	0.570	-- --	0.175	0.220
0.4690	15/32 [A]	0.610	-- --	0.190	0.230

HAND OR MACHINE DRIVEN RIVET BUTTON DIMENSIONS
TABLE II

Dimensions for Driving Fluid-Tight Solid Shank Rivets
Figure 4 (Sheet 2 of 2)



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STRUCTURAL REPAIR MANUAL

IN THIS SKIN THICKNESS MEASURED AT THE HOLE	THE LARGEST DIAMETER RIVET ALLOWED IS:
0.050	5/32
0.056	3/16
0.072	7/32
0.081	1/4
0.090	9/32

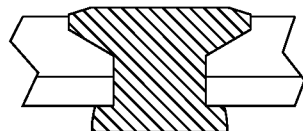
BACR15FV AND MS14218 RIVET REPLACEMENT
TABLE I

NOTES

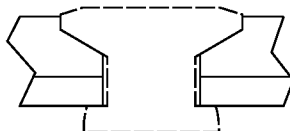
- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-1
 - REFER TO FIGURE 3 FOR GRIP RANGE, RIVET LENGTH, AND BUTTON DIMENSIONS
 - REFER TO FIGURES 6 AND 7 FOR ANALYSIS OF THE RIVET HEAD AND BUTTON AFTER INSTALLATION
- A** THE OVERSIZE RIVET IS LARGER THAN THE LIMITS SPECIFIED IN TABLE I.
 - B** THE OVERSIZE RIVET IS WITHIN THE LIMITS SPECIFIED IN TABLE I.
 - C** IF THE ORIGINAL COUNTERSINK WAS CUT TOO DEEP, THEN DO NOT MAKE THE OVERSIZE RIVET THE SAME DEPTH. OVERSIZE THE HOLE AND THEN COUNTERSINK TO THE CORRECT DEPTH.
 - D** REFER TO FIGURE 2 OR THE ENGINEER DRAWING FOR THE FASTENER FLUSHNESS SPECIFICATIONS

Installation of BACR15FV and MS14218 Oversize Rivets
Figure 5 (Sheet 1 of 2)

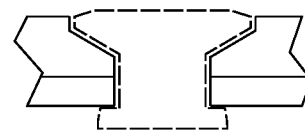
757-200 STRUCTURAL REPAIR MANUAL



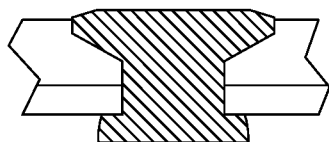
1. THE INITIAL RIVET



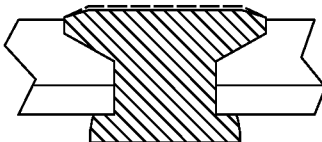
2. REMOVE THE INITIAL RIVET AND DRILL THE OVERSIZED HOLE DIAMETER AS GIVEN IN SRM 51-40-08



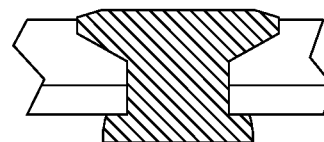
3. INCREASE COUNTERSINK DIAMETER AS GIVEN IN SRM 51-40-08. COUNTERSINK TO THE SAME DEPTH AS THE INITIAL RIVET **C**



4. DRIVE THE RIVET ONLY UNTIL IT IS TIGHT IN THE HOLE. AS GIVEN IN PARAGRAPH 4.

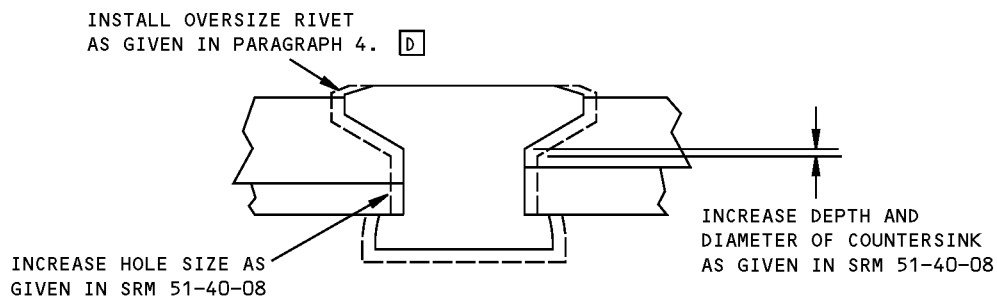


5. SHAVE THE OVERSIZE RIVET HEAD **D**



6. DRIVE THE RIVET UNTIL THE RIVET IS FULLY INSTALLED

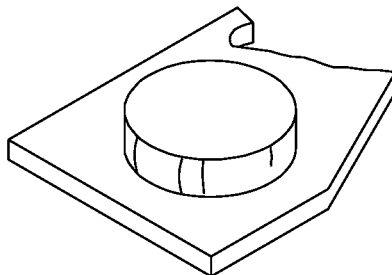
OVERSIZE RIVET IN THIN SKIN **A** DETAIL I



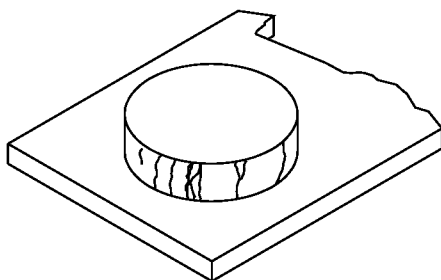
OVERSIZE RIVET IN THICK SKIN **B** DETAIL II

Installation of BACR15FV and MS14218 Oversize Rivets
Figure 5 (Sheet 2 of 2)

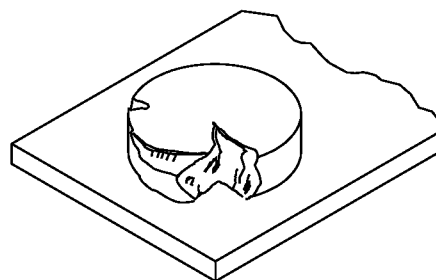
757-200
STRUCTURAL REPAIR MANUAL



VERTICAL CRACKS DUE TO LAPS
IN THE MATERIAL IS SATISFACTORY
DETAIL I



VERTICAL CRACKS IN CRES ALLOY,
NICKEL-COPPER ALLOY, AND TITANIUM RIVETS
DETAIL II



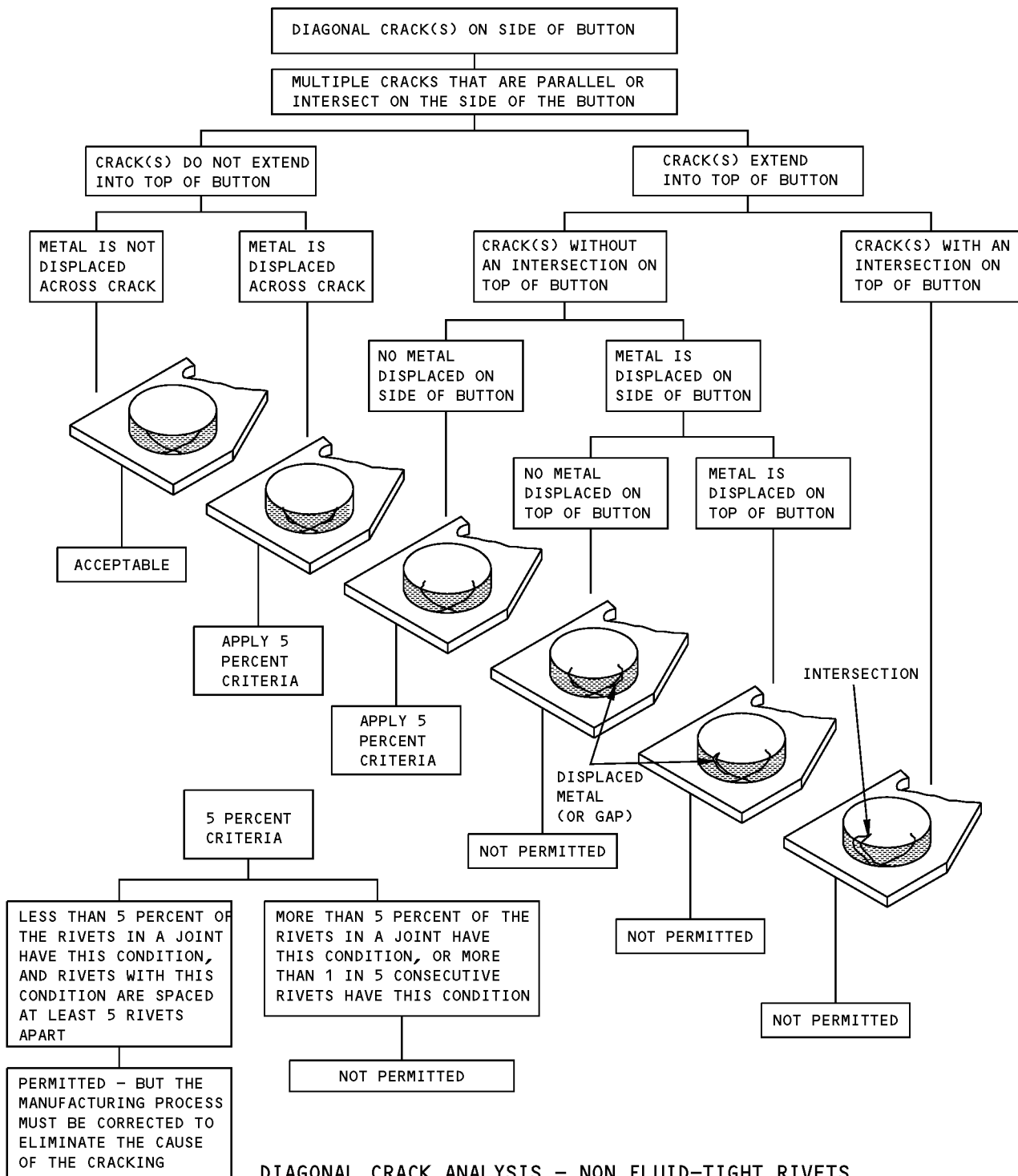
VERTICAL CRACKS DUE TO OVERHEATING
DURING HEAT TREATMENT
IS UNSATISFACTORY
DETAIL III

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATIONS BAC5004-1 AND BAC5047
- SEE DETAILS I THRU III FOR VERTICAL CRACKS IN FLUID-TIGHT AND NON FLUID-TIGHT RIVETS
- SEE DETAIL IV FOR DIAGONAL CRACKS IN NON FLUID-TIGHT RIVETS
- SEE DETAIL V FOR DIAGONAL CRACKS IN FLUID-TIGHT RIVETS

Analysis of Cracks in the Buttons of Solid Shank Rivets
Figure 6 (Sheet 1 of 3)

757-200 STRUCTURAL REPAIR MANUAL

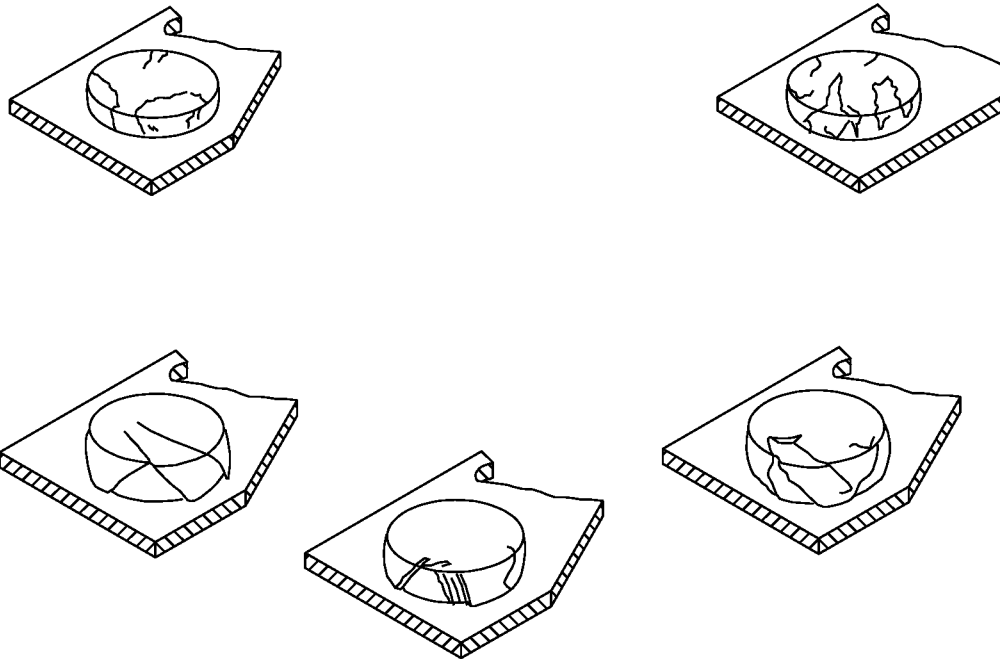


Analysis of Cracks in the Buttons of Solid Shank Rivets
Figure 6 (Sheet 2 of 3)

757-200
STRUCTURAL REPAIR MANUAL



SATISFACTORY
NO DISPLACED METAL (OR GAPS)

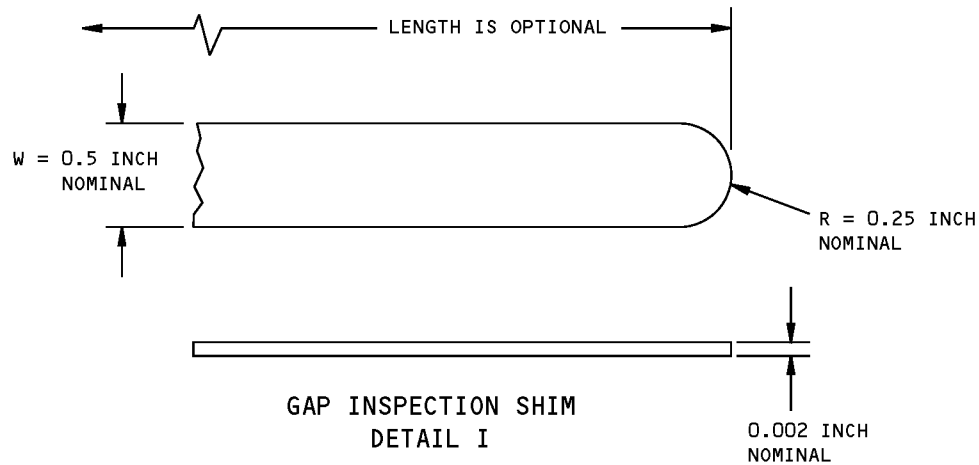


UNSATISFACTORY
DISPLACED METAL OR CRACKS WITH AN INTERSECTION
ON THE FLAT SURFACE

DIAGONAL CRACKS – FLUID-TIGHT RIVETS
DETAIL V

Analysis of Cracks in the Buttons of Solid Shank Rivets
Figure 6 (Sheet 3 of 3)

757-200
STRUCTURAL REPAIR MANUAL

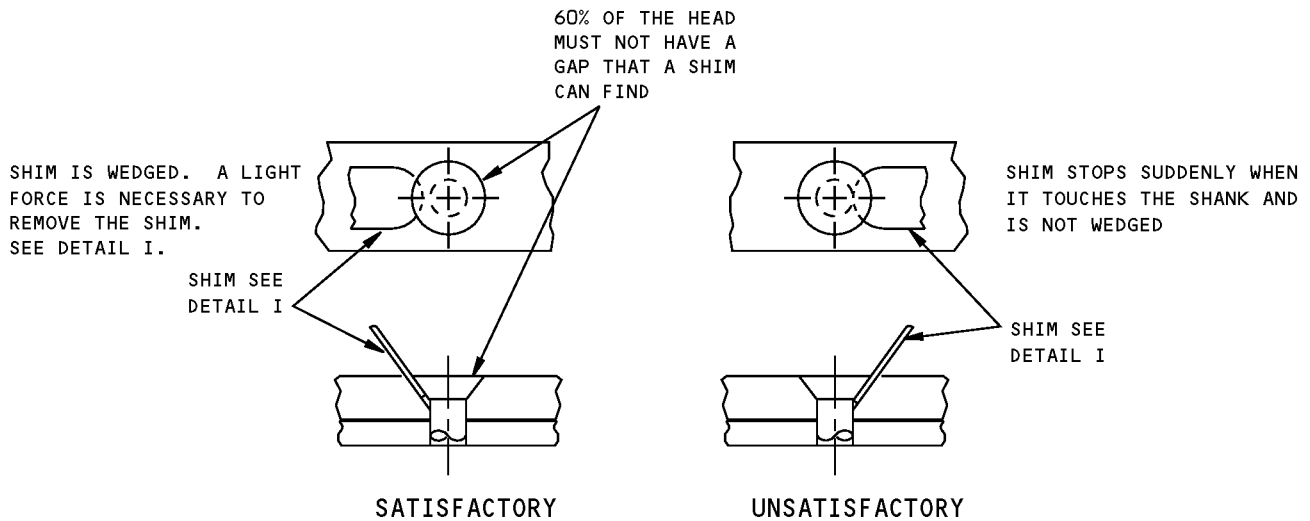
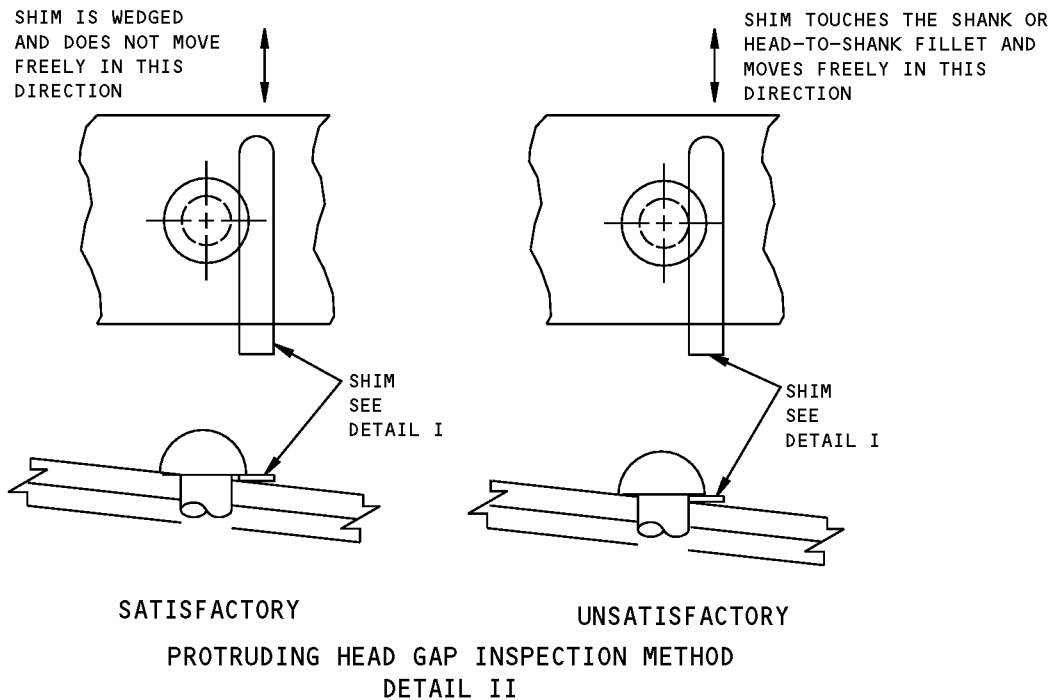


INSPECTION	GAP ANALYSIS (REFERENCE BAC5004-1 AND BAC5047)
PROTRUDING HEADS	<ul style="list-style-type: none"> • SEE DETAIL II
FLUSH HEADS	<ul style="list-style-type: none"> • SEE DETAIL III FOR NON-FLUID-TIGHT RIVETS • SEE DETAIL IV FOR FLUID-TIGHT RIVETS • SEE DETAIL V FOR BACR15FV AND MS14218 RIVETS
NON-FLUSH DRIVEN BUTTONS (ALL RIVETS)	<ul style="list-style-type: none"> • SEE DETAIL VI
FLUSH DRIVEN BUTTONS (ALL RIVETS)	<ul style="list-style-type: none"> • SEE DETAIL VII

TABLE I

Gap Analysis for Rivet Heads and Buttons
Figure 7 (Sheet 1 of 3)

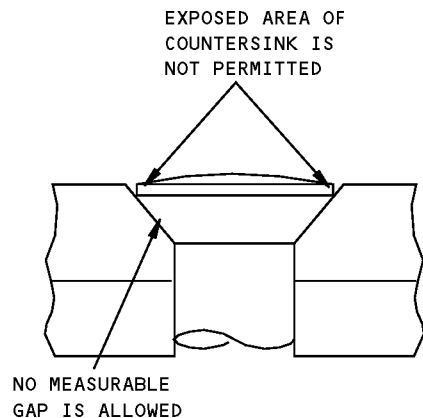
757-200 STRUCTURAL REPAIR MANUAL



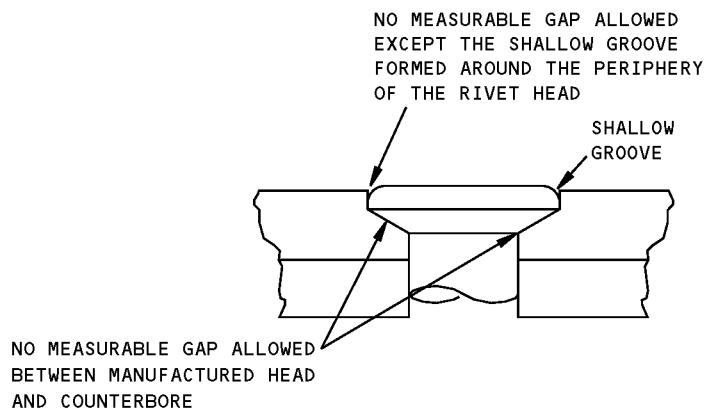
GAP INSPECTION METHOD FOR FLUSH HEAD NON-FLUID-TIGHT RIVETS
DETAIL III

Gap Analysis for Rivet Heads and Buttons Figure 7 (Sheet 2 of 3)

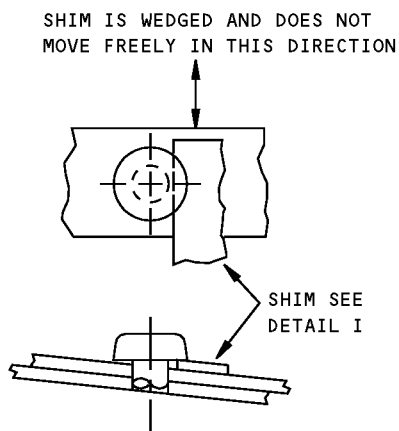
757-200 STRUCTURAL REPAIR MANUAL



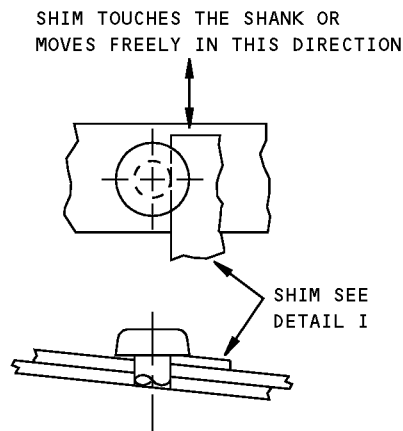
GAP INSPECTION METHOD FOR
FLUSH HEAD FLUID-TIGHT RIVETS
DETAIL IV



GAP INSPECTION METHOD FOR
BACR15FV AND MS14218 RIVET HEADS
DETAIL V

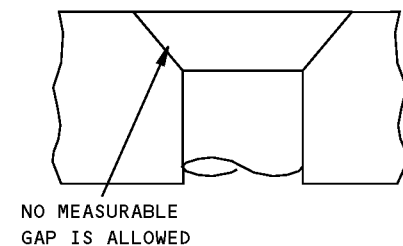


SATISFACTORY



UNSATISFACTORY

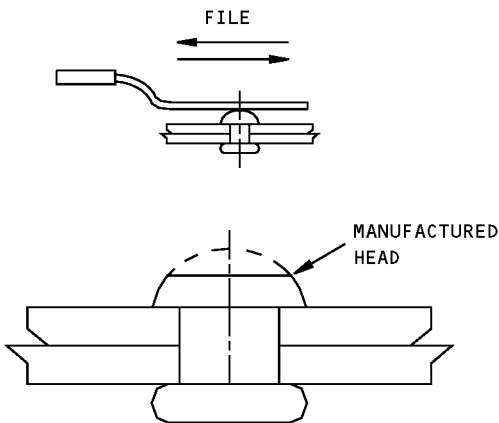
GAP INSPECTION METHOD FOR NON-FLUSH DRIVEN BUTTONS (ALL RIVETS)
DETAIL VI



GAP INSPECTION METHOD FOR
FLUSH DRIVEN BUTTONS (ALL RIVETS)
DETAIL VII

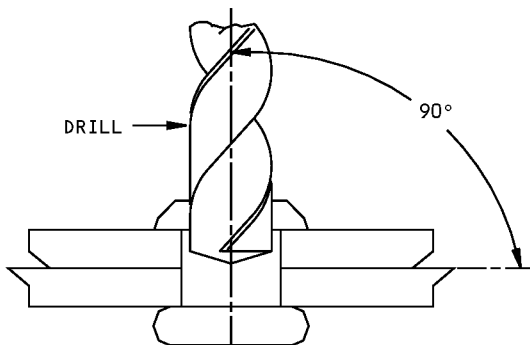
Gap Analysis for Rivet Heads and Buttons
Figure 7 (Sheet 3 of 3)

757-200 STRUCTURAL REPAIR MANUAL



STEP NO. 1

FILE A FLAT AREA ON THE
MANUFACTURED HEAD WITH A FILE

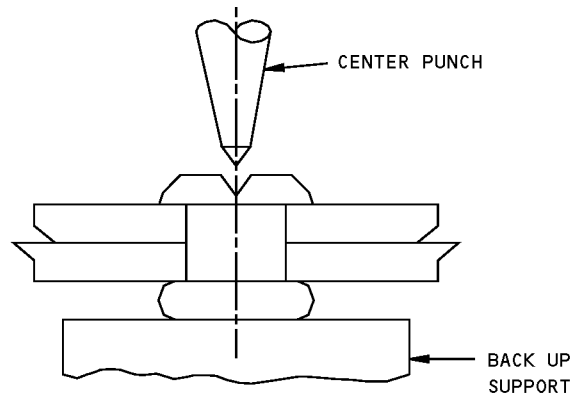


STEP NO. 3

CAUTION: TO PREVENT CRACKED DIMPLES
OR DAMAGED UNDERSTRUCTURE,
WHEN REMOVING RIVETS FROM
DIMPLED HOLES, DRILL A HOLE
INTO THE RIVET SHANK BEFORE
DRIVING IT OUT

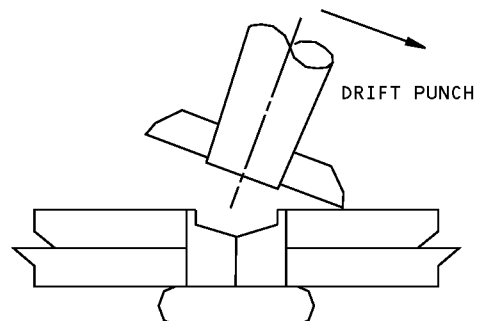
DRILL THROUGH THE HEAD OF THE RIVET SO
THAT THE DRILL DOES NOT DAMAGE THE SKIN
OR CUT THE SIDES OF THE RIVET HOLE.

NOTE: START THE DRILL BY HAND. USE A
DRILL BIT 1/32 INCH DIAMETER
SMALLER THAN THE RIVET SHANK.



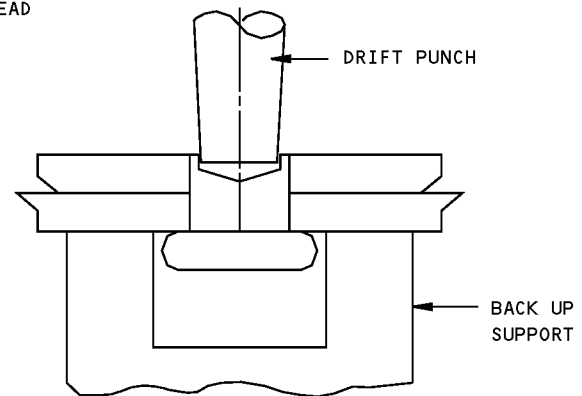
STEP NO. 2

CENTER PUNCH THE CENTER OF THE MANUFACTURED HEAD.
FOR BOTH FLUSH AND NON-FLUSH RIVETS USE A BLOCK
OF WOOD OR A BUCKING BAR AS A BACKUP SUPPORT



STEP NO. 4

INSERT A DRIFT PUNCH INTO THE HOLE DRILLED IN THE
RIVET AND TILT THE PUNCH TO BREAK OFF THE RIVET
HEAD



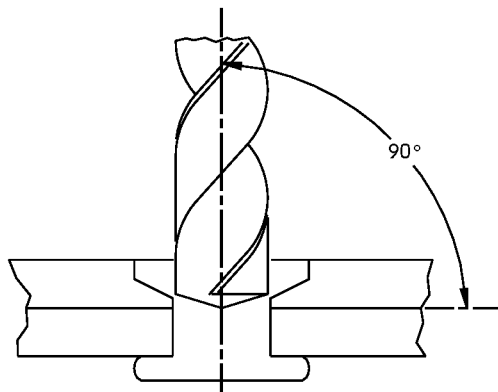
STEP NO. 5

DRIVE OUT THE RIVET SHANK WITH A DRIFT PUNCH
AND HAMMER. USE A BLOCK OF WOOD OR A BUCKING
BAR AS A BACKUP SUPPORT.

REMOVAL OF PROTRUDING HEAD RIVETS DETAIL I

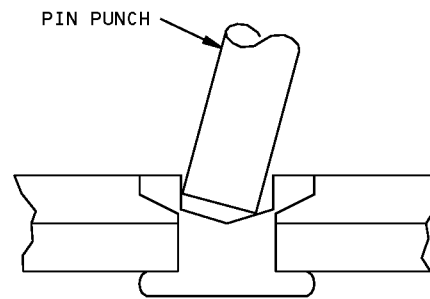
Removal of Solid Shank Rivets Figure 8 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



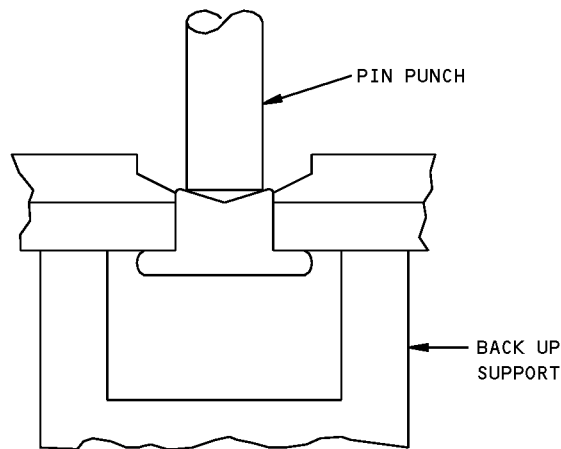
STEP NO. 1

SELECT A DRILL THE SAME SIZE AS THE RIVET HOLE. CENTER THE DRILL ON THE MANUFACTURED HEAD AND DRILL THROUGH THE HEAD OF THE RIVET AS SHOWN.



STEP NO. 2

INSERT A PIN PUNCH INTO THE HOLE DRILLED IN THE RIVET AND EXERT A PRYING MOTION TO BREAK OFF THE MANUFACTURED HEAD OF THE RIVET.



STEP NO. 3

USE A PIN PUNCH AND HAMMER TO DRIVE OUT THE RIVET SHANK WHILE SUPPORTING THE OPPOSITE SIDE OF THE STRUCTURE.

NOTE: WHEN REMOVING RIVETS IT IS IMPORTANT TO AVOID DAMAGING THE INITIAL COUNTERBORE, HOLE, OR ADJACENT STRUCTURE.

REMOVAL OF BACR15FV AND MS14218 RIVETS DETAIL II

Removal of Solid Shank Rivets Figure 8 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

NOMINAL RIVET DIA	A	B	C	
1/8	±0.020	+0.015	+0.020	-0.010
5/32	±0.020	+0.020	+0.020	-0.010
3/16	±0.020	+0.025	+0.020	-0.010
1/4	±0.020	+0.030	+0.020	-0.010

STEM AND COLLAR PROTRUSION LIMITS FOR NAS1398, NAS1399, NAS1738, AND NAS1739 BLIND RIVETS

TABLE I **A**

NOMINAL BOLT DIA	A	B	C
5/32	±0.017	-	±0.010
3/16	±0.022	-	±0.012
1/4	±0.029	-	±0.015
5/16	±0.037	-	±0.019
3/8	±0.045	-	±0.023
7/16	±0.050	-	±0.027
1/2	±0.056	-	±0.031

STEM AND COLLAR PROTRUSION LIMITS FOR MS21140, MS21141, MS90353, AND MS90354 BLIND BOLTS

TABLE II **A**

NOMINAL RIVET DIAMETER INCH	A	B	C	
1/8	+0.005	---	+0.010	-0.015
5/32	+0.005	---	+0.010	-0.020
3/16	+0.005	---	+0.010	-0.020

STEM AND COLLAR PROTRUSION LIMITS FOR BACR15FP AND BACR15FR BLIND RIVETS

TABLE III **A** **B**

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-3
- SEE TABLES I THRU III FOR STEM AND COLLAR PROTRUSION LIMITS
- SEE DETAILS IV AND V FOR GAP ANALYSIS

A SEE DETAILS I AND II FOR VALUES THAT FOLLOW:

- A = MAXIMUM ALLOWABLE DISTANCE OF LOCKING COLLAR ABOVE (+) OR BELOW (-) FASTENER HEAD
- B = MAXIMUM ALLOWABLE DISTANCE OF LOCKING COLLAR ABOVE TOP OF LAND ON STEM
- C = MAXIMUM ALLOWABLE DISTANCE OF TOP OF LAND ON STEM ABOVE (+) OR BELOW (-) FASTENER HEAD

B SEE DETAIL III FOR THE LOCKRING FLASH POSITION

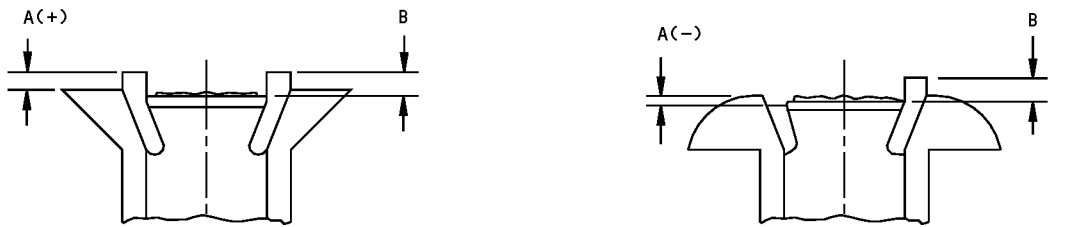
C EVALUATE GAPS AS FOLLOWS:

- THE HEADS OF ALL PROTRUDING-HEAD FASTENERS MUST SEAT SO THAT A 0.003-INCH THICK SHIM DOES NOT CONTACT THE FASTENER SHANK WHEN INSPECTED AS SHOWN IN DETAIL V. CONTACT WITH THE SHANK IS INDICATED WHEN THE SHIM DOES NOT WEDGE AND WILL SLIDE FREELY UNDER THE HEAD AS SHOWN IN DETAIL V. THE HEADS OF PROTRUDING-HEAD BLIND BOLTS MUST SEAT IN AT LEAST ONE LOCATION ON THE PERIPHERY OF THE HEAD AND THE REMAINING GAP SHALL BE IN ACCORDANCE WITH DETAIL V USING THE SHIM THICKNESS SHOWN IN TABLE IV.
- THE HEADS OF ALL FLUSH-HEAD FASTENERS MUST SEAT SO THAT:
 - A 0.003-INCH THICK SHIM CANNOT BE INSERTED BETWEEN THE FASTENER HEAD AND THE COUNTERSINK FOR MORE THAN 40 PERCENT OF THE CIRCUMFERENCE OF THE HEAD.
 - A 0.003-INCH THICK SHIM DOES NOT CONTACT THE FASTENER SHANK WHEN INSPECTED AS SHOWN IN DETAIL VI.

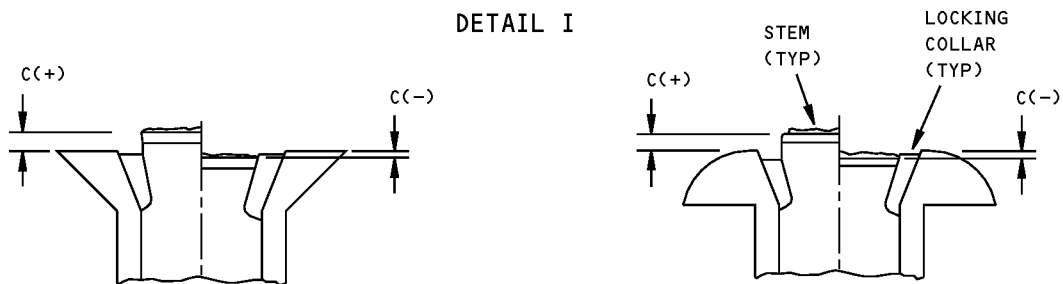
Installation of Blind Bolts and Blind Rivets

Figure 9 (Sheet 1 of 3)

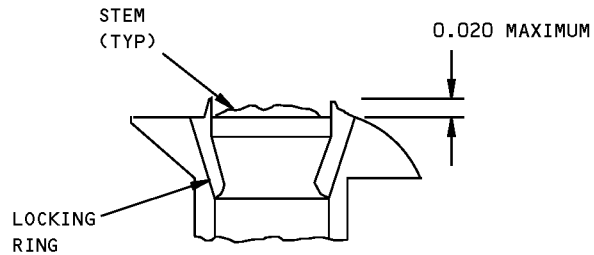
757-200
STRUCTURAL REPAIR MANUAL



LOCKING COLLAR PROTRUSION LIMITS
DETAIL I



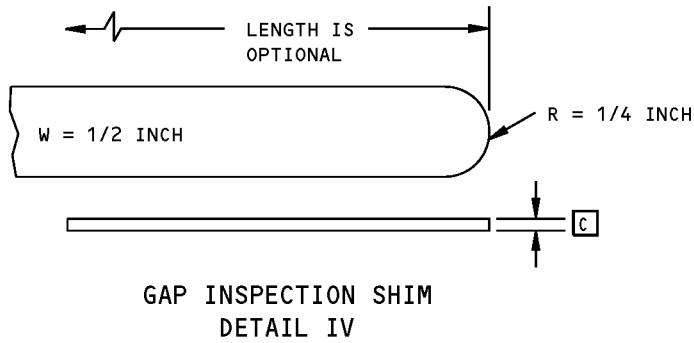
STEM PROTRUSION LIMITS
DETAIL II



LOCKING RING FLASH POSITION (BACR15FP AND BACR15FR)
DETAIL III

Installation of Blind Bolts and Blind Rivets
Figure 9 (Sheet 2 of 3)

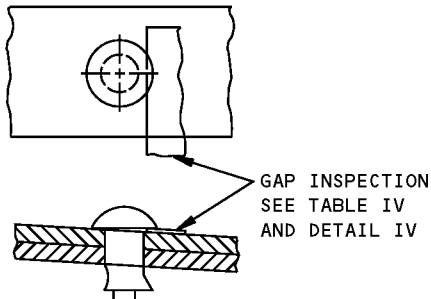
757-200 STRUCTURAL REPAIR MANUAL



NOMINAL FASTENER DIAMETER (INCH)	SHIM THICKNESS T + 0.0005 - 0.0000
5/32	0.004
3/16	0.005
1/4	0.006
5/16	0.007
3/8	0.008
7/16	0.009
1/2	0.010

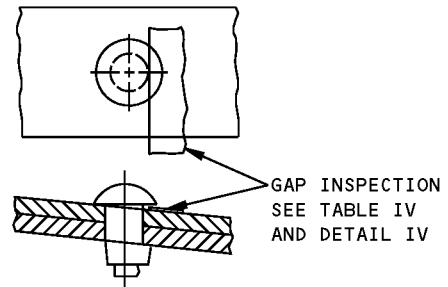
SHIM THICKNESS FOR BLIND BOLTS
TABLE IV

GAP INSPECTION
SHIM WEDGES AND DOES
NOT MOVE FREELY IN
THIS DIRECTION



SATISFACTORY

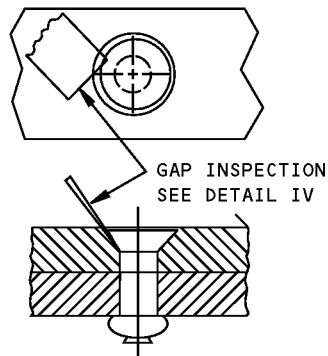
GAP INSPECTION
SHIM CONTACTS SHANK
AND MOVES FREELY
IN THIS DIRECTION



UNSATISFACTORY

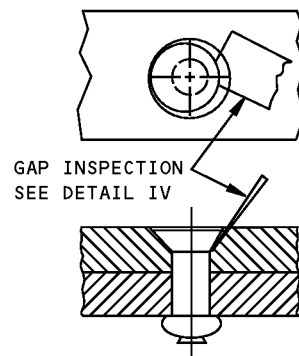
GAP ANALYSIS FOR PROTRUDING HEAD FASTENERS
DETAIL V

GAP INSPECTION SHIM FINDS A GAP
UNDER THE HEAD BUT DOES NOT TOUCH
THE SHANK. NO MORE THAN 40 PERCENT
OF THE HEAD PERIPHERY CAN HAVE A
A GAP THAT THE SHIM CAN FIND.



SATISFACTORY

GAP INSPECTION SHIM TOUCHES THE SHANK



UNSATISFACTORY

GAP ANALYSIS FOR FLUSH HEAD FASTENERS
DETAIL VI

Installation of Blind Bolts and Blind Rivets Figure 9 (Sheet 3 of 3)

STRUCTURAL REPAIR MANUAL

BLIND RIVET REMOVAL INSTRUCTIONS

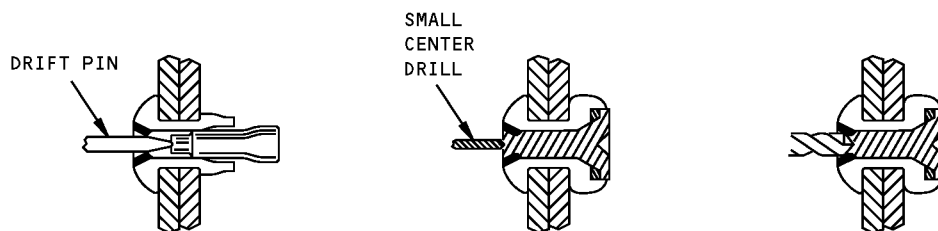
1. For fasteners installed in thick material, remove the lock by driving out the rivet stem with a tapered steel drift pin. Refer to Detail I.

NOTE: If the rivets were installed in thin sheets, driving out the locked stem may cause damage to the sheets. The recommended procedure is to use a small drill as a guide for a larger drill on top of the rivet stem, and the tapered portion of the stem to drill and destroy the lock.

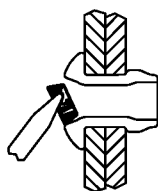
2. Pry the rest of the locking collar out of the rivet head with the drift pin. Refer to Detail II.

CAUTION: DO NOT DRILL COMPLETELY THROUGH THE RIVET SLEEVE TO REMOVE THE RIVET. IF YOU DO, DAMAGE WILL OCCUR FROM AN ENLARGED HOLE.

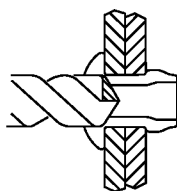
3. Drill (nearly completely) through the head of the rivet with a drill that is the same size as the rivet shank. Refer to Detail III.
4. Break off the rivet head. Use the drift pin as a pry tool. Refer to Detail IV.
5. Drive out the rivet shank that remains with a pin that has the same diameter as the rivet shank. Refer to Detail V.



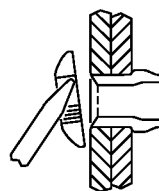
DETAIL I



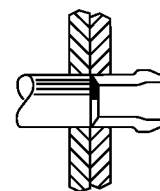
DETAIL II



DETAIL III



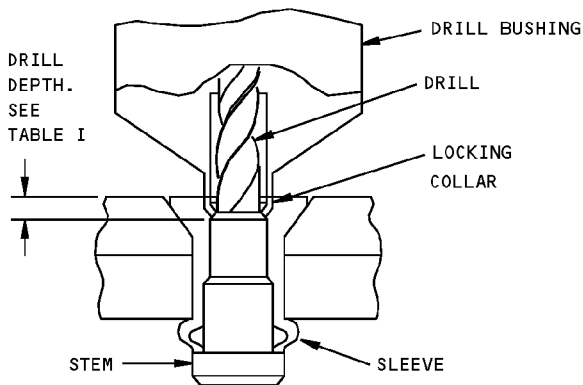
DETAIL IV



DETAIL V

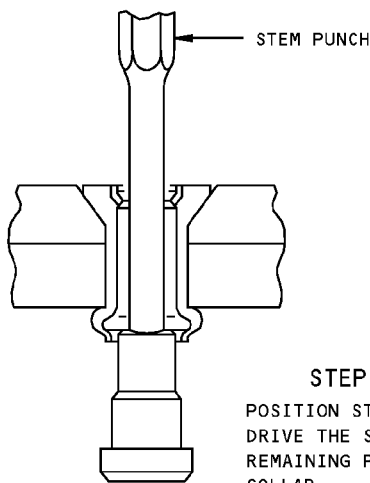
Removal of Blind Rivets Figure 10

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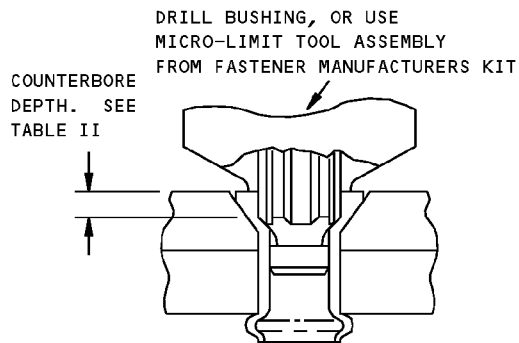
STEP NO. 1

PLACE DRILL BUSHING SQUARELY ON THE LOCKING COLLAR AND DRILL THE STEM TO THE DEPTH SHOWN IN TABLE I



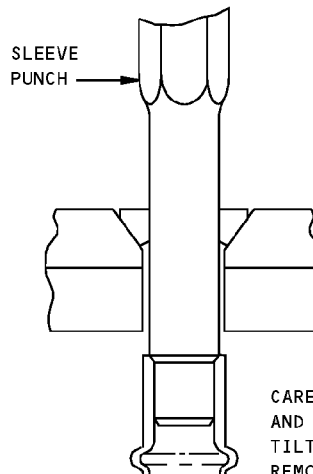
STEP NO. 2

POSITION STEM PUNCH AND DRIVE THE STEM OUT. REMOVE REMAINING PORTION OF LOCKING COLLAR



STEP NO. 3

COUNTERBORE SLEEVE TO THE DEPTH SHOWN IN TABLE II



STEP NO. 4

CAREFULLY POSITION SLEEVE PUNCH AND DRIVE OUT THE SLEEVE. TILT THE PUNCH SLIGHTLY AND REMOVE FASTENER HEAD.

NOTE: WHEN USING DRILL BUSHING, ENSURE THAT CONCENTRICITY IS MAINTAINED WITH DIAMETER OF BOLT

NOMINAL BOLT DIA	DRILL DEPTH
5/32	0.070/0.050
3/16	0.090/0.070
1/4	0.110/0.090
5/16	0.130/0.110
3/8	0.150/0.130

TABLE I

NOMINAL BOLT DIA	COUNTERBORE DEPTH	
	PROTRUDING HEAD	FLUSH HEAD
5/32	0.065/0.055	0.067/0.057
3/16	0.130/0.120	0.075/0.065
1/4	0.135/0.125	0.100/0.090
5/16	0.136/0.126	0.132/0.122
3/8	0.200/0.190	0.160/0.150

TABLE II

Removal of Blind Bolts Figure 11

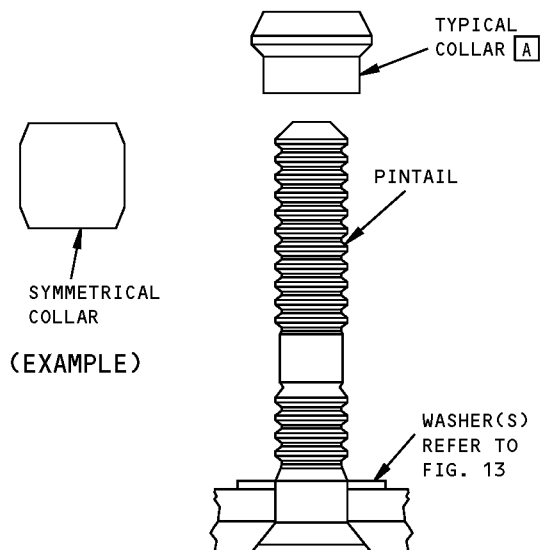
757-200
STRUCTURAL REPAIR MANUAL

NOTES

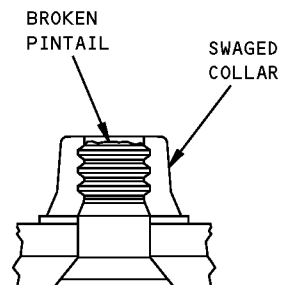
- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-2.
 - SEE DETAIL I FOR LOCKBOLT INSTALLATION.
 - SEE DETAILS II AND III FOR HEX-DRIVE BOLT INSTALLATION.
 - PULL-TYPE, SHEAR, LIGHTWEIGHT TITANIUM LOCK-BOLTS MUST BE INSTALLED WITH TOOLS THAT ARE FITTED WITH SWAGE DIES AS SHOWN IN TABLE I AND DETAIL IV (OR EQUIVALENT TOOLS).
 - SEE TABLE II AND DETAIL V FOR HEAD DISHING SPECIFICATIONS.
 - SEE TABLE III AND DETAILS VI AND VII FOR GAP ANALYSIS.
 - REFER TO FIGURE 13 FOR WASHER INSTALLATION.
 - REFER TO FIGURE 14 FOR PIN PROTRUSION AND COLLAR LIMITS.
 - COLLARS WITH SELF RETAINING FEATURES (FOR EXAMPLE: BACC30BK()R AND BACC30BF()R MUST BE POINTED SO THAT THE RETAINING FEATURE POINTS AWAY FROM THE STRUCTURE. DO NOT USE THESE COLLARS INSIDE OF FUEL TANKS.
 - PULL-TYPE SHEAR AND TENSION STANDARD LOCK-BOLTS MUST BE INSTALLED WITH PULL TOOLS FITTED WITH SWAGE DIES HAVING ST10-1027G, (OR EQUIVALENT), CAVITY CONFIGURATION.
- A** TYPICAL COLLARS ARE NOT SYMMETRICAL AND MUST BE INSTALLED AS SHOWN IN DETAIL I. IF THE COLLAR IS SYMMETRICAL IN SHAPE, IT WILL NOT BE IMPORTANT WHICH END IS AGAINST THE STRUCTURE. EXAMPLES OF SYMMETRICAL COLLARS ARE: BACC30BE, BACC30BF, BACC30L, BACC30K, BACC30BK, NAS1080C04, NAS1080C05, NAS1080E04, NAS1080E05, NAS1080MG04, NAS1080MG05, AND NAS1080K

Lockbolt and Hex-Drive Bolt Installation
Figure 12 (Sheet 1 of 6)

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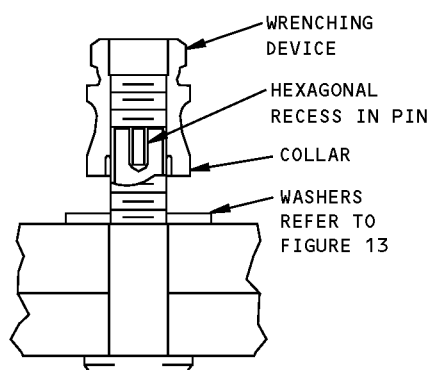
PULL TYPE
BEFORE INSTALLATION



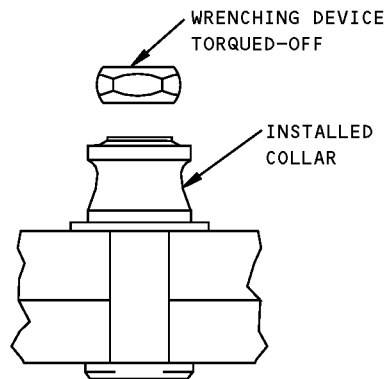
PULL TYPE
AFTER INSTALLATION

LOCKBOLT INSTALLATION

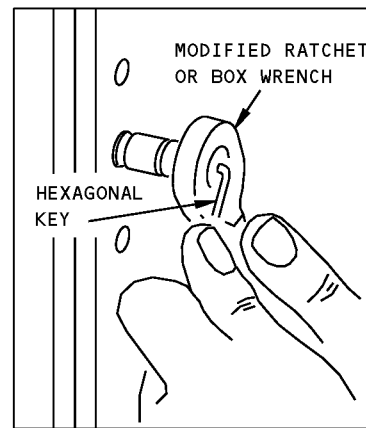
DETAIL I



BEFORE INSTALLATION



AFTER INSTALLATION

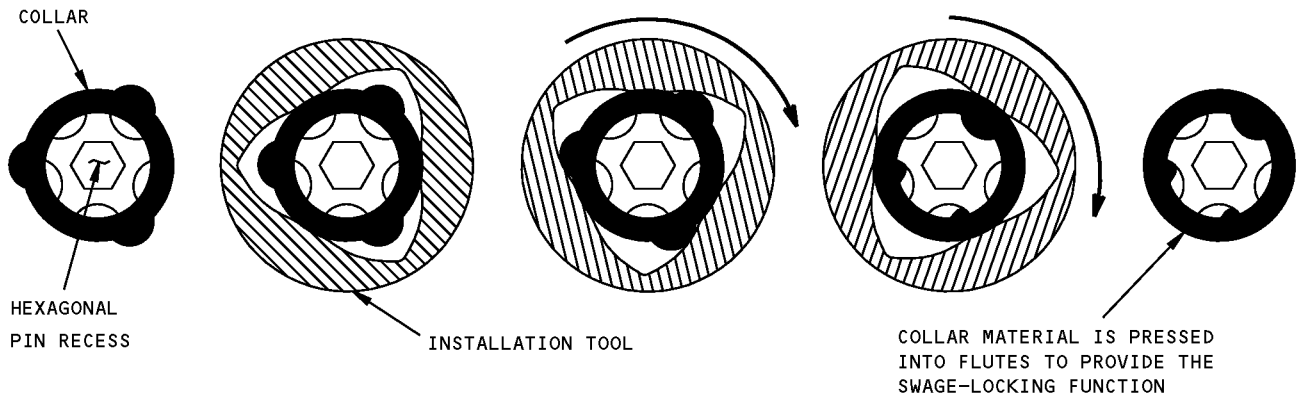
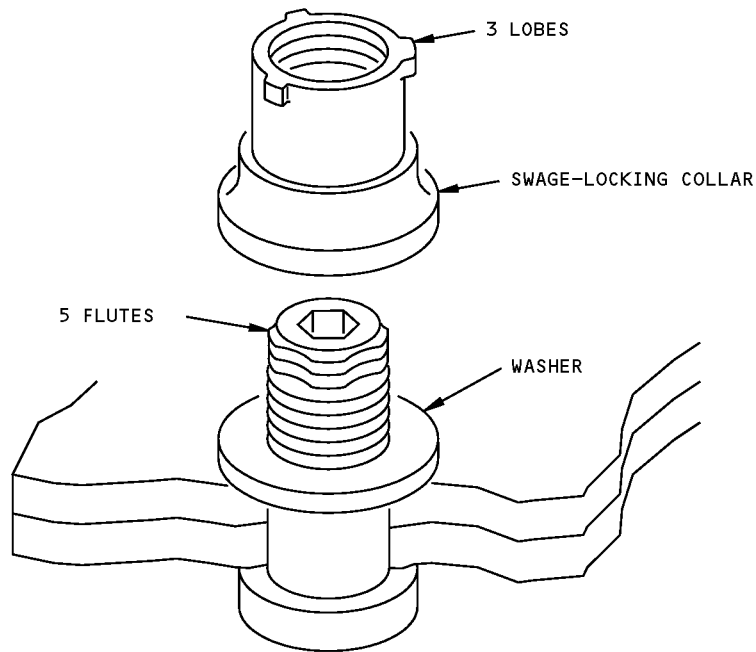


HEX-DRIVE BOLT INSTALLATION

DETAIL II

Lockbolt and Hex-Drive Bolt Installation
Figure 12 (Sheet 2 of 6)

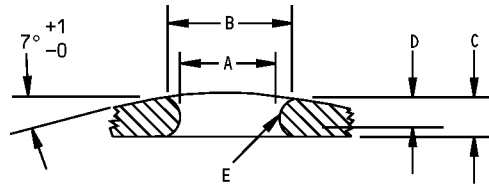
**757-200
STRUCTURAL REPAIR MANUAL**



**INSTALLATION WITH SWAGE-LOCKING COLLAR AND
SWAGE-LOCKING (FLUTED SHANK) BOLT
DETAIL III**

**Lockbolt and Hex-Drive Bolt Installation
Figure 12 (Sheet 3 of 6)**

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STRUCTURAL REPAIR MANUAL



LIGHTWEIGHT LOCKBOLT SWAGE DIE DIMENSIONS
DETAIL IV

NOMINAL DIAMETER	A +0.0010 -0.0000	B +0.0030 -0.0000	C +0.0015 -0.0005	D REFERENCE	E +0.0010 -0.0000 RADIUS
5/32	0.2219	0.2580	0.103	0.0661	0.121
3/16	0.2450	0.2813	0.120	0.0670	0.130
1/4	0.3241	0.3722	0.157	0.0928	0.188
5/16	0.4062	0.4667	0.195	0.1201	0.250
3/8	0.4797	0.5525	0.233	0.1469	0.311

LIGHTWEIGHT LOCKBOLT SWAGE DIE DIMENSIONS (INCH)
TABLE I

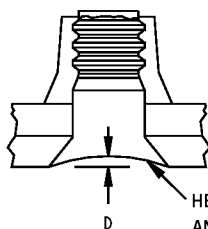
Lockbolt and Hex-Drive Bolt Installation
Figure 12 (Sheet 4 of 6)

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STRUCTURAL REPAIR MANUAL

FASTENER TYPE	FASTENER MATERIAL	NOMINAL DIAMETER	D (MAX)
PULL TYPE SHEAR HEAD LOCKBOLTS	ALUMINUM AND ALLOY STEEL	3/16	0.012
		1/4	0.012
		5/16	0.010
		3/8 AND LARGER	0.007
	A286 CRES	ALL	0.008
PULL-TYPE TENSION HEAD LOCKBOLTS	TITANIUM	ALL	0.004
ALL OTHERS	ALL	ALL	0.004

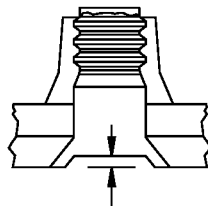
FASTENER HEAD DISH LIMITS

TABLE II



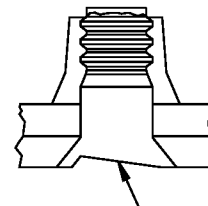
HEAD DISH SMOOTH
AND UNIFORM. SEE
TABLE II

PERMITTED



HEAD DISH WITH A
DISTINCT RING

NOT PERMITTED



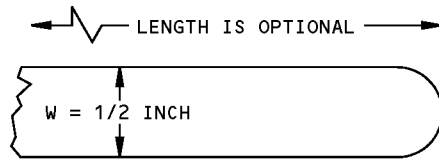
HEAD DISH WITH A
SUDDEN CHANGE
IN CONTOUR

NOT PERMITTED

**HEAD DISHING LIMITATIONS FOR FLUSH HEAD LOCKBOLTS
AND HEX-DRIVE BOLTS
DETAIL V**

Lockbolt and Hex-Drive Bolt Installation
Figure 12 (Sheet 5 of 6)

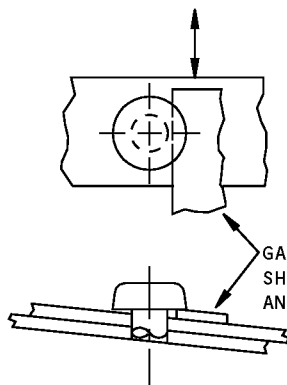
757-200 STRUCTURAL REPAIR MANUAL



USE 0.003 -0.0000/+0.0005 INCH SHIM TO FIND GAPS AROUND INSTALLED FLUSH HEADS. FOR GAPS UNDER COLLARS, NUTS AND PROTRUDING HEADS, SEE TABLE III

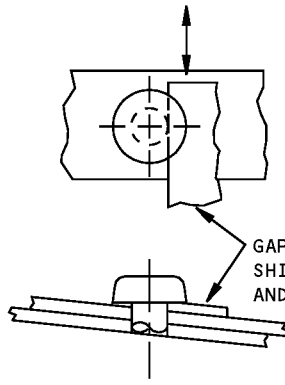
GAP INSPECTION SHIM
DETAIL VI

GAP INSPECTION SHIM
WEDGES AND DOES NOT MOVE
FREELY IN THIS DIRECTION



SATISFACTORY
FOR PROTRUDING HEADS, AND
NON SELF-ALIGNING NUTS AND
COLLARS FOR HEX-DRIVE BOLTS

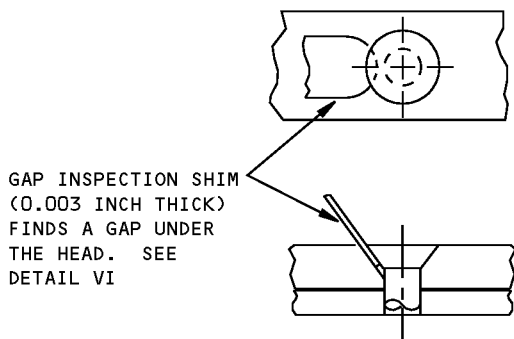
GAP INSPECTION SHIM
TOUCHES SHANK OR MOVES
FREELY IN THIS DIRECTION



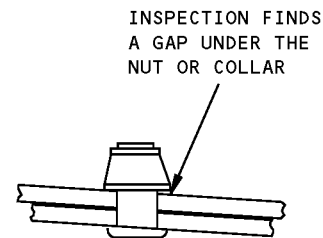
UNSATISFACTORY
FOR PROTRUDING HEADS, AND
NON SELF-ALIGNING NUTS,
AND COLLARS

NOMINAL FASTENER DIAMETER	SHIM THICKNESS +0.0005 -0.0000
5/32	0.164
3/16	0.190
1/4	0.250
5/16	0.313
3/8	0.375
7/16	0.438
1/2	0.500
9/16	0.563
5/8	0.625
3/4	0.750
7/8	0.875
1	1.000

SHIM STOCK SIZE FOR
COLLARS, NUTS AND
PROTRUDING HEADS OF
LOCKBOLTS AND HEX-DRIVE
FASTENERS
TABLE III



UNSATISFACTORY
FOR FLUSH HEADS



UNSATISFACTORY
FOR LOCKBOLTS AND SELF-ALIGNING
NUTS AND COLLARS FOR HEX-DRIVE BOLTS

GAP ANALYSIS FOR LOCKBOLTS AND HEX-DRIVE BOLTS
DETAIL VII

Lockbolt and Hex-Drive Bolt Installation
Figure 12 (Sheet 6 of 6)

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STRUCTURAL REPAIR MANUAL

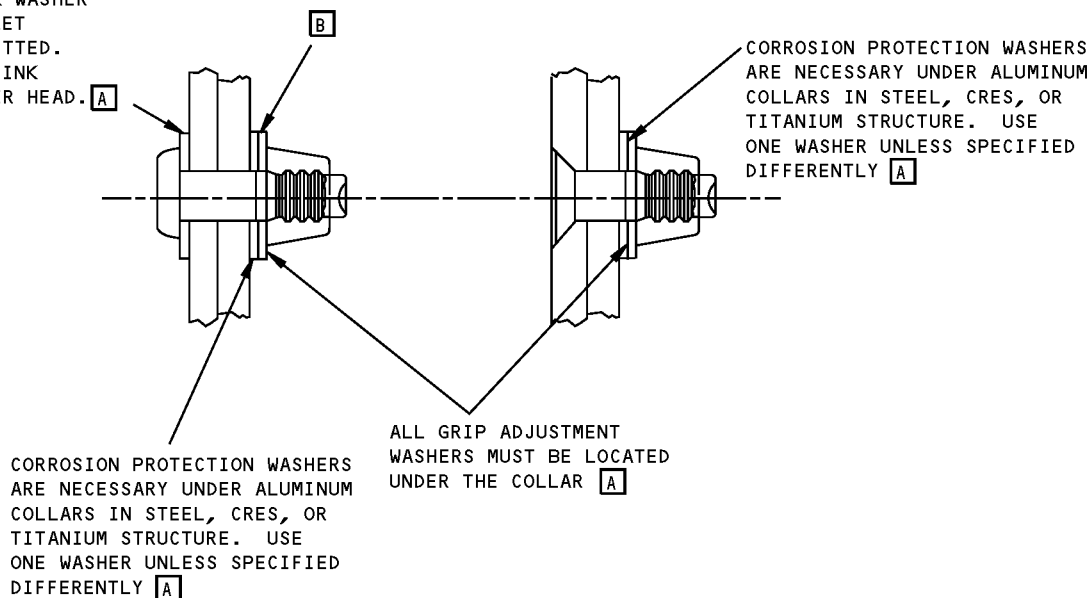
NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-2
- SEE DETAILS I AND II FOR WASHER LIMITATIONS
- [A]** SEE TABLE I FOR THE CORRECT WASHER MATERIAL. SEE TABLE II FOR WASHER PART NUMBERS.
- [B]** DO NOT USE MORE THAN TWO WASHERS UNDER A LOCKBOLT COLLAR. (THIS INCLUDES THE CORROSION PROTECTION WASHER). SEE DETAILS III AND IV FOR ADDITIONAL INFORMATION ON WASHERS USED WITH LOCKNUTS AND HEX-DRIVE BOLTS.
- [C]** ALUMINUM WASHERS MUST BE ALODINE COATED AS GIVEN IN SRM 51-20-01
- [D]** LOCATE CORROSION PROTECTION WASHER NEXT TO STRUCTURE WHEN A SECOND WASHER IS USED FOR GRIP ADJUSTMENT (EXCEPT AS NOTED)
- [E]** LOCATE GRIP ADJUSTMENT WASHER NEXT TO COLLAR WHEN USED WITH A CORROSION PROTECTION WASHER
- [F]** USE AN UNPLATED CRES WASHER NEXT TO STRUCTURE AND A CAD PLATED CRES WASHER NEXT TO COLLAR
- [G]** A MAXIMUM OF TWO WASHERS IS ALLOWED UNDER COLLAR
- [H]** FOR MAXIMUM HEAD DISHING (D) ALLOWED SEE TABLE II
- [I]** 5052 ALUMINUM WASHER IS MANDATORY UNDER PROTRUDING FASTENER HEAD IF HEAD END BEARS ON MAGNESIUM.
- [J]** CAD PLATED WASHER MUST NOT COME IN CONTACT WITH THE TITANIUM STRUCTURE. IT IS TO BE USED BETWEEN THE CRES UNPLATED WASHER AND THE ALUMINUM COLLAR OR NUT.
- [K]** DO NOT USE ALUMINUM WASHERS WITH NON-ALUMINUM TENSION FASTENERS. (EXAMPLE: BACB30NX/NY BOLTS WITH BACC30BH OR BACC30X COLLARS)

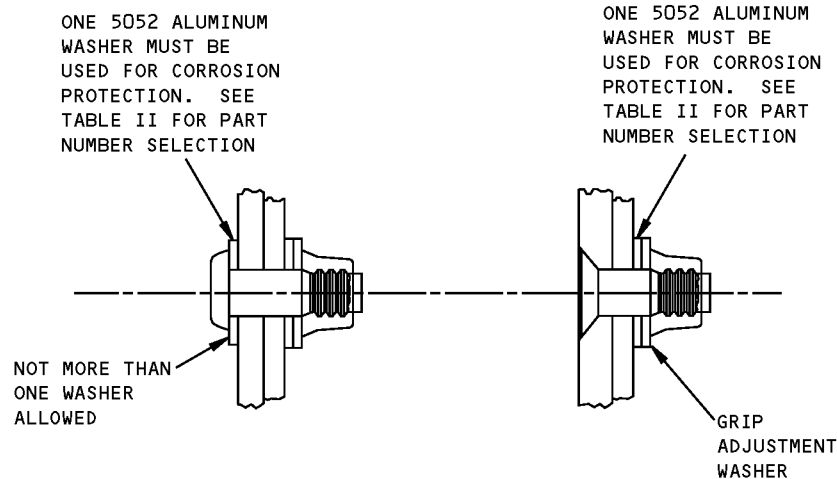
Washers with Lockbolts and Hex-Drive Bolts
Figure 13 (Sheet 1 of 5)

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ONE COUNTERSUNK WASHER
TO PROVIDE FILLET
RELIEF IS PERMITTED.
LOCATE COUNTERSINK
NEXT TO FASTENER HEAD. **A**



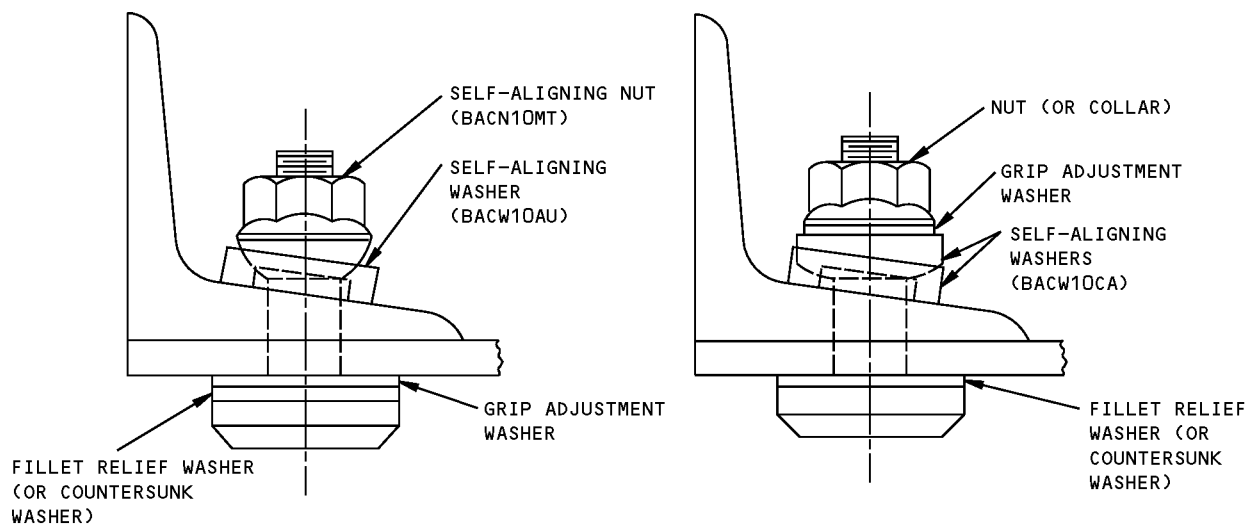
WASHER LIMITATIONS FOR STEEL, ALUMINUM, AND TITANIUM STRUCTURES DETAIL I



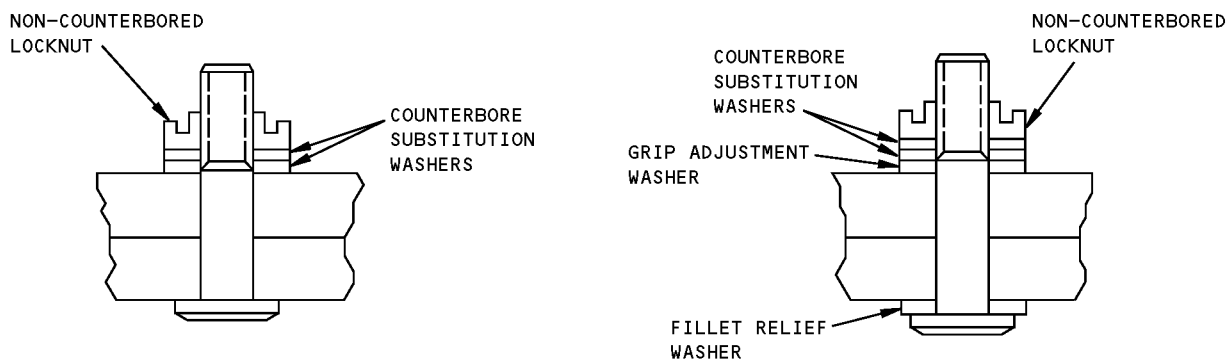
WASHER LIMITATIONS FOR MAGNESIUM STRUCTURES DETAIL II

Washers with Lockbolts and Hex-Drive Bolts Figure 13 (Sheet 2 of 5)

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STRUCTURAL REPAIR MANUAL



USE OF WASHERS WITH SELF-ALIGNING NUTS AND SELF-ALIGNING WASHERS
DETAIL III



USE OF COUNTERBORE SUBSTITUTION WASHERS
DETAIL IV

Washers with Lockbolts and Hex-Drive Bolts
Figure 13 (Sheet 3 of 5)

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COLLAR OR NUT MATERIAL	STRUCTURE MATERIAL	CORROSION PROTECTION WASHER MATERIAL [D] [G] (MANDATORY)	COUNTERBORE SUBSTITUTION OR GRIP ADJUSTMENT WASHER MATERIAL [E] [G]	FILLET RELIEF WASHER (LOCATE NEXT TO STRUCTURE)	SELF- ALIGNING WASHER (LOCATE NEXT TO STRUCTURE)
ALUMINUM	ALUMINUM	NONE	2024 AL [C] OR CAD PLATED CRES	2024 OR 7075	CAD PLATED CRES
	STEEL	CAD PLATED CRES	2024 AL [C] OR CAD PLATED CRES	CAD PLATED CRES	CAD PLATED CRES
	CRES	CAD PLATED CRES	2024 AL [C] OR CAD PLATED CRES	UNPLATED CRES	CAD PLATED CRES [J]
	TITANIUM	[F] [J]	2024 AL [C] OR CAD PLATED CRES	UNPLATED CRES	CAD PLATED CRES [J]
	MAGNESIUM	5052 AL [I]	2024 AL [C]	5052 AL [I]	---
CAD PLATED STEEL, CAD PLATED CRES, OR CAD PLATED NICKEL-COPPER ALLOY	ALUMINUM	NONE	2024 AL [C] OR CAD PLATED CRES	2024 OR 7075 AL OR CAD PLATED CRES	CAD PLATED CRES
	STEEL	NONE	UNPLATED CRES	UNPLATED CRES	CAD PLATED CRES
	CRES	NONE	UNPLATED CRES	UNPLATED CRES	CAD PLATED CRES
	TITANIUM	UNPLATED CRES	UNPLATED CRES	UNPLATED CRES	---
	MAGNESIUM	5052 AL [I]	2024 AL [C] OR CAD PLATED CRES	5052 AL [I]	---
UNPLATED CRES OR UNPLATED NICKEL-COPPER ALLOY	ALUMINUM	CAD PLATED CRES	CAD PLATED CRES	2024 OR 7075 AL OR CAD PLATED CRES	CAD PLATED CRES
	STEEL	CAD PLATED CRES	CAD PLATED CRES	CAD PLATED CRES	CAD PLATED CRES
	CRES	NONE	UNPLATED CRES	UNPLATED CRES	UNPLATED CRES
	TITANIUM	NONE	UNPLATED CRES	UNPLATED CRES	UNPLATED CRES
	MAGNESIUM	5052 AL [I]	CAD PLATED CRES	5052 AL [I]	---

WASHER MATERIAL [K]
TABLE I

Washers with Lockbolts and Hex-Drive Bolts
Figure 13 (Sheet 4 of 5)



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STRUCTURAL REPAIR MANUAL

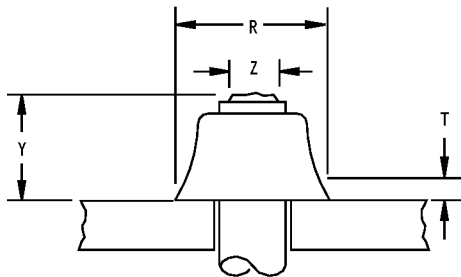
PLAIN WASHER MATERIAL	WASHER PART NUMBERS (REF)			
	NOMINAL	0.0156 O.S.	0.0312 O.S.	0.0468 O.S.
STEEL OR CRES CAD PLATED	NAS1149E()P BACW10BN()SP	BACW10BP()1DP BACW10BP()1DPN	BACW10BP()2DP BACW10BP()2DPU	USE NEXT LARGER STANDARD SIZE
2024 ALUMINUM	BACW10BN()AP NAS1149D()J	BACW10AW()AS BACW10AW()AST BACW10BN()1AP	BACW10AW()AS BACW10AW()AST BACW10BN()2AP	BACW10AW30()AS BACW10AW30()AST
5052 ALUMINUM	BACW10BN()ANP NAS620A() NAS1197-()	BACW10AW()AN BACW10AW()ANT BACW10BN()1ANP	BACW10AW10()AN BACW10AW10()ANT BACW10BN()2ANP	BACW10AW30()AN BACW10AW30()ANT
CRES UNPLATED	BACW10BN()UP BACW10BP()APU BACW10BP()PTU NAS620C() NAS1149E()R	BACW10BP()1APU BACW10BP()1PTU	BACW10BP()2APU BACW10BP()2PTU	USE NEXT LARGER STANDARD SIZE.
COUNTERSUNK WASHER MATERIAL	WASHER PART NUMBERS (REF)			
	NOMINAL	0.0156 O.S.	0.0312 O.S.	0.0466 O.S.
STEEL OR CRES CAD PLATED	BACW10CT()C	BACW10CT()1C	BACW10CT()2C	USE NEXT LARGER STANDARD SIZE.
2024 OR 7075 ALUMINUM	BACW10CT()D BACW10CT()J	BACW10AW-C()AS BACW10CT()1J	BACW10AW-C10()AS BACW10CT()2D BACW10CT()2J	BACW10AW-C30()AS
5052 ALUMINUM	BACW10BN()ANC	BACW10AW-C()AN	BACW10AW-C10()AN	BACW10AW-C30()AN
CRES UNPLATED	BACW10CT()CU	BACW10()1CU	BACW10CT()2CU	USE NEXT LARGER STANDARD SIZE.

WASHER PART NUMBER REFERENCE K
TABLE II

Washers with Lockbolts and Hex-Drive Bolts
Figure 13 (Sheet 5 of 5)

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STRUCTURAL REPAIR MANUAL



- R = SWAGED COLLAR REFERENCE DIA.
T = MAXIMUM HEIGHT OF R DIA ABOVE SHEET OR WASHER.
Y = PIN PROTRUSION-HEIGHT OF Z DIA ABOVE SHEET OR WASHER.
Z = REFERENCE DIA LOCATES MEASURING POINT FOR Y.

TENSION, PULL TYPE LOCKBOLTS AND COLLARS A DETAIL I

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE IS FOUND IN BOEING PROCESS SPECIFICATION BAC5004-2.
- SEE DETAIL I FOR LOCKBOLTS
- SEE DETAILS VI AND VII FOR HEX-DRIVE BOLTS

A SEE TABLE I FOR LIGHTWEIGHT LOCKBOLTS AND TABLE II FOR TENSION, PULL TYPE LOCKBOLTS. SEE TABLE III FOR SHEAR, PULL TYPE LOCKBOLTS.

B SEE DETAIL III FOR HG85-10, HG99-(), AND HG100-().

C BOTH ENDS OF THE GAGE MUST ACCEPT.

D PIN PROTRUSION IS MEASURED FROM THE STRUCTURE SURFACE WHEN COUNTERBORE SUBSTITUTION WASHERS ARE USED OR WHEN NO GRIP ADJUSTMENT WASHER IS PRESENT, AND FROM THE COLLAR/NUT SIDE SURFACE OF GRIP ADJUSTMENT WASHER(S) WHERE THESE WASHERS ARE USED. SEE TABLE IV.

E IF SELF-ALIGNING NUTS (EXAMPLE: BACN10MT) ARE USED ON SLOPED SURFACES, MEASURE PROTRUSION AS SHOWN. PIN PROTRUSION IS MEASURED FROM THE TOP OF SELF-ALIGNING WASHERS (EXAMPLE: BACW10CA) IF USED UNDER COLLAR OR NUT. SEE TABLE IV.

F PIN PROTRUSION IS MEASURED FROM THE PIN END ABOVE THE SHEET OR WASHER. SEE TABLE V

G THESE GAGES CAN BE PURCHASED FROM:
FAIRCHILD AEROSPACE FASTENER DIVISION
CHATSWORTH OPERATIONS
9631 DESOTO AVE.
CHATSWORTH, CA 91311-5013

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 1 of 12)



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STRUCTURAL REPAIR MANUAL

LOCKBOLT PART NO.	COLLAR PART NO.	Y		Z	R	T		GAGE NO.
		TOUCH GO	TOUCH NO GO			TOUCH GO	TOUCH NO GO	
BACB30VM5 BADB30VN5	BACC30BK5 (2024-T4)	0.131	0.237	0.124	0.234	0.039	0.112	HG110-05
BACB30VM6 BACB30VN6 BACB30XT6	BACC30BK6 (2024-T4)	0.134	0.250	0.152	0.262	0.031	0.113	HG110-06
BACB30VM8 BACB30VN8 BACB30XT8	BACC30BK8 (2024-T4)	0.193	0.301	0.209	0.344	0.058	0.139	HG110-08
BACB30VM10 BACB30VN10 BACB30XT10	BACC30BK10 (2024-T4)	0.252	0.367	0.259	0.436	0.072	0.145	HG110-10
BACB30VM12 BACB30VN12 BACB30XT12	BACC30BK12 (2024-T4)	0.304	0.419	0.322	0.512	0.103	0.172	HG110-12

LIGHTWEIGHT LOCKBOLT INSPECTION DIMENSION
TABLE I

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 2 of 12)



757-200
STRUCTURAL REPAIR MANUAL

LOCKBOLT PART NO.	COLLAR PART NO.	Y	Z	R	T	GAGE NO.
BACB30GP5 BACB30GQ5 NAS1525 NAS1535 (7075-T6)	NAS1080D05 (6061-T7)	0.230 0.167	0.136	0.253	0.030	HG85-7 ST8711D-5
BACB30DX5 BACB30DY5 NAS1465 NAS1475 (STEEL)	NAS1080R05 (STEEL) NAS1080-05 (2024-T4) NAS1080MG05 (NICKEL-COPPER ALLOY)	0.234 0.161	0.136	0.253	0.037	HG85-12 ST8711S-5
BACB30UA6 BACB30UB6 (TITANIUM)	BACC30BF6 (2024-T42)	0.406 0.271	0.160	0.285	0.095	HG100-06 ST8707A-06
BACB30GP6 BACB30GQ6 NAS1526 NAS1536 (7075-T6)	NAS1080D06 (6061-T7)	0.280 0.208	0.164	0.303	0.039	HG85-10 ST8711H-6
BACB30DX6 BACB30DY6 BACB30GX6 NAS1466 (STEEL)	NAS1080R06 (STEEL) BACC30Q6 NAS1080-06 (2024-T4)	0.280 0.208	0.164	0.303	0.039	HG85-10 ST8711H-6

STANDARD TENSION, PULL TYPE LOCKBOLT INSPECTION DIMENSION
TABLE II

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 3 of 12)



757-200
STRUCTURAL REPAIR MANUAL

LOCKBOLT PART NO.	COLLAR PART NO.	Y	Z	R	T	GAGE NO.
BACB30TY6 BACB30TZ6	BACC30BE6 (2024-T73)	0.343 0.228	0.160	0.285	0.094	HG99-06 ST8728B-06
BACB30AU8 (BLIND)	NONE	0.280 0.208	0.164	0.303	0.039	HG85-10 ST8711H-6
BACB30UA8 BACB30UB8 (TITANIUM)	BACC30BF8 (2024-T42)	0.487 0.349	0.214	0.380	0.120	HG100-08 ST8707A-08
BACB30GP-8 BACB30GQ-8 NAS1528 NAS1538 (7075-T6)	NAS1080D08 (6061-T7)	0.374 0.295	0.224	0.400	0.038	HG85-2 ST8711DS-8
BACB30DX8 BACB30DY8 BACB30GX8 NAS1468 NAS1478 (STEEL)	NAS1080R08 (STEEL) BACC30Q8 NAS1080-08 (2024-T4)	0.374 0.295	0.224	0.400	0.038	HG85-2 ST8711DS-8
BACB30TY-8 BACB30TZ-8 (TITANIUM)	BACC30BE8 (2024-T73)	0.411 0.289	0.214	0.380	0.121	HG99-08 ST8728-B-08
BACB30AU10 (BLIND)	NONE	0.374 0.295	0.224	0.400	0.038	HG85-2 ST8711DS-8
BACB30UA10 BACB30UB10 (TITANIUM)	BACC30BF10 (2024-T42)	0.591 0.452	0.279	0.462	0.184	HG100-10 ST8707A-10
BACB30GP10 BACB30GQ10 NAS1530 NAS1540 (7075-T6)	NAS1080D10 (6061-T7)	0.459 0.339	0.268	0.486	0.083	HG85-3 ST8711D-10
BACB30DX10 BACB30DY10	NAS1080P10 (2024-T4)	0.492 0.404	0.268	0.473	0.110	HG85-8 ST8711F-10

STANDARD TENSION, PULL TYPE LOCKBOLT INSPECTION DIMENSION
TABLE II (CONT)

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 4 of 12)



757-200
STRUCTURAL REPAIR MANUAL

LOCKBOLT PART NO.	COLLAR PART NO.	Y	Z	R	T	GAGE NO.
BACB30GX10 NAS1470 NAS1480 (STEEL)	NAS1080R10 (STEEL)	0.492 0.404	0.268	0.473	0.110	HG85-8 ST8711F-10
BACB30TY10 BACB30TZ10 (TITANIUM)	BACC30BE10 (2024-T73)	0.496 0.385	0.278	0.462	0.150	HG99-10 ST8728B-10
BACB30UA12 BACB308B12 (TITANIUM)	BACC30BF12 (2024-T42)	0.642 0.503	0.341	0.572	0.156	HG100-12 ST8707A-12
BACB30GP12 BACB30GQ12 NAS1532 NAS1542 (7075-T6)	NAS1080D12 (6061-T7)	0.549 0.411	0.339	0.602	0.062	HG85-4 ST8711D-12
BACB30DX12 BACB30DY12 BACB30GX12 NAS1472 NAS1482 (STEEL)	NAS1080P12 (2024-T4) NAS1080R12 (STEEL)	0.604 0.507	0.339	0.576	0.120	HG85-9 ST8711F-12
BACB30TY12 BACB30TZ12 (TITANIUM)	BACC30BE12 (2024-T73)	0.531 0.420	0.339	0.572	0.146	HG99-12 ST8728-B-12

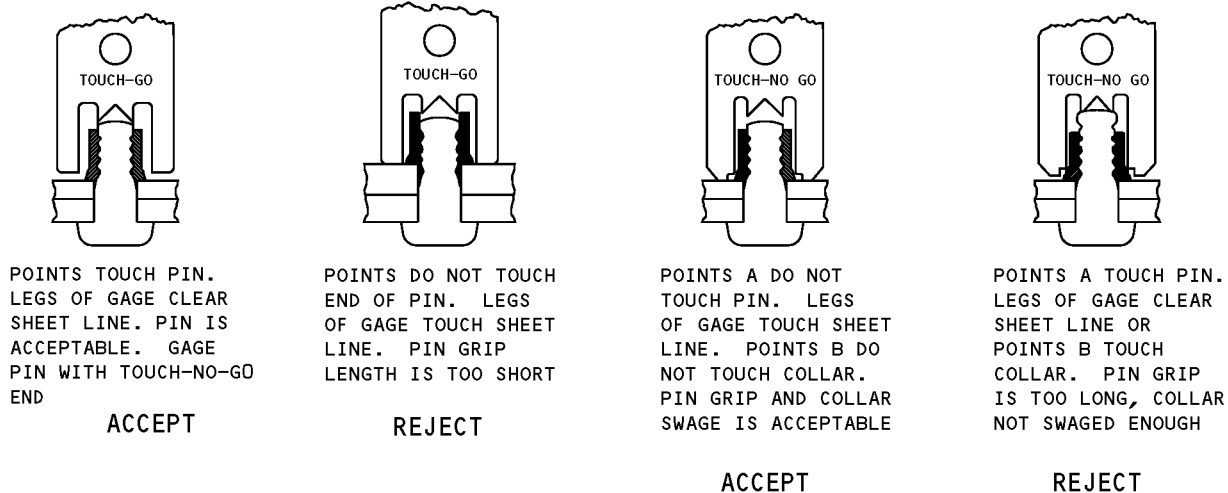
STANDARD TENSION, PULL TYPE LOCKBOLT INSPECTION DIMENSION
TABLE II (CONT)

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 5 of 12)

757-200 STRUCTURAL REPAIR MANUAL

LOCKBOLT PART NO.	COLLAR PART NO.	Y	Z	R	T	GAGE NO.
BACB30GW6 BACB30GY6 BACB30LD6	BACC30K6 (2024-T4) NAS1080E06 (STEEL)	0.264 0.191	0.164	N/A	N/A	HG77-14A
BACB30GW8 BACB30GY8 BACB30LD8	BACC30K8 (2024-T4) NAS1080E08 (STEEL)	0.243 0.316	0.224	N/A	N/A	HG77-13A
BACB30GW10 BACB30GY10 BACB30LD10	BACC30K10 (2024-T4) NAS1080E10 (STEEL)	0.341 0.268	0.268	N/A	N/A	HG76-3
BACB30GW12 BACB30GY12 BACB30LD12	BACC30K12 (2024-T4) NAS1080E12 (STEEL)	0.390 0.319	0.339	N/A	N/A	HG77-17A

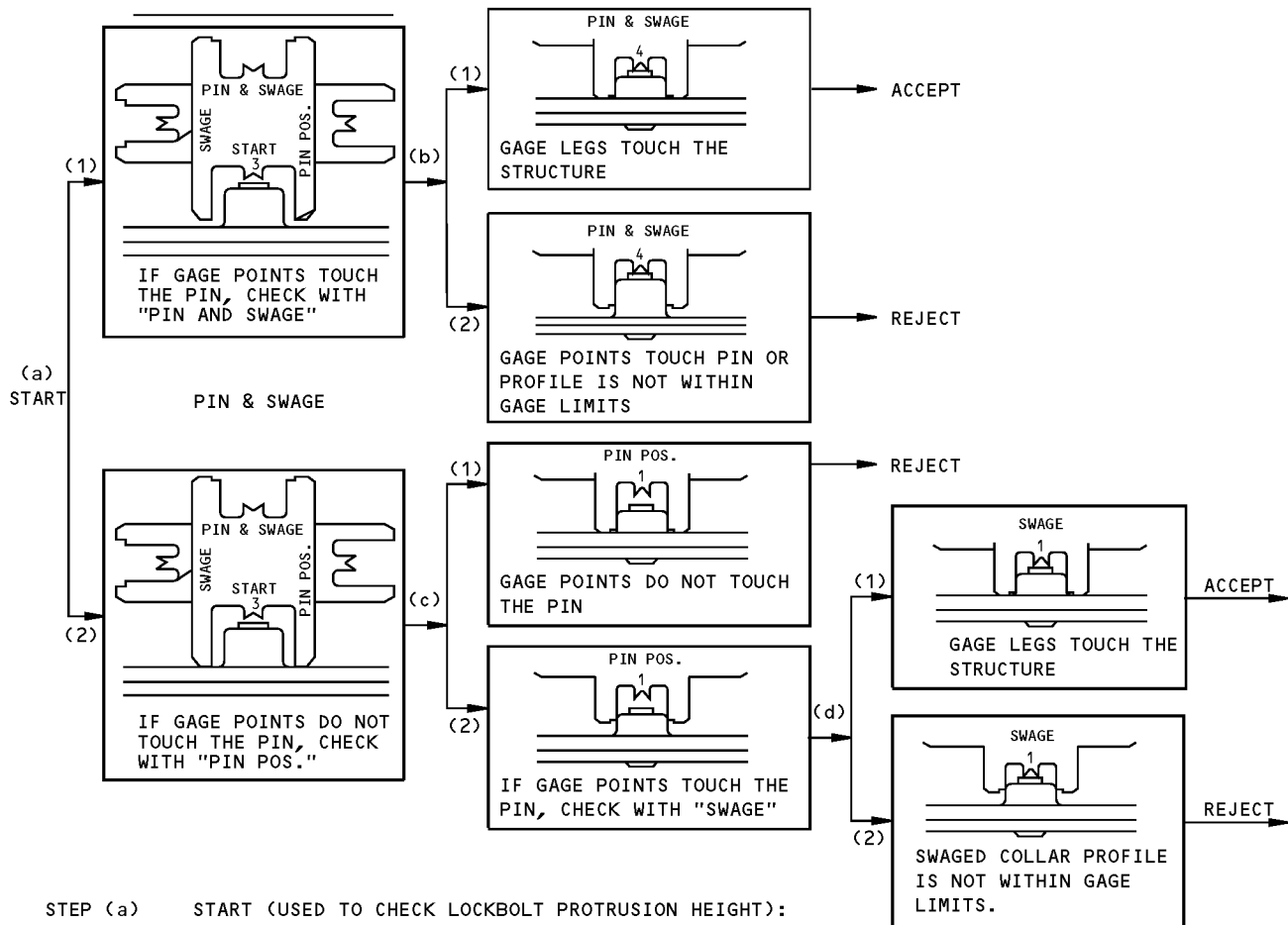
STANDARD SHEAR, PULL TYPE LOCKBOLT INSPECTION DIMENSION
TABLE III



USE OF GAGE HG85-() ☐ B ☐ C
DETAIL II

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 6 of 12)

757-200 STRUCTURAL REPAIR MANUAL



STEP (a) START (USED TO CHECK LOCKBOLT PROTRUSION HEIGHT):

1. If gage points touch the pin, the protrusion height is between nominal (0.225) and maximum (0.280). Check for acceptance with PIN AND SWAGE (Step (b)).
2. If gage points do not touch the pin, the protrusion height is between nominal (0.225) and minimum (0.208). Check for minimum height with PIN POS. (Step (c)).

STEP (b) PIN AND SWAGE, (USED TO CHECK MINIMUM PROTRUSION HEIGHT AND SWAGED COLLAR PROFILE FOR NOMINAL TO MAXIMUM PROTRUSION HEIGHT INSTALLATION):

1. Accept the installation if gage legs touch the structure.
2. Reject if gage points touch the pin (protrusion too high) or if profile is not within limits.

STEP (c) PIN POSITION, (USED TO CHECK MINIMUM PROTRUSION HEIGHT):

1. Reject if gage points do not touch the pin (protrusion height shorter than minimum).
2. If gage points touch the pin, check swage profile with Swage (Step (d)).

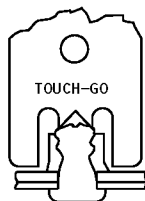
STEP (d) SWAGE, (USED TO CHECK SWAGED COLLAR PROFILE FOR PROTRUSION HEIGHT, NOMINAL TO MINIMUM INSTALLATION):

1. Accept the installation if gage legs touch the structure.
2. Reject if swaged collar profile is not within gage limits.

USE OF HG85-10, HG99-(), AND HG100-()
DETAIL III

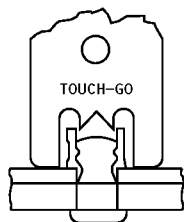
**Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 7 of 12)**

757-200 STRUCTURAL REPAIR MANUAL



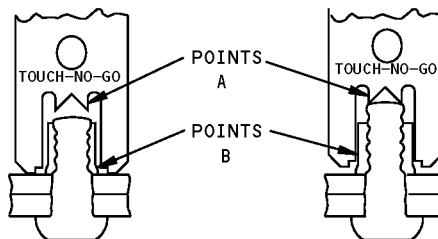
POINTS TOUCH PIN.
LEGS OF GAGE CLEAR
SHEET LINE. PIN IS
ACCEPTABLE. GAGE PIN
WITH TOUCH-NO-GO END

ACCEPT



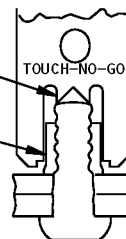
POINTS DO NOT TOUCH
PIN. LEGS OF GAGE
CLEAR SHEET LINE.
PIN GRIP IS TOO SHORT.

REJECT



POINTS A DOES NOT TOUCH
PIN. LEGS OF GAGE CLEAR
SHEET LINE. POINTS B DO
NOT TOUCH COLLAR. PIN
GRIP AND COLLAR SWAGE
IS ACCEPTABLE.

ACCEPT

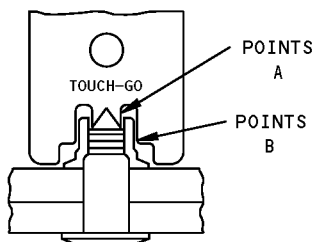


POINTS A TOUCH PIN.
LEGS OF GAGE CLEAR
SHEET LINE. POINTS B
TOUCH COLLAR. PIN
GRIP IS TOO LONG,
COLLAR IS NOT SWAGED
ENOUGH

REJECT

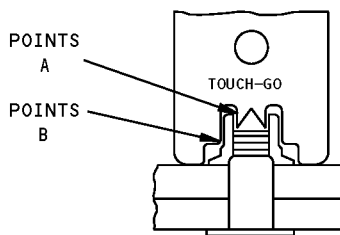
USE OF HG77-()A

DETAIL IV



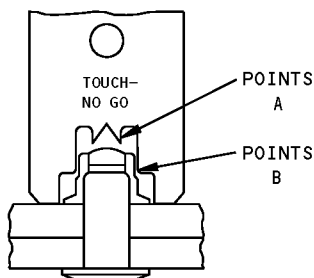
POINTS A TOUCH PIN. GRIP
LENGTH IS NOT TOO SHORT.
POINTS B DO NOT TOUCH
COLLAR- COLLAR IS SWAGED ENOUGH

ACCEPT



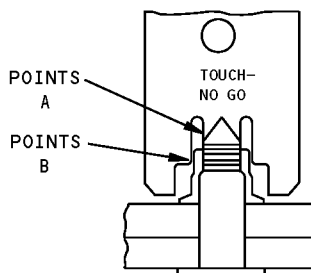
POINTS A DO NOT TOUCH PIN.
GRIP LENGTH IS TOO SHORT AND/OR
POINTS B TOUCH COLLAR -
COLLAR IS NOT SWAGED ENOUGH

REJECT



POINTS A DO NOT TOUCH PIN.
GRIP LENGTH IS NOT TOO LONG.
POINTS B DO NOT TOUCH COLLAR -
COLLAR IS SWAGED ENOUGH

ACCEPT



POINTS A TOUCH PIN.
GRIP LENGTH IS TOO LONG AND/OR
POINTS B TOUCH COLLAR -
COLLAR IS NOT SWAGED ENOUGH

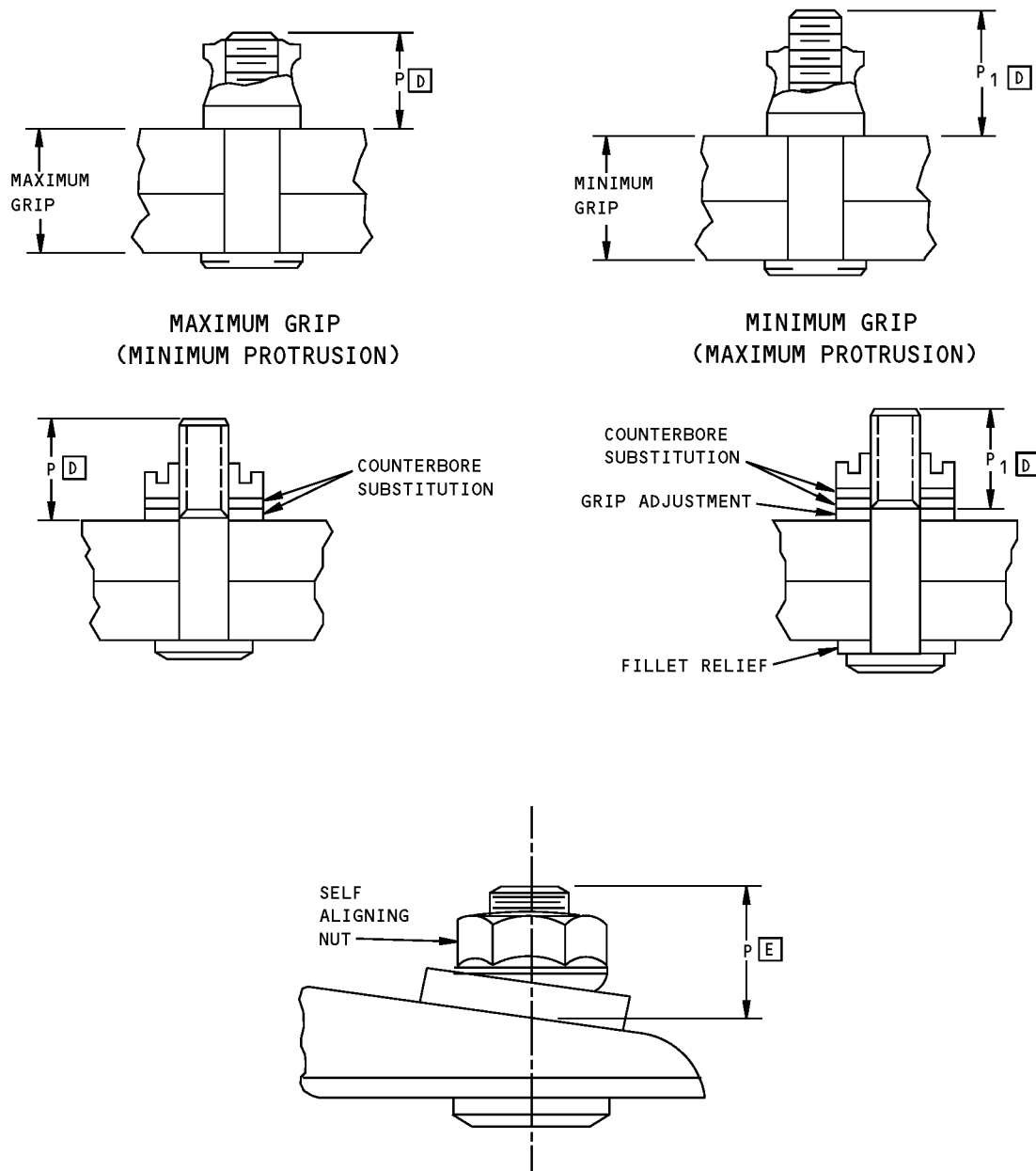
REJECT

USE OF HG110-()

DETAIL V

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts Figure 14 (Sheet 8 of 12)

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STRUCTURAL REPAIR MANUAL



PIN PROTRUSION LIMITS FOR INSTALLED HEX-DRIVE BOLTS
DETAIL VI

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 9 of 12)



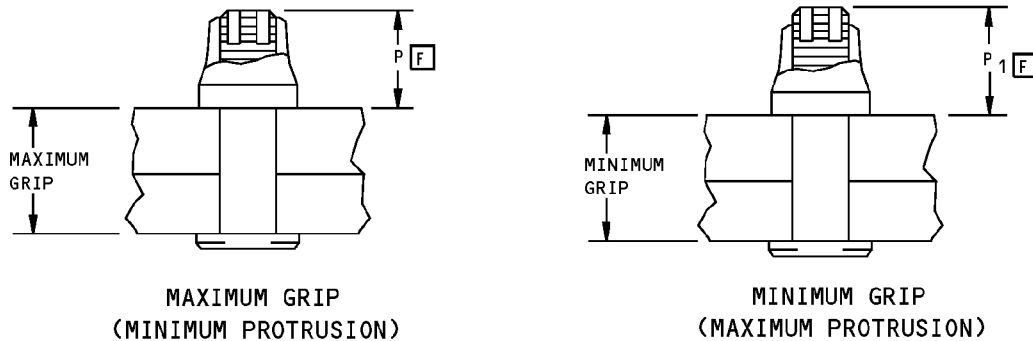
757-200 STRUCTURAL REPAIR MANUAL

FASTENER		STANDARD							LIGHTWEIGHT		
		NOMINAL, 0.0156 AND 0.0312 OVERSIZE, INCH			0.0468 OVERSIZE, INCH				NOMINAL, INCH		
		SHEAR AND TENSION		ST8712 PROT GAGE DASH NO. (2-1522) PROT GAGE SIZE NO.	SHEAR		TENSION		SHEAR		ST8712 PROT GAGE DASH NO. (2-1522) PROT GAGE SIZE NO.
DASH NO.	NOMINAL THREAD	P MIN (MINIMUM PROTRUSION)	P MIN (MAXIMUM PROTRUSION)		P		P		P		
					MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
-5	0.1640-32	0.302	0.384	-5 (5/32)	0.333	0.414	0.315	0.397	0.270	0.352	5/32
-6	0.1900-32	0.315	0.397	-6 (3/16)	0.346	0.427	0.350	0.432	0.280	0.362	3/16
-8	0.2500-28	0.385	0.467	-8 (1/4)	0.416	0.497	0.420	0.502	0.310	0.392	1/4
-10	0.3125-24	0.490	0.572	-10 (5/6)	0.521	0.602	0.520	0.602	0.370	0.452	5/16
-12	0.3750-24	0.535	0.617	-12 (3/8)	0.566	0.647	0.565	0.647	0.410	0.492	3/8
-14	0.4375-20	0.625	0.707	-14--	0.656	0.737	0.650	0.732	0.475	0.557	--
-16	0.5000-20	0.675	0.757	-16--	0.706	0.787	0.700	0.782	0.515	0.597	--
-18	0.5625-18	0.760	0.842	-18--	0.791	0.872	0.790	0.872	0.590	0.672	--
-20	0.6250-18	0.815	0.897	-20--	0.846	0.927	0.865	0.947	0.630	0.712	--
-24	0.7500-16	1.040	1.122	-24--	1.071	1.152	1.090	1.172	--	--	--
-28	0.8750-14	1.200	1.282	-28--	1.231	1.312	--	--	--	--	--
-32	1.0000-12	1.380	1.462	-32--	1.411	1.492	--	--	--	--	--

PIN PROTRUSION FOR HEX-DRIVE BOLTS
TABLE IV

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 10 of 12)

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STRUCTURAL REPAIR MANUAL



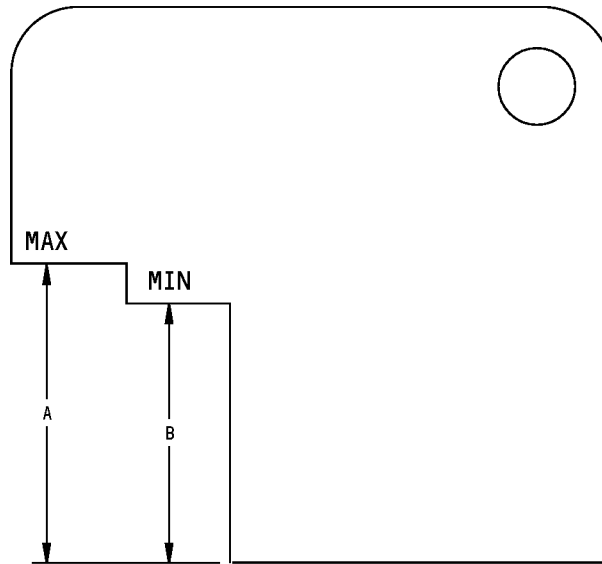
PIN PROTRUSION LIMITS FOR INSTALLED SWAGE-LOCKING HEX DRIVE BOLTS
DETAIL VII

NOMINAL BOLT DIAMETER	STANDARD AND 0.0156 OVERSIZE BOLTS		INSPECTION GAGE SEE DETAIL VIII	0.0312 OVERSIZE BOLTS	
	MINIMUM PROTRUSION P (INCH)	MAXIMUM PROTRUSION P ₁ (INCH)		MINIMUM PROTRUSION P (INCH)	MAXIMUM PROTRUSION P ₁ (INCH)
5/32	0.275	0.358	EB2G1309-5	-	-
3/16	0.295	0.378	EB2G1309-6	0.315	0.398
1/4	0.340	0.423	EB2G1309-8	0.375	0.458
5/16	0.435	0.518	EB2G1309-10	0.480	0.563
3/8	0.475	0.558	EB2G1309-12	0.520	0.603

PIN PROTRUSION LIMITS FOR SWAGE-LOCKING HEX DRIVE BOLTS
TABLE V

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 11 of 12)

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STRUCTURAL REPAIR MANUAL



PROTRUSION GAGE (SEE TABLE VI)
DETAIL VIII

GAGE NUMBER G	A (INCH) ±0.002	B (INCH) ±0.002
EB2G1309-5	0.358	0.275
EB2G1309-6	0.378	0.295
EB2G1309-8	0.423	0.340
EB2G1309-10	0.518	0.435
EB2G1309-12	0.558	0.475

PROTRUSION GAGE TOLERANCES
TABLE VI

Pin and Collar Limits for Installed Lockbolts and Hex-Drive Bolts
Figure 14 (Sheet 12 of 12)

STRUCTURAL REPAIR MANUAL

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5060.
- SEE DETAIL I FOR BOLT ALIGNMENT AND DETAIL II FOR THREAD PROTRUSION.
- SEE TABLE I FOR NUT PART NUMBERS, TABLES II AND III FOR WASHERS, AND TABLES IV AND V FOR THREAD PROTRUSION LIMITS.
- SEE DETAILS II AND III FOR WASHER USE.

A DO NOT INSTALL BACN10TN, BACN10WM, BACN10HY, OR BACN10SZ NUTS ON SLOPE ANGLES GREATER THAN 2 DEGREES. USE BACN10MT NUT AND BACW10AU SELF-ALIGNING WASHER ON SLOPES BETWEEN 2 AND 6 DEGREES.

B DO NOT USE BACN10WM OR BACN10TN SEALNUTS WITH OVERSIZE BOLTS. DO NOT USE WASHERS WITH BACN10WM AND BACN10TN SEALNUTS.

C FOR BACN10TN AND BACN10WM SEALNUTS, THE TEFLON SEAL MUST NOT EXTRUDE BEYOND THE PERIPHERY OF THE NUT BASE.

D FILLET RELIEF WASHER MUST BE A COUNTERSUNK WASHER AND MUST BE INSTALLED UNDER THE HEAD OF THE BACB30WR RADIUS LEAD-IN BOLT WITH COUNTERSINK DIRECTLY UNDER THE HEAD OF THE BOLT. SEE TABLE III.

E COUNTERBORE SUBSTITUTION WASHERS FOR OVERSIZE FASTENERS CAN ADD ONE ADDITIONAL 0.032 THICK WASHER TO THIS INSTALLATION. SEE TABLE I.

F COUNTERBORE SUBSTITUTION WASHERS ARE NECESSARY AS FOLLOWS: ONE 0.063 INCH NOMINAL THICKNESS PLAIN WASHER, EXCEPT FOR SIZE 7 NUTS WHERE ONE 0.063 INCH NOMINAL THICKNESS PLAIN WASHER PLUS ONE 0.032 INCH NOMINAL THICKNESS PLAIN WASHER IS NECESSARY. A MAXIMUM THICKNESS CORRESPONDING TO ONE ADDITIONAL 0.063 INCH NOMINAL THICKNESS PLAIN WASHER MAY BE USED FOR GRIP ADJUSTMENT. IN FUEL TANK AREAS, SEAL AS SHOWN IN SRM 51-20-05.

G COUNTERBORE SUBSTITUTION WASHERS ARE NECESSARY AS FOLLOWS: ONE 0.063 INCH NOMINAL THICKNESS PLAIN WASHER PLUS ONE 0.032 INCH THICKNESS PLAIN WASHER. A MAXIMUM THICKNESS CORRESPONDING TO ONE ADDITIONAL 0.063 INCH NOMINAL THICKNESS PLAIN WASHER CAN BE USED FOR GRIP ADJUSTMENT. IN FUEL TANK AREAS, SEAL AS SHOWN IN SRM 51-20-05.

H ONE 0.063 INCH NOMINAL THICKNESS PLAIN COUNTERBORE SUBSTITUTION WASHER IS NECESSARY.

I BACN10MT()X NUT USES THE NEXT FULL SIZE OVER BACW10AU SELF-ALIGNING WASHER (AS AN EXAMPLE, BACN10MT4X USES THE BACW10AU5 WASHER) AND USES ONE 0.063 INCH NOMINAL THICKNESS PLAIN WASHER PLUS ONE 0.032 INCH NOMINAL THICKNESS PLAIN WASHER. BACN10MT()X AND BACW10AU() SELF-ALIGNING NUT COMBINATIONS ARE NOT ALLOWED WITH NOMINAL OR OVERSIZE BACB30PT BOLTS.

J SEE TABLE III FOR CORRECT WASHER.

K IT IS NECESSARY THAT BACN10MT()X BE USED WITH THE NEXT FULL SIZE OF BACW10AU() WASHER, (FOR EXAMPLE, THE BACN10MX4X NUT USES THE BACW10AU5 WASHER).

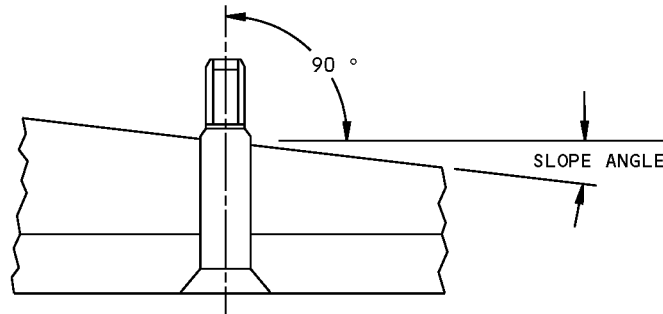
DO NOT USE BACN10MT()X WITH BACB30PT NOMINAL OR OVERSIZES.

L WHEN OVERSIZE NUTS ARE USED WITH OVERSIZE BOLTS, PROTRUSION VALUES ARE NOT AFFECTED. SEE TABLE II FOR WASHER THICKNESS SELECTION. SEE TABLE III FOR GRIP ADJUSTMENT.

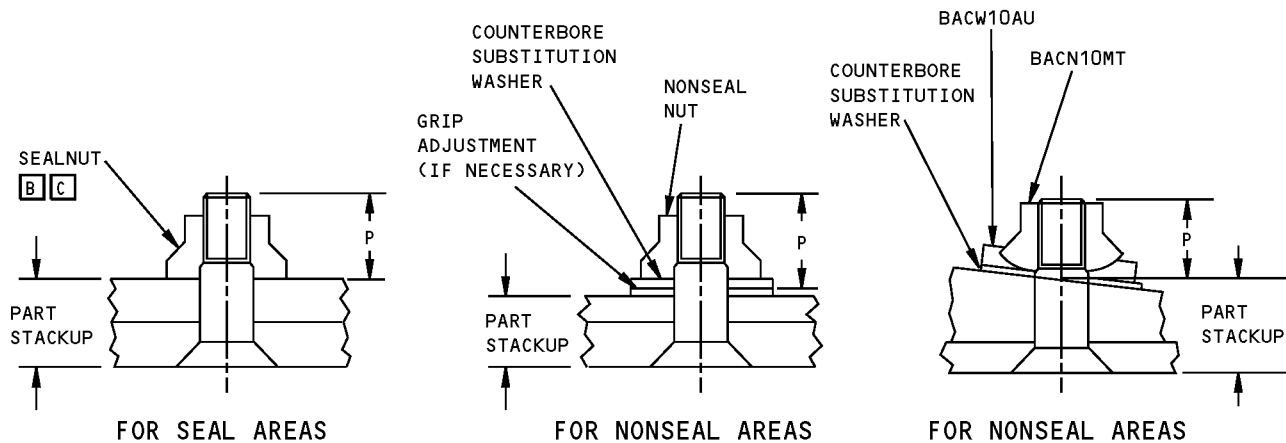
M BACW10P416AN THROUGH BACW10421AN ALUMINUM WASHERS MAY BE USED WHERE THE USE OF THE LARGE WASHER WILL INTERFERE WITH ADJACENT STRUCTURE AND REWORK OF THE WASHERS BY RADIUSING OR TRIMMING IS REQUIRED TO ELIMINATE THE INTERFERENCE. THE TRIMMED WASHER MAY NOT PROVIDE LESS BEARING SURFACE THAN THE BACW10AU WASHER (SEE DETAIL III). SURFACE FINISH MUST BE 125 RHR OR BETTER. THE TRIMMED SURFACES MUST BE FINISHED WITH A MANUAL APPLICATION OF A CONVERSION COATING AS SPECIFIED IN SRM 51-20-01, BEFORE YOU INSTALL THE FASTENER.

Installation of Radius Lead-In Bolts
Figure 15 (Sheet 1 of 7)

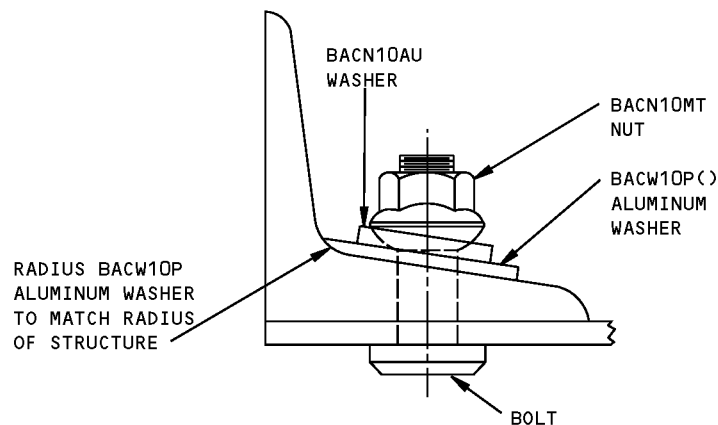
757-200 STRUCTURAL REPAIR MANUAL



ANGULAR MEASUREMENT BETWEEN BOLT AND STRUCTURE MATERIAL
FOR PROPER NUT SELECTION
DETAIL I **A**



THREAD PROTRUSION AND WASHER USE
DETAIL II



RADIUS WASHER WITH THE SELF-ALIGNING NUT
DETAIL III

Installation of Radius Lead-In Bolts Figure 15 (Sheet 2 of 7)



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STRUCTURAL REPAIR MANUAL

NUT ON STANDARD SIZE BOLT J	NUT ON FIRST OVERSIZE BOLT J	NUT ON SECOND OVERSIZE BOLT J
BACN10HY<>M	BACN10HY<>M F	BACN10HY<>MX G
BACN10HY<>AC	BACN10HY<>AC F	BACN10HY<>ACX G
BACN10MY<> AND BACW10AU<>	BACN10MT<> AND BACW10AU<> H	BACN10MY<>X AND BACW10AU<> I
BACN10TN<>K B	BACN10SZ<> F BACN10HY<>M F BACN10HY<>AC F	BACN10HY<>MX G BACN10HY<>ACX G
BACN10WM<> B	BACN10HY<>AC F	BACN10HY<>MX G BACN10HY<>ACX G

NOMINAL AND OVERSIZE NUT PART NUMBERS
TABLE I

Installation of Radius Lead-In Bolts
Figure 15 (Sheet 3 of 7)



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STRUCTURAL REPAIR MANUAL

NOMINAL DIA. NUT AND BOLT COMBINATIONS	WASHER TYPE			TOTAL QUANTITY OF WASHERS E
	FILLET RELIEF	COUNTERBORE SUBSTITUTION E	GRIP ADJUSTMENT	
BACB30PT()K()L WITH BACN10WM()	DO NOT USE	NOT NECESSARY	DO NOT USE	NONE
BACB3WQ()K()L WITH BACN10TN()K	DO NOT USE	NOT NECESSARY	DO NOT USE	NONE
BACB30PT()K()L, OR BACB30WQ()K()L WITH ALL NON-SEAL NUTS	DO NOT USE	ONE 0.063 THICK WASHER IS NECESSARY (SEE TABLE III)	ONE 0.032 OR 0.063 THICK WASHER IS PERMITTED (SEE TABLE III)	2 MAXIMUM
BACB30WR()K()L WITH BACN10TN()K	ONE 0.063 THICK WASHER IS PERMITTED D	NOT PERMITTED	ONE 0.032 OR 0.063 THICK WASHER IS PERMITTED (SEE TABLE III)	2 MAXIMUM
BACB30WR()K()L WITH ALL NON-SEAL NUTS	ONE 0.063 THICK WASHER IS PERMITTED D	ONE 0.063 THICK WASHER IS NECESSARY (SEE TABLE III)	ONE 0.032 OR 0.063 THICK WASHER IS PERMITTED (SEE TABLE III)	3 MAXIMUM

THE QUANTITY OF NECESSARY AND PERMITTED WASHERS ON
A NOMINAL DIAMETER FASTENER

TABLE II

Installation of Radius Lead-In Bolts
Figure 15 (Sheet 4 of 7)

757-200 STRUCTURAL REPAIR MANUAL

NOMINAL WASHER THICKNESS	COUNTERSUNK WASHER FOR FILLET RELIEF OR GRIP ADJUSTMENT FOR USE WITH NOMINAL AND OVERSIZE BACB30WR BOLTS	COUNTERBORE SUBSTITUTION AND GRIP ADJUSTMENT WASHERS FOR USE UNDER NUTS USED WITH NOMINAL AND OVERSIZE BACB30WR, BACB30WQ AND BACB30PT BOLTS	
		NUT PART NUMBER	
		BACN10HY() BACN10SZ() BACN10HY()X	BACN10MT() +BACW10AU() BACN10MT()X +BACW10AU() K
NOMINAL I.D. WASHERS			
0.032	-----	BACW10AT2()AS BACW10AW()AS	BACW10P410CG THRU BACW10P415CG
0.063	BACW10EG()J BACW10EG()C	BACW10AW()AST BACW10AT3()AS	BACW10P416CG THRU BACW10P421CG BACW10P416AN M THRU BACW10P421AN
0.0156 OVERSIZE I.D. WASHERS			
0.032	-----	BACW10AW()AS BACW10AT2()AS	BACW10P422CG THRU BACW10P427CG
0.063	BACW10EG()1J BACW10EG()1C	BACW10AW()AST BACW10AT3()AS	BACW10P428CG THRU BACW10P433CG
0.0312 OVERSIZE I.D. WASHERS			
0.032		BACW10P446AN CG THRU BACW10P451ANCG	BACW10P434CG THRU BACW10P439CG
0.063	BACW10EG()2J BACW10EG()2C	BACW10P452ANCG THRU BACW10P457ANCG	BACW10P440CG THRU BACW10P445CG

WASHER SELECTION
TABLE III

Installation of Radius Lead-In Bolts
Figure 15 (Sheet 5 of 7)



757-200
STRUCTURAL REPAIR MANUAL

BOLT PART NUMBERS	1st DASH NUMBER	NOMINAL THREAD SIZE	NUT PART NUMBERS	MINIMUM PROTRUSION (P MIN)	MAXIMUM PROTRUSION (P MIN)
BACB30PT()K()L	4	0.2500-28	BACN10TN	0.428	0.510
	5	0.3125-24	BACN10WM	0.503	0.585
	6	0.3750-24		0.528	0.610
BACB30WQ()K()L BACB30WR()K()L	4	0.2500-28	BACN10TN	0.381	0.454
	5	0.3125-24		0.435	0.508
	6	0.3750-24		0.493	0.566
	7	0.4375-20		0.590	0.663
BACB30WQ()K()L BACB30WR()K()L	3	0.1900-32	BACN10HY	0.326	0.399
	4	0.2500-28	BACN10SZ	0.381	0.454
	5	0.3125-24	BACN10MT	0.435	0.508
	6	0.3750-24	+BACW10AU	0.493	0.566
	7	0.4375-20		0.590	0.663

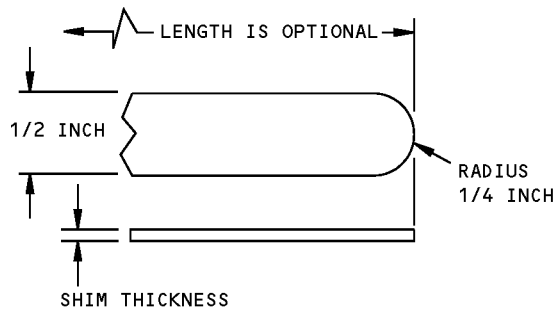
FASTENER THREAD PROTRUSION LIMITS
TABLE IV

BOLT PART NUMBERS	1st DASH NUMBER	NOMINAL THREAD SIZE	NUT PART NUMBERS <input type="checkbox"/>	MINIMUM PROTRUSION (P MIN)	MAXIMUM PROTRUSION (P MIN)
BACB30PT()K()LX BACB30PT()K()LY	4	0.2500-28	---	0.428	0.510
	5	0.3125-24	BACN10HY()()	0.503	0.585
	6	0.3750-24	BACN10HY()()X	0.528	0.610
BACB30WQ()K()LX BACB30WQ()K()LY BACB30WR()K()LX BACB30WR()K()LY	3	0.1900-32	BACN10HY()()	0.374	0.447
	4	0.2500-28	BACN10MT()	0.426	0.499
	5	0.3125-24	+BACW10AU()	0.460	0.533
	6	0.3750-24	BACN10MT()()X	0.535	0.608
	7	0.4375-20	+BACW10AU() BACN10HY()()X	0.625	0.698

OVERSIZE FASTENER THREAD PROTRUSION LIMITS
TABLE V

Installation of Radius Lead-In Bolts
Figure 15 (Sheet 6 of 7)

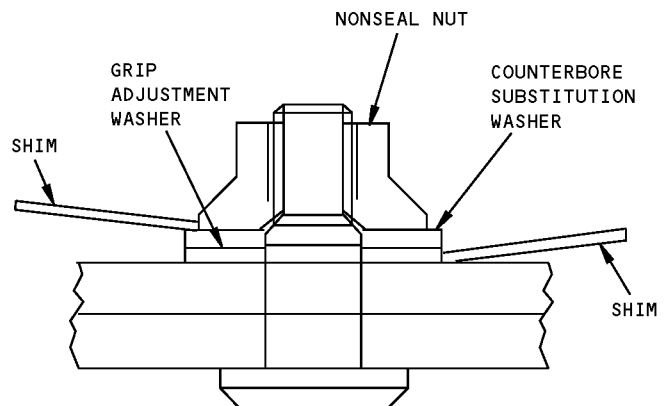
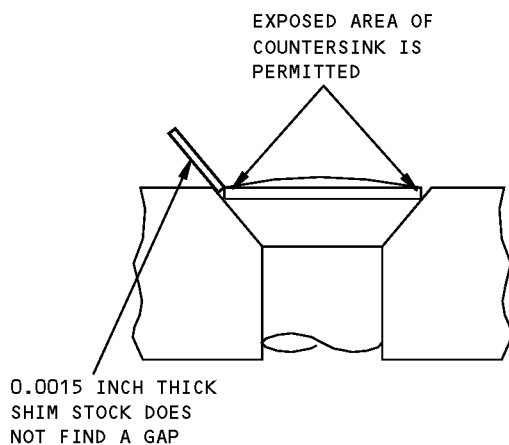
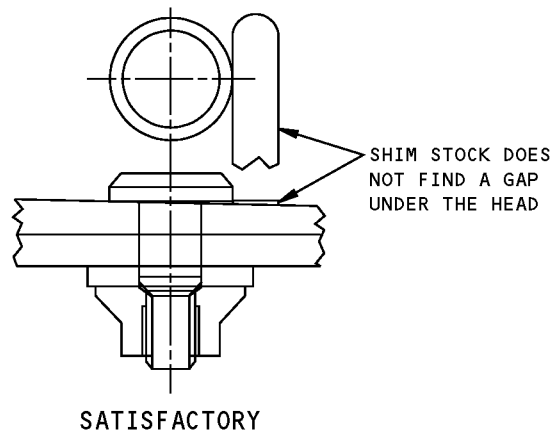
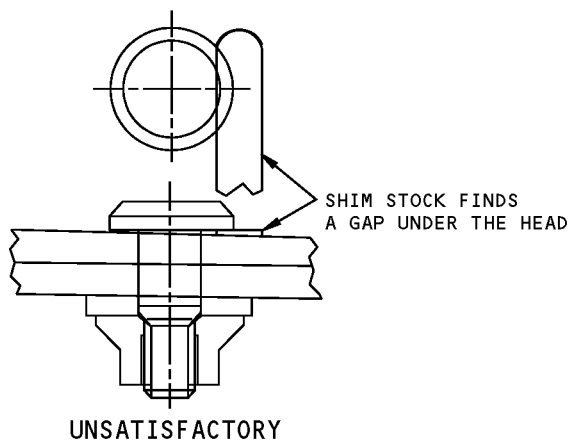
757-200 STRUCTURAL REPAIR MANUAL



SHIM CONFIGURATION
DETAIL IV

NOMINAL THREAD SIZE	MAXIMUM SHIM THICKNESS
0.1900-32	0.005
0.2500-28	0.006
0.3125-24	0.007
0.3750-24	0.008
0.4375-20	0.008

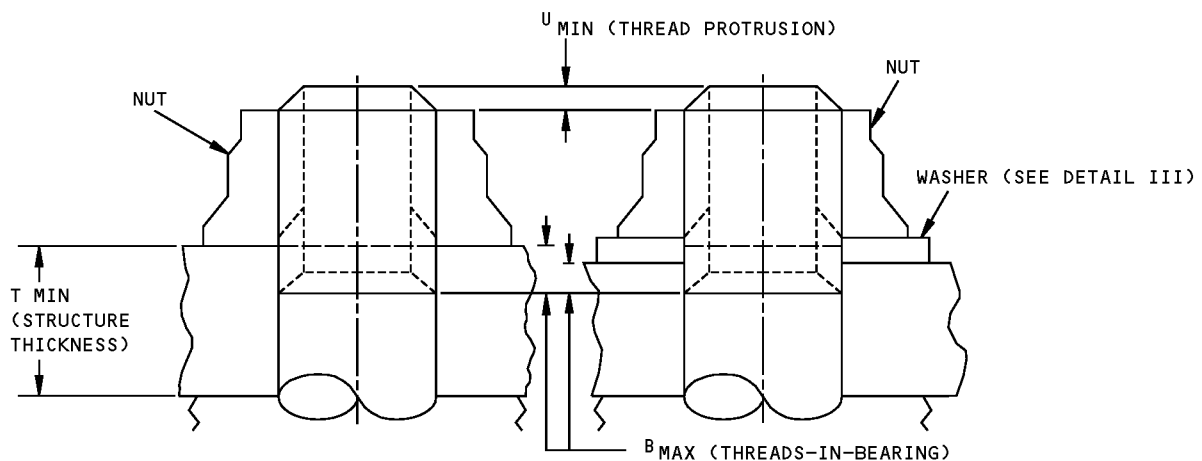
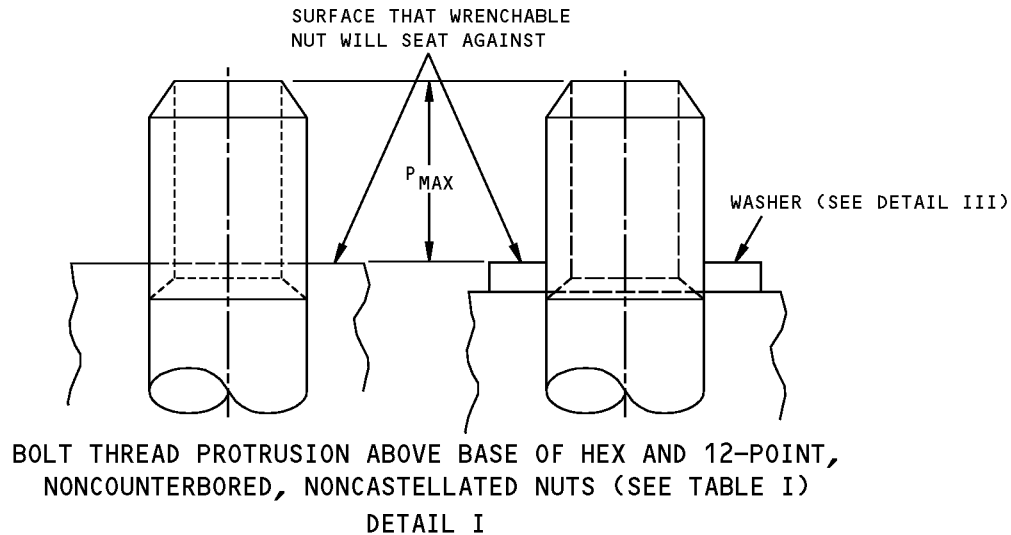
SHIM THICKNESS UNDER INSTALLED NUTS
AND PROTRUDING HEADS OF RADIUS LEAD-BOLTS
TABLE VI



SHIM THICKNESS UNDER INSTALLED NUTS AND
HEADS OF RADIUS LEAD-IN BOLTS
DETAIL V

Installation of Radius Lead-In Bolts
Figure 15 (Sheet 7 of 7)

757-200 STRUCTURAL REPAIR MANUAL



NOTES:

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5009.
 - SEE DETAILS I AND II FOR THREAD PROTRUSION
 - SEE DETAIL III AND TABLE III FOR WASHER USAGE
 - SEE DETAILS IV AND V AND TABLE IV FOR GAP ANALYSIS
- A** PREFIX FOR 2 LETTER BOLT PART NUMBER CODES SHOWN IS BACB30. EXAMPLE: PN INDICATES BACB30PN SERIES. PREFIX FOR 4 DIGIT BOLT PART NUMBER CODES SHOWN IS NAS. EXAMPLE: 6603 INDICATES NAS6603 SERIES (NAS6603 THRU NAS 6620).

- B** NOT APPLICABLE TO BOLTS WITH CASTELLATED NUTS. NOT APPLICABLE TO PLATE NUTS. NOT APPLICABLE TO BARREL NUTS. NOT APPLICABLE TO FULLY THREADED SCREWS.
- C** TO CALCULATE ACTUAL B MAX, MEASURE TOTAL STRUCTURE THICKNESS (STACKUP) AT HOLE, (ADD THICKNESS FOR ANY WASHERS), SUBTRACT NOMINAL GRIP LENGTH (GRIP LENGTH DASH NUMBER TIMES 0.0625) OF FASTENER AND SUBTRACT 0.010 INCH FOR FASTENER GRIP LENGTH TOLERANCE.

Installation of Bolts Figure 16 (Sheet 1 of 6)

757-200 STRUCTURAL REPAIR MANUAL

NOMINAL THREAD SIZE	THREAD PROTRUSION "P MAX" NOMINAL SIZE BOLTS A					THREAD PROTRUSION "P MAX" 0.0156 O.S. BOLTS A				
	PN, LE,US	LM, LP,LR, LU,MR, PC,MS XJ,NM, XK,XM, LN,NN, 6603, XL,WP, 6703, NE, 6803,NS	LH,LJ, LK,LL, LT,NF, NR,NT, NU,NJ, UU,NK, UW,XN, NL,RF	VF, 6203, 6303, 8702	PU,PF, PW	PN,LE, US	LM,LP, LR,LU, MR,PC, MS,XJ, NM,XK, NN,XL, XM,LN, 6603, WP, 6703, NE, 6803,NS	LH,LJ, LK,LL, LT,NF, NJ,NR, NK,NT, NL, NU,RF, UU, UW, XN	VF, 6203, 6303, 8703	PU,PF, PW
0.0860-56	---	---	---	---	---	---	---	---	---	---
0.1120-40	---	0.213	0.213	---	---	---	0.196	0.196	---	---
0.1380-32	---	0.252	0.252	---	0.262	---	0.235	0.235	---	0.245
0.1640-32	---	0.289	0.289	0.266	---	---	0.272	0.272	0.249	---
0.1900-32	0.334	0.289	0.289	0.277	0.299	0.317	0.272	0.272	0.260	0.282
0.2500-28	0.439	0.364	0.328	0.319	0.374	0.423	0.348	0.312	0.303	0.358
0.3125-24	0.526	0.402	0.387	0.381	0.412	0.510	0.386	0.371	0.365	0.396
0.3750-24	0.576	0.511	0.403	0.397	0.521	0.560	0.495	0.387	0.381	0.505
0.4375-20	0.658	0.619	0.466	0.463	0.629	0.641	0.602	0.449	0.446	0.612
0.5000-20	0.738	0.660	0.466	0.463	0.670	0.721	0.643	0.449	0.446	0.653
0.5625-18	0.829	0.759	0.524	0.523	---	0.813	0.743	0.508	0.507	---
0.6250-18	0.889	0.821	0.556	0.555	0.831	0.873	0.805	0.540	0.539	0.815
0.7500-16	1.064	0.954	0.586	0.588	---	1.047	0.937	0.569	0.572	---
0.8750-14	1.241	1.088	0.666	0.673	---	1.224	1.071	0.649	0.656	---
1.0000-12	1.415	1.201	0.783	0.797	---	1.398	1.184	0.766	0.780	---
1.1250-12	1.575	1.350	0.877	0.891	---	1.558	1.333	0.860	0.874	---
1.2500-12	1.715	1.538	0.971	0.985	---	1.698	1.521	0.954	0.968	---
1.3750-12	2.173	---	---	---	---	2.156	---	---	---	---
1.5000-12	2.360	---	---	---	---	2.343	---	---	---	---

BOLT THREAD PROTRUSION ABOVE BASE OF HEX AND 12-POINT,
NONCOUNTERBORED, NONCASTELLATED NUTS **B**

TABLE I

Installation of Bolts
Figure 16 (Sheet 2 of 6)

757-200
STRUCTURAL REPAIR MANUAL

NOMINAL THREAD SIZE	THREAD PROTRUSION "P MAX" 0.0312 O.S.BOLTS A				
	PN,LE,US	LM,LP,LR,LU MR,PC,MS,XJ, NM,XK,NN,XM, LN,6603,WP, 6703,NE,6803, NS,XL	LH,LJ,LK,LL, LT,NF,NR,NT, NU,NJ,UU,NK, UW,XN,NL,RF	VF,6203,6303, 8703	PU,PF,PW
0.0860-56	---	---	---	---	---
0.1120-40	---	0.180	0.180	---	---
0.1380-32	---	0.213	0.218	---	0.228
0.1640-32	---	0.255	0.255	0.232	---
0.1900-32	0.300	0.255	0.255	0.243	0.265
0.2500-28	0.406	0.331	0.295	0.286	0.341
0.3125-24	0.493	0.369	0.354	0.348	0.379
0.3750-24	0.543	0.478	0.370	0.364	0.488
0.4375-20	0.625	0.586	0.433	0.430	0.596
0.5000-20	0.705	0.627	0.433	0.430	0.637
0.5625-18	0.796	0.726	0.491	0.490	---
0.6250-18	0.856	0.788	0.523	0.522	0.798
0.7500-16	1.030	0.920	0.552	0.555	---
0.8750-14	1.207	1.054	0.632	0.639	---
1.0000-12	1.381	1.167	0.749	0.763	---
1.1250-12	1.541	1.316	0.843	0.857	---
1.2500-12	1.681	1.504	0.937	0.951	---
1.3750-12	2.139	---	---	---	---
1.5000-12	2.326	---	---	---	---

BOLT THREAD PROTRUSION ABOVE BASE OF HEX AND 12-POINT,
NONCOUNTERBORED, NONCASTELLATED NUTS **B**

TABLE I (CONTD)

Installation of Bolts
Figure 16 (Sheet 3 of 6)



757-200
STRUCTURAL REPAIR MANUAL

NOMINAL THREAD SIZE	MINIMUM THREAD PROTRUSION THROUGH THE NUT			THREADS IN BEARING FOR STRUCTURE THICKNESS UNDER THE NUT								THREADS- IN- BEARING <div>C</div>
				STRUCTURE THICKNESS T MIN								
	U MIN			EQUAL TO OR LESS THAN 0.093	0.100	0.200	0.300	0.400	0.500	0.600	EQUAL TO OR GREATER THAN	
	ALL BOLTS EXCEPT AS NOTED	<div>A</div> VF (ONLY)	<div>A</div> LK (ONLY)	B MAX								
B MAX												
0.0860-56	--	--	--	0.000	0.025	0.036	0.036	0.036	0.036	0.036	0.143	0.036
0.1120-40	0.031	--	0.031	0.000	0.025	0.050	0.050	0.050	0.050	0.050	0.200	0.050
0.1380-32	0.039	--	0.039	0.000	0.025	0.050	0.063	0.063	0.063	0.063	0.250	0.063
0.1640-32	0.039	0.031	0.039	0.000	0.025	0.050	0.063	0.063	0.063	0.063	0.250	0.063
0.1900-32	0.039	0.031	0.045	0.000	0.025	0.050	0.063	0.063	0.063	0.063	0.250	0.063
0.2500-28	0.045	0.036	0.045	0.000	0.025	0.050	0.071	0.071	0.071	0.071	0.286	0.071
0.3125-24	0.052	0.042	0.052	0.000	0.025	0.050	0.075	0.083	0.083	0.083	0.333	0.083
0.3750-24	0.052	0.042	0.052	0.000	0.025	0.050	0.075	0.083	0.083	0.083	0.333	0.083
0.4375-20	0.062	0.050	--	0.000	0.025	0.050	0.075	0.100	0.100	0.100	0.400	0.100
0.5000-20	0.062	0.050	--	0.000	0.025	0.050	0.075	0.100	0.100	0.100	0.400	0.100
0.5625-18	0.068	--	--	0.000	0.025	0.050	0.075	0.100	0.111	0.111	0.444	0.111
0.6250-18	0.068	--	--	0.000	0.025	0.050	0.075	0.100	0.111	0.111	0.444	0.111
0.7500-16	0.078	--	--	0.000	0.025	0.050	0.075	0.100	0.125	0.125	0.500	0.125
0.8750-14	0.089	--	--	0.000	0.025	0.050	0.075	0.100	0.125	0.125	0.571	0.143
1.0000-12	0.104	--	--	0.000	0.025	0.050	0.075	0.100	0.125	0.150	0.667	0.167
1.1250-12	0.104	--	--	0.000	0.025	0.050	0.075	0.100	0.125	0.150	0.667	0.167
1.2500-12	0.104	--	--	0.000	0.025	0.050	0.075	0.100	0.125	0.150	0.667	0.167
1.3750-12	0.104	--	--	0.000	0.025	0.050	0.075	0.100	0.125	0.150	0.667	0.167
1.5000-12	0.104	--	--	0.000	0.025	0.050	0.075	0.100	0.125	0.150	0.667	0.167

**BOLT THREAD PROTRUSION THROUGH THE NUT
AND FOR THREADS-IN-BEARING**

TABLE II

**Installation of Bolts
Figure 16 (Sheet 4 of 6)**

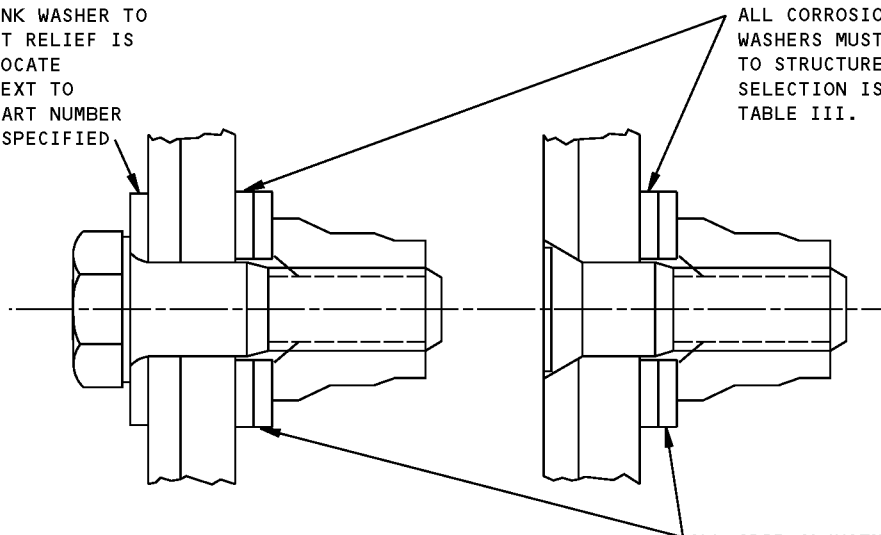
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GENERAL
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ONE COUNTERSUNK WASHER TO PROVIDE FILLET RELIEF IS PERMITTED. LOCATE COUNTERSINK NEXT TO BOLT HEAD. PART NUMBER SELECTION IS SPECIFIED IN TABLE III.



ALL CORROSION PROTECTION WASHERS MUST BE LOCATED NEXT TO STRUCTURE. PART NUMBER SELECTION IS SPECIFIED IN TABLE III.

ALL GRIP ADJUSTMENT AND COUNTERBORE SUBSTITUTION WASHERS MUST BE LOCATED NEXT TO NUT. PART NUMBER SELECTION IS SPECIFIED IN TABLE III

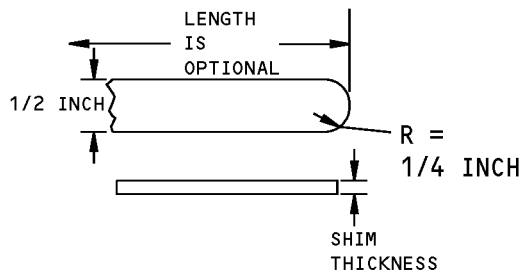
USE OF WASHERS
DETAIL III

EXAMPLE BOLT PART NUMBERS	STRUCTURE MATERIAL	PLAIN WASHER UNDER NUT	COUNTERSUNK WASHER UNDER BOLT HEAD
BACB30 TYPE EM, FD, GU, LE, LM, LN, LP, LR, LU, MR, MS, NE, NM, NN, PN, SW, UG, US, VC, WP, XA, XJ, XK, XL, XM, MS21250, NAS6603 THRU 6620, NAS6703 THRU 6720, NAS6803 THRU 6820	ALUMINUM	BACW10BP()DP, OR NAS1149E()P	BACW10BP()CD
	STEEL	BACW10BP()DP, OR NAS1149E()P	BACW10BP()CD
	CRES	BACW10BP()APU, OR NAS1149E()R	BACW10BP()ACU
	TITANIUM	BACW10BP()APU, OR NAS1149E()R	BACW10BP()ACU
ALL OTHER BOLTS AND SCREWS	ALUMINUM	BACW10BN()AP, OR NAS1149E()P	BACW10BN()AC
	STEEL	BACW10BP()DP, OR NAS1149D()J	BACW10BP()CD
	CRES	BACW10BP()APU, OR NAS1149C()R, OR NAS1149E()R	BACW10BP()ACU
	TITANIUM	BACW10BP()APU, OR NAS1149C()R, OR NAS1149E()R	BACW10BP()ACU

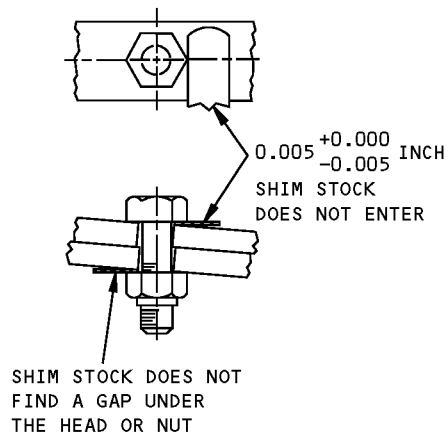
WASHER USAGE
TABLE III

Installation of Bolts
Figure 16 (Sheet 5 of 6)

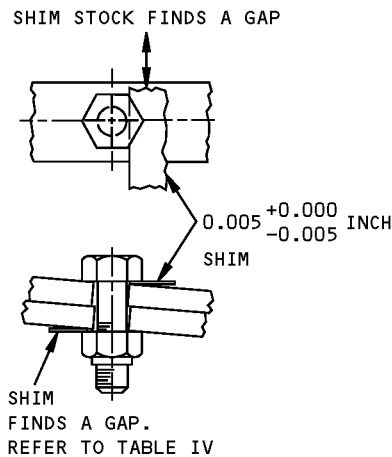
757-200 STRUCTURAL REPAIR MANUAL



**GAP INSPECTION SHIM
DETAIL IV**



SATISFACTORY

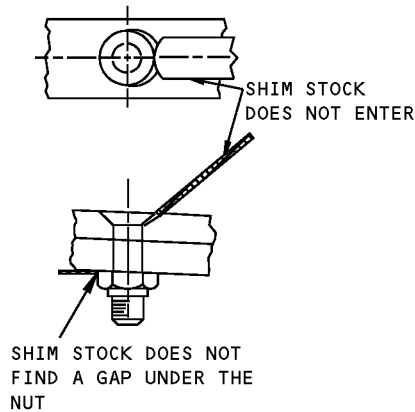


UNSATISFACTORY

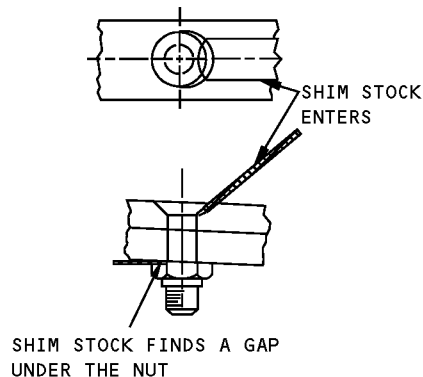
NOMINAL THREAD SIZE	SHIM THICKNESS +0.0000/ -0.0005
0.1640-32	0.004
0.1900-32	0.005
0.2500-28	0.006
0.3125-24	0.007
0.3750-24	0.008
0.4375-20	0.009
0.5000-20	0.010
0.5625-20	0.011
0.6250-18	0.012
0.7500-16	0.014
0.8750-14	0.016
1.0000-12	0.018
1.1250-12	0.020
1.2500-12	0.022
1.3750-12	0.024
1.5000-12	0.026
1.6250-12	0.028
1.7500-12	0.030
2.0000-12	0.034

NUT GAP SHIM THICKNESS

TABLE IV



SATISFACTORY

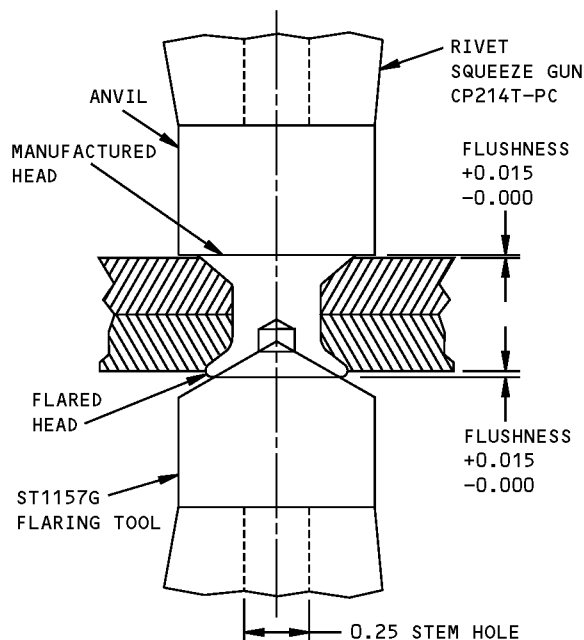


UNSATISFACTORY

**GAP ANALYSIS FOR REMOVABLE FASTENERS (BOLTS)
DETAIL V**

**Installation of Bolts
Figure 16 (Sheet 6 of 6)**

757-200 STRUCTURAL REPAIR MANUAL



PREFERRED METHOD

RIVET SQUEEZE GUN
CP505A SEE TABLE I
FOR EQE 1555 FORCE
SETTINGS

'C' YOKE
ST-1010-399-3

ST1157A
FLARING TOOL

'C' YOKE

0.25

ALTERNATE METHOD

TOOL AND FLUSHNESS REQUIREMENTS FOR HOLLOW-ENDED (BACR15GA) RIVETS DETAIL I

ST1157G-2

BASIC TOOL NUMBER

TOOL LENGTH REFER TO TABLE II

ST1157A-2-4-100-106

BASIC TOOL NUMBER

HEAD DIAMETER IN 1/8THS INCH

HEAD LENGTH IN 1/8THS INCH

INCLUDED ANGLE IN DEGREES

SPHERICAL RADIUS IN 1/1000THS INCH

FLARING TOOL DESCRIPTION

NOMINAL RIVET DIAMETER	SQUEEZE FORCE (LB) ±200 LB
5/32	3000
3/16	3500
7/32	4000

FORCE SETTINGS FOR POWER SUPPLY
UNIT EQE 1555 **A**

TOOL LENGTH NUMBER	TOOL LENGTH 'L' (INCHES)
-1	0.150
-2	0.300
-3	0.500
-4	0.750

TOOL LENGTH NUMBERS
TABLE II

NOTES

- A** POWER SUPPLY UNIT IS AVAILABLE FROM
E. F. BAILEY CO
5610 4TH AVE SO
SEATTLE, WA 98108
SPECIFY BOEING STANDARD PUMP SPL 1555-7-1

TABLE I

Installation of Hollow-Ended (BACR15GA) Rivets Figure 17



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - FASTENER SUBSTITUTION

1. Applicability

- A. Use this chapter-section-subject to find an equivalent fastener or an alternative fastener to replace the fastener that was initially installed in the airplane structure. You can also use this chapter-section-subject to find replacement fasteners for subsequent repairs on the airplane.

2. General

- A. When the repairs given in this manual are adapted for in-service repair, it is possible for the operator to use a different type of fastener as an alternative to the fastener specified in the repair procedure.
- B. The fastener selection for repairs specified in the Structural Repair Manual or by the Engineering drawings is based on the data that follows:
- Strength
 - Corrosion Protection
 - Weight
 - Temperature
 - Fatigue Properties
 - Method of Installation
- C. It can be necessary to install alternative fasteners because:
- The specified fastener is not available
 - It is not easy to get access to a necessary location
 - The special repair is different from the general repair
- D. Paragraph 4./GENERAL gives definitions and other fastener data that are related to the Fastener Substitution Tables given in Figure 1/GENERAL, Figure 2/GENERAL and Figure 3/GENERAL.

3. References

Reference	Title
51-40-06, GENERAL	Fastener Edge Margins

4. Fastener Substitution Tables

- A. Table 1/GENERAL gives an index for the Fastener Substitution Tables. Equivalent and alternative fasteners are shown by part numbers in different columns in the Fastener Substitution Tables. The flagnotes given near the fastener part numbers tell about the permitted use of the equivalent or alternative fasteners.
- B. An EQUIVALENT fastener is a fastener which is directly interchangeable with the initial fastener. Usually the equivalent fasteners are given under a vendor part number and are not always the same as those supplied to The Boeing Company.

CAUTION: DO NOT USE THE FASTENER SUBSTITUTION TABLES TO FIND ALTERNATIVES FOR THE FASTENERS LISTED IN THE ALTERNATIVE COLUMN. IF YOU DO NOT OBEY, YOU WILL NOT HAVE AN APPROVED REPAIR.

- C. An ALTERNATIVE fastener is a fastener with equal or greater strength properties than the initial fastener. However, an alternative fastener cannot be used when:
- (1) They do not give the necessary pressure or fuel seal.
 - (2) Nonmagnetic fasteners are necessary and the alternative fastener is magnetic.

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STRUCTURAL REPAIR MANUAL

- (3) Fastener thread length, grip length or diameter is not available.
- (4) Access does not permit fastener installation.
- (5) Fastener installation tools are not available.
- D. When the equivalent or alternative fastener is used, use the same fastener spacing shown in the applicable repair procedure.
- E. Do not use an equivalent or alternative flush-head fastener if the necessary countersink is deeper than the initial flush-head fastener.
- F. If an alternative bolt is used, it must have the same locking feature as the initial bolt. Usual locking features include a drilled head, drilled shank, or a self-locking nut. For bolts used as an alternative for hex-drive bolts or lockbolts that are installed in non-interference holes, an applicable self-locking nut must be installed.
- G. Do not use aluminum or alloy steel fasteners as alternatives for titanium or corrosion-resistant steel fasteners in graphite structures.
- H. The equivalent and alternative fasteners given in the substitution tables can have different electrical conductivity than the initial fasteners.

If electrical bonding across the fastener is necessary, make sure that the equivalent or alternative fasteners have the necessary electrical conductivity.

5. Fasteners Inactive for Boeing Design (Supersessions)

- A. It is possible to continue to use fasteners that are inactive for design in Boeing Airplanes. If you have a fastener in stock that a Boeing Fastener Specification shows as superseded, you are permitted to use it if the alternative fastener (or fasteners) is a Class I, II, IIA, III or IV Supersession.

NOTE: A Class IV Supersession fastener and a fastener that it supersedes, are not interchangeable.

- B. If a fastener has been superseded by a Class V Supersession, Boeing recommends that you use an alternative fastener.

Table 1: Index to Fastener Substitution Tables

Fastener Substitution - Rivets	Figure 1/GENERAL
Fastener Substitution - Bolts	Figure 2/GENERAL
Fastener Substitution - Lockbolts	Figure 3/GENERAL

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NOTES

- REFER TO TABLE I FOR THE FASTENER SUBSTITUTION INDEX.
- REFER TO SRM 51-40-02 FOR THE REMOVAL AND THE INSTALLATION OF FASTENERS.
- REFER TO SRM 51-30-01 FOR THE NECESSARY PROTECTIVE TREATMENT TO INSTALL FASTENERS.

A YOU MUST KEEP THE COUNTERSINK DEPTH CONSTANT FOR ALL BACR15CE AND BACR15GF RIVETS.

- IF SUBSTITUTE RIVETS ARE INSTALLED, YOU MUST MICRO-SHAVE THE ALTERNATIVE RIVET TO MAKE SURE THAT THE REPAIR SURFACE IS SMOOTH.

B THE NOMINAL DIAMETER OF THE BACR15FP, BACR15FR, NAS1738, AND THE NAS1739 BLIND RIVETS ARE APPROXIMATELY 1/64 INCH GREATER THAN THE NOMINAL DIAMETER OF NAS1398 AND NAS1399 BLIND RIVETS. REFER TO SRM 51-40-05.

C NAS1398 AND NAS1399 BLIND RIVETS ARE SUPPLIED WITH SPINDLES THAT HAVE A FULL SERRATION, OR A PARTIAL SERRATION.

- NAS1398-()-() AND NAS1399-()-() HAVE A PARTIAL SERRATION
- NAS1398-()A() AND NAS1399-()A() HAVE A FULL SERRATION.

NOTE: USE ONLY THE SPECIFIED TOOL FOR A GIVEN TYPE OF SPINDLE SERRATION.

D THESE FASTENERS ARE ONLY PERMITTED FOR THE ATTACHMENT OF NUTPLATES.

E THIS FASTENER IS NOT PERMITTED FOR USE IN MAGNESIUM STRUCTURES.

F ASK THE BOEING COMPANY FOR FASTENER ALTERNATIVES.

G THIS FASTENER IS PERMITTED WHEN THE DIAMETER IS $\leq 5/16$ INCH.

H THE INITIAL FASTENER IS USED IN FUEL AREAS OF THE WING. IT IS POSSIBLE THAT THE REPLACEMENT FASTENER WILL HAVE SPECIAL INTERFERENCE REQUIREMENTS. ASK THE BOEING COMPANY FOR ALTERNATIVE FASTENER AND INSTALLATION INSTRUCTIONS.

I THE BLIND RIVET IS ONLY APPLICABLE TO THE ATTACHMENT OF NUTPLATES THAT HAVE A PRIMARY FASTENER HOLE DIAMETER UP TO A MAXIMUM OF 1/4 INCH.

- THIS IS NOT APPLICABLE TO THE ATTACHMENT OF DOME SEAL NUTS, RIGHT ANGLE NUTPLATES, OR STANDOFFS.

- THIS IS APPLICABLE TO NUTPLATE ATTACHMENT WHERE THE PRIMARY FASTENER IS INSTALLED IN A NON-COLD WORKED CLASS 2 OR CLASS 3 HOLE.

THE BLIND RIVET IS NOT PERMITTED IN AREAS NEAR THE ENGINE INLETS, FUSELAGE SKINS, FUSELAGE FRAMES, FLOOR BEAMS, WING LEADING OR TRAILING EDGE STRUCTURE.

THE BLIND RIVET CAN ONLY BE USED WHEN YOU DO NOT HAVE SUFFICIENT ACCESS TO INSTALL SOLID RIVETS.

- INSTALL THE BLIND RIVETS WET WITH THE APPLICABLE SEALANT.

J DO NOT USE THESE FASTENERS IN FUEL TANK AREAS.

K THIS FASTENER IS ALLOY STEEL AND IS ONLY PERMITTED FOR USE INSIDE THE PRESSURIZED FUSELAGE ABOVE THE FLOOR.

L REDUCED HEAD FASTENERS ARE NOT PERMITTED AS SUBSTITUTES FOR UNIVERSAL HEAD RIVETS IN FUSELAGE SKIN AND PRESSURE BULKHEAD STRUCTURES.

M THIS FASTENER IS NOT PERMITTED IN ALUMINUM STRUCTURE OR WHERE ELECTRICAL CONDUCTIVITY IS REQUIRED.

N SUBSTITUTION IS NOT PERMITTED IN AREAS WHERE THE ALTERNATIVE PART RIVET HEAD WOULD TOUCH A PART RADIUS ON THE STRUCTURE.

O SUBSTITUTION FOR REDUCED HEAD RIVET NOT PERMITTED IN ALUMINUM STRUCTURE. DO NOT MICROSHAVE MONEL RIVETS IN ALUMINUM STRUCTURE.

P INSTALL TO THE SAME BUTTON DIMENSIONS AS THE BACR15GF RIVET.

Fastener Substitution - Rivets
Figure 1 (Sheet 1 of 16)



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STRUCTURAL REPAIR MANUAL

TYPE OF RIVET FASTENER	LOCATION OF FASTENER	
	TABLE NUMBER	SHEET NUMBER
RIVET - SOLID SHANK - PROTRUDING HEAD	II	3 THROUGH 5
RIVET - SOLID SHANK - FLUSH HEAD	III	6 THROUGH 9
RIVET - BLIND - PROTRUDING HEAD	IV	10 THROUGH 12
RIVET - BLIND - FLUSH HEAD	V	13 THROUGH 15
RIVET - SLUG	VI	16

RIVET FASTENER SUBSTITUTION INDEX
TABLE I

Fastener Substitution - Rivets
Figure 1 (Sheet 2 of 16)

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INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15AY()-()	ALLOY STEEL HI SHEAR FLAT HEAD INTERFERENCE F17 160 KSI	NO EQUIVALENT	F
BACR15BB()-A()	1100F AL, ANODIZED, CLOSE TOLERANCE SHANK	MS20470A	BACR15DR()-P() E I J K BACR15DR()-PAC() E I J
BACR15BB()-A()-C	1100-F AL, CONVERSION COATED, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15DR()-P() E I J K BACR15DR()-PAC() E I J
BACR15BB()-AD()	2117-T4 AL, ANODIZED OR CONVERSION COATED, CLOSE TOLERANCE SHANK	MS20470AD	BACR15BB()-AD()-C BACR15DR()-P() E I J K BACR15DR()-PAC() E I J BACR15FT()-AD L
BACR15BB()-AD()-C	2117-T4 AL, CONVERSION COATED, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15DR()-P() E I J K BACR15DR()-PAC() E I J
BACR15BB()-B()	5056-H32 AL, ANODIZED OR CONVERSION COATED, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15BB()-B()-C BACR15DR()-P() E I J K BACR15DR()-PAC() E I J
BACR15BB()-B()-C	5056-H32 AL, CONVERSION COATED, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15DR()-P() E I J K BACR15DR()-PAC() E I J
BACR15BB()-D()	2017-T4 AL, ANODIZED OR CONVERSION COATED, CLOSE TOLERANCE SHANK	MS20470D	BACR15BB()-D()-C BACR15BB()-DD() BACR15DR()-P() E I J K BACR15DR()-PAC() E I J BACR15FT()-D() G L BACR15FT()-KE()-C G L MS20470DD
BACR15BB()-D()-C	2017-T4 AL, CONVERSION COATED, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15DR()-P() E I J K BACR15DR()-PAC() E I J BACR15FT()-KE()-C G L

RIVET - SOLID SHANK - PROTRUDING HEAD
TABLE II

Fastener Substitution - Rivets
Figure 1 (Sheet 3 of 16)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15BB()DD()	2024-T4 AL, ANODIZED, CLOSE TOLERANCE SHANK	MS20470DD	BACR15DR()P() <input type="checkbox"/> E <input type="checkbox"/> I <input type="checkbox"/> J <input type="checkbox"/> K
			BACR15DR()PAC() <input type="checkbox"/> E <input type="checkbox"/> I <input type="checkbox"/> J
			BACR15FT()DD() <input type="checkbox"/> L
			BACR15FT()KE()C <input type="checkbox"/> G <input type="checkbox"/> J <input type="checkbox"/> L
BACR15DX()M()	MONEL, CLOSE TOLERANCE SHANK	NO EQUIVALENT	NASM20615-()M()
BACR15DX()-()	A286 CRES UNIVERSAL HEAD CLOSE TOLERANCE SHANK	NO EQUIVALENT	NAS1198()-()
BACR15ET()AD()	2117-T4 AL, ANODIZED, UNIVERSAL HEAD, CLOSE TOLERANCE SHANK, 0.031 OVERSIZE	NO EQUIVALENT	NAS1242AD
BACR15ET()B()	5056-H32 AL, ANODIZED, UNIVERSAL HEAD, CLOSE TOLERANCE SHANK, 0.031 OVERSIZE	NO EQUIVALENT	NAS1242B
BACR15ET()D()	2017-T4 AL, ANODIZED, UNIVERSAL HEAD, CLOSE TOLERANCE SHANK, 0.031 OVERSIZE	NO EQUIVALENT	NAS1242D
			NAS1242DD
BACR15ET()DD()	2024-T4 AL, ANODIZED, UNIVERSAL HEAD, CLOSE TOLERANCE SHANK, 0.031 OVERSIZE	NO EQUIVALENT	NAS1242DD
BACR15FT()AD()	2117-T4 AL, ANODIZED, MODIFIED UNIVERSAL HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15BB()AD() <input type="checkbox"/> N
			BACR15BB()AD()C <input type="checkbox"/> N
			MS20470AD <input type="checkbox"/> N
BACR15FT()D()	2017-T4 AL, ANODIZED, MODIFIED UNIVERSAL HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15BB()D() <input type="checkbox"/> N
			BACR15BB()DD() <input type="checkbox"/> N
			BACR15FT()KE()C
			MS20470D <input type="checkbox"/> N
			MS20470DD <input type="checkbox"/> N

RIVET - SOLID SHANK - PROTRUDING HEAD
TABLE II

Fastener Substitution - Rivets
Figure 1 (Sheet 4 of 16)

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15FT()DD()	2024-T4 AL, ANODIZED, MODIFIED UNIVERSAL HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15BB()DD() N
			BACR15DR()P() E I J K
			BACR15DR()PAC() E I J
			BACR15FT()KE()C G J L
			MS20470DD N
BACR15FT()KE()C	7050-T73 AL, CONVERSION COATED, MODIFIED UNIVERSAL HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15BB()DD() N
			BACR15FT()DD()
			MS20470DD N
MS20470A	1100-F AL, UNIVERSAL HEAD	BACR15BB()A()	BACR15FT()A()C
MS20470AD()-()	2117-T4 AL, ANODIZED, UNIVERSAL HEAD	BACR15BB()AD()	BACR15BB()AD()C
			BACR15FT()AD() L
MS20470B()-()	5056-H32 AL, ANODIZED, UNIVERSAL HEAD	BACR15BB()B()	BACR15FT()B()C
MS20470D()-()	2017-T4 AL, ANODIZED, UNIVERSAL HEAD	BACR15BB()D()	BACR15BB()D()C
			BACR15BB()DD()
			BACR15FT()D() G L
			BACR15FT()DD() L
			BACR15FT()KE()C G L
			MS20470DD
MS20470DD	2024-T4 AL, ANODIZED, UNIVERSAL HEAD	BACR15BB()DD()	BACR15FT()DD() L
MS20470E	7050-T73 AL, UNIVERSAL HEAD	NO EQUIVALENT	BACR15BB()DD()
			BACR15FT()KE()C L
			MS20470DD
MS20615()M	MONEL	BACR15DX()M()	NO ALTERNATIVE
NAS1198	A286 CRES	BACR15DX()-()	NO ALTERNATIVE

RIVET - SOLID SHANK - PROTRUDING HEAD
TABLE II

Fastener Substitution - Rivets
Figure 1 (Sheet 5 of 16)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15AD()AD()	2117-T4 AL, ANODIZED, 100° HEAD, 0.031 OVERSIZE	NO EQUIVALENT	NAS1241AD
BACR15AD()DD()	2024-T4 AL, ANODIZED, 100° HEAD, 0.031 OVERSIZE	NO EQUIVALENT	NAS1241DD
BACR15AD()D()	2017-T4 AL, ANODIZED, 100° HEAD, 0.031 OVERSIZE	NO EQUIVALENT	NAS1241DD
			NAS1241D
BACR15AD()B()	5056-H32 AL, ANODIZED, 100° HEAD, 0.031 OVERSIZE	NO EQUIVALENT	NAS1241B
BACR15AZ()-()	ALLOY STEEL HI SHEAR 100° HEAD INTERFERENCE FIT 160 KSI	NO EQUIVALENT	F
BACR15BA()A()	1100F AL, ANODIZED, 100° HEAD, CLOSE TOLERANCE SHANK	MS20426A	BACR15DR()-() E I J K
			BACR15DR()AC() E I J
BACR15BA()A()C	1100-F AL, CONVERSION COATED, 100° PRECISION HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15DR()-() E I J K
			BACR15DR()AC() E I J
BACR15BA()AD()	2117-T4 AL, ANODIZED OR CONVERSION COATED, 100° PRECISION HEAD, CLOSE TOLERANCE SHANK	MS20426AD	BACR15BA()AD()C
			BACR15DR()AC() E I J
			BACR15DR()-() E I J K
			BACR15GE()CW() E I J
BACR15BA()AD()C	2117-T4 AL, CONVERSION COATED, 100° PRECISION HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15DR()-() E I J K
			BACR15DR()AC() E I J
			BACR15GE()CW() E I J

RIVET – SOLID SHANK – FLUSH HEAD
TABLE III

Fastener Substitution - Rivets
Figure 1 (Sheet 6 of 16)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15BA()B()	5056F AL, ANODIZED, 100° HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15BA()AD() E BACR15BA()D() E MS20426AD E MS20426B E MS20426D E
BACR15BA()B()C	5056-H32 AL, CONVERSION COATED, 100° PRECISION HEAD, CLOSE TOLERANCE SHANK	NO EQUIVALENT	BACR15DR()-() E I J K BACR15DR()AC() E I J
BACR15BA()D()	2017-T3 AL, CONVERSION COATED, 100° PRECISION HEAD, CLOSE TOLERANCE SHANK	MS20426D	BACR15BA()D()C BACR15BA()DD() BACR15DR()-() E I J K BACR15DR()AC() E I J MS20426DD
BACR15BA()DD()	2024-T4 AL, ANODIZED, 100° PRECISION HEAD, CLOSE TOLERANCE SHANK	MS20426DD	BACR15DR()-() E I J K BACR15DR()AC() E I J
BACR15CE()AD()	2117-T4 AL, ANODIZED, 100° SHEAR HEAD	NO EQUIVALENT	BACR15BA()AD A MS20426AD A NAS1097AD
BACR15CE()B()	5056-H32 AL, ANODIZED, 100° SHEAR HEAD	NO EQUIVALENT	BACR15BA()B A MS20426B A NAS1097B
BACR15CE()D()	2017-T4 AL, CONVERSION COATED, 100° SHEAR HEAD	NO EQUIVALENT	BACR15BA()D() A BACR15BA()DD() A BACR15GF()D() MS20426D A MS20426DD A NAS1097D
BACR15CE()M()	MONEL, 100° SHEAR HEAD	NO EQUIVALENT	NAS1200M MS20427M A O

RIVET - SOLID SHANK - FLUSH HEAD
TABLE III

Fastener Substitution - Rivets
Figure 1 (Sheet 7 of 16)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15DY()-()	A286 CRES 100° SHEAR HEAD CLOSE TOLERANCE SHANK	NO EQUIVALENT	NAS1200()-()
BACR15DY()M()	MONEL 100° SHEAR HEAD CLOSE TOLERANCE SHANK	NO EQUIVALENT	NAS1200M()-()
BACR15FH()AD()	2117-T4 AL, ANODIZED, MODIFIED, 82° HEAD (INDEX HEAD)	NO EQUIVALENT	H
BACR15FH()DD()	2024-T4 AL, ANODIZED, MODIFIED, 82° HEAD (INDEX HEAD)	NO EQUIVALENT	H
BACR15FH()KE()	7050-T73 AL, ANODIZED, MODIFIED 82° HEAD (INDEX HEAD)	NO EQUIVALENT	H
BACR15GF()D()	2017-T4 AL, CONVERSION COATED, 100° PRECISION SHEAR HEAD	NO EQUIVALENT	BACR15CE()D() P
BACR15GH()KE()	7050-T73 AL, ANODIZED, INDEX HEAD	NO EQUIVALENT	H
MS20427M()	MONEL, 100° HEAD	NO EQUIVALENT	BACR15GE()C() E I J
MS20427M()C()	MONEL, CADMIUM PLATED, 100° HEAD	NO EQUIVALENT	BACR15GE()CW() E I J
MS20426AD	2117-T4 AL, ANODIZED, 100° HEAD	BACR15BA()AD()	BACR15BA()AD()C MS20426AD
MS20426DD	2024-T4 AL, ANODIZED, 100° HEAD	BACR15BA()DD()	BACR15DR()-() E I J K BACR15DR()AC() E I J
MS20426D()-()	2017-T4 AL, ANODIZED, 100° HEAD	BACR15BA()D()	BACR15BA()D()C BACR15BA()DD MS20426DD

RIVET - SOLID SHANK - FLUSH HEAD
TABLE III

Fastener Substitution - Rivets
Figure 1 (Sheet 8 of 16)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION					
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE				
MS20426A	1100-F, 100° HEAD	BACR15BA()A()	BACR15DR()-() <table><tr><td>E</td><td>I</td><td>J</td><td>K</td></tr></table>	E	I	J	K
E	I	J	K				
MS20426B	5056-H32 AL, ANODIZED, 100° HEAD	BACR15BA()B()	BACR15DR()AC() <table><tr><td>E</td><td>I</td><td>J</td></tr></table>	E	I	J	
E	I	J					
BACR15FV()KE()	7050-T73 AL, ANODIZED OR CONVERSION COATED, 120° MODIFIED SHEAR HEAD	MS14218E()-()	NO ALTERNATIVE				
MS14218E()-()	7050-T73 AL, ANODIZED OR CONVERSION COATED, 120° FLUSH INTERFERENCE SHEAR HEAD	BACR15FV()KE()	NO ALTERNATIVE				

RIVET - SOLID SHANK - FLUSH HEAD
TABLE III

Fastener Substitution - Rivets
Figure 1 (Sheet 9 of 16)



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INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15DA()-()	5056-F AL BLIND SELF PLUGGING	NO EQUIVALENT	BACR15FR()E()R
			NAS1398B()-()
			NAS1738B()-()
			NAS1738E()-()
BACR15DA()H()	5056-F AL BLIND-PULL THRU	NO EQUIVALENT	BACR15FR()E()R
			MS20604B()T()
			MS20604B()W()
			NAS1398B()-()
			NAS1738B()-()
BACR15DR()P()	NONSTRUCTURAL (PULL THRU TYPE), C1018 STEEL SLEEVE, CAD PLATED, MAX TEMP 450°F (232°C), UNIVERSAL HEAD	NO EQUIVALENT	BACR15BB()D D
			BACR15DR()PAC()
			BACR15FT()D() D
			MS20470D D
BACR15EB-P()-()	BULBED CHERRYLOCK, SELF-PLUGGING, 5056 AL SLEEVE. MAX TEMP 250°F (121°C)	NO EQUIVALENT	BACR15FR()E()R
			NAS1738E
			NAS1738MW
BACR15FR()E()R	CHERRY-MAX SYSTEM, CRES STEM, 5056 AL SLEEVE, LOCKED SPINDLE-BULBED, MAX TEMP 250°F	ALLFAST AF3253-()-()B CHERRY CR3253-()-() HUCK HR3253-()-()	NO ALTERNATIVE
CHERRY CR6253-()-()	CHERRY SST, 5056 AL SLEEVE, A-286 CRES STEM, A-286 CRES LOCK COLLAR, UNIVERSAL HEAD, OVERSIZED DIAMETER, MAX TEMP 250°F	NO EQUIVALENT	NO ALTERNATIVE
NAS1398B()-() C	5056 AL SLEEVE, LOCKED SPINDLE, PARTIAL SERRATED STEM, MAX TEMP 250°F, UNIVERSAL HEAD	CHERRY CR2263-()-() ALLFAST AF2050-()-()	NAS1398D()-() C E
			NAS398D()A() C E
			NAS1738E B
			BACR15FR()E() B
			BACR15FR()E()R B
			NAS1738B B

RIVET - BLIND - PROTRUDING HEAD
TABLE IV

Fastener Substitution - Rivets
Figure 1 (Sheet 10 of 16)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
NAS1398B()A() C	5056 AL SLEEVE, LOCKED SPINDLE, FULL SERRATED STEM, MAX TEMP 250°F	CHERRY CR2273-()-() ALLFAST RV1250-()-()	BACR15FR()E() B
			BACR15FR()E()R B
			NAS1398B()-() C
			NAS1398D()-() C E
			NAS1398D()A() C E
			NAS1738B B
			NAS1738E B
NAS1398C()-() C	A-286 CRES SLEEVE, LOCKED SPINDLE, PARTIAL SERRATED STEM, MAX TEMP 1200°F	CHERRY CR2663-()-() ALLFAST AF2040-()-()	NAS1398C()A() C
NAS1398C()A() C	A-286 CRES SLEEVE, LOCKED SPINDLE, FULL SERRATED STEM, MAX TEMP 1200°F (649°C)	CHERRY CR2673-()-() ALLFAST RV1240-()-()	NAS1398C()-() C
NAS1398CW()-() C	A-286 CRES SLEEVE, CADMIUM PLATED, LOCKED SPINDLE, PARTIAL SERRATED STEM, MAX TEMP 450°F (232°C)	ALLFAST AF2040W-()-() CHERRY CR2663CW-()-()	NAS1398CW()A() C
NAS1398CW()A() C	A-286 CRES SLEEVE, CADMIUM PLATED, LOCKED SPINDLE, FULL SERRATED STEM, MAX TEMP 450°F (232°C)	CHERRY CR2673CW-()-() ALLFAST RV1240W-()-()	NAS1398CW()-() C
NAS1398D()-() C	2017 AL SLEEVE, LOCKED SPINDLE, PARTIAL SERRATED STEM, MAX TEMP 250°F (121°C)	ALLFAST AF2000-()-() CHERRY CR2163-()-()	BACR15FR()E() B
			BACR15FR()E()R B
			NAS1398D()A() C
			NAS1738B B
			NAS1738E B
NAS1398D()A() C	2017 AL SLEEVE, LOCKED SPINDLE, FULL SERRATED STEM, MAX TEMP 250°F (121°C)	ALLFAST RV1200-()-() CHERRY CR2173-()-()	BACR15FR()E() B
			BACR15FR()E()R B
			NAS1398D()-() C
			NAS1738B B
			NAS1738E B

RIVET - BLIND - PROTRUDING HEAD
TABLE IV

Fastener Substitution - Rivets
Figure 1 (Sheet 11 of 16)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
NAS1398M()-() [C]	MONEL SLEEVE, LOCKED SPINDLE, PARTIAL SERRATED STEM, MAX TEMP 900°F (482°C)	ALLFAST AF2090M()-() CHERRY CR2563M()-()	BACR15FR()M() [B]
			BACR15FR()M()R [B]
			NAS1398M()A() [C]
			NAS1738M [B]
NAS1398M()A() [C]	MONEL SLEEVE, LOCKED SPINDLE, FULL SERRATED STEM, MAX TEMP 900°F (482°C)	ALLFAST RV1290M()-() CHERRY CR2573()-()	BACR15FR()M() [B]
			BACR15FR()M()R [B]
			NAS1398M()-() [C]
			NAS1738M [B]
NAS1398MW()-() [C]	MONEL SLEEVE, CADMIUM PLATED, LOCKED SPINDLE, PARTIAL SERRATED STEM, MAX TEMP 450°F (232°C)	ALLFAST AF2090W()-() CHERRY CR2563()-()	NAS1398MW()A() [C]
			NAS1738MW [B]
NAS1398MW()A() [C]	MONEL SLEEVE, CADMIUM PLATED, LOCKED SPINDLE, FULL SERRATED STEM, MAX TEMP 450°F (232°C)	ALLFAST RV1290()-() CHERRY CR2573P()-()	NAS1398MW()-() [C]
			NAS1738MW [B]
NAS1738B()-()	5056 AL SLEEVE, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 250°F, UNIVERSAL HEAD	CHERRY CR2249()-()	NAS1738E BACR15FR()E BACR15FR()E()R
NAS1738C	INCONEL 600 SLEEVE, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 250°F (121°C), UNIVERSAL HEAD	CHERRY CR2839()-()	NO ALTERNATIVE
NAS1738E()-()	5056 AL SLEEVE, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 250°F (121°C)	CHERRY CR2239()-() ALLFAST AF2550()-()	BACR15FR()E()
			BACR15FR()E()R
NAS1738M()-()	MONEL SLEEVE, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 900°F (482°C)	CHERRY CR2539()-() ALLFAST AF2290()-()	BACR15FR()M()
			BACR15FR()M()R
NAS1738MW()-()	MONEL SLEEVE, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 450°F (232°C)	CHERRY CR2539P()-() ALLFAST AF2290W()-()	BACR15FR()MP() [M]

RIVET - BLIND - PROTRUDING HEAD
TABLE IV

Fastener Substitution - Rivets
Figure 1 (Sheet 12 of 16)

STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15DA()C()	5056-F BLIND 100° HEAD SELF PLUGGING	NO EQUIVALENT	BACR15FP()E()R NAS1399B()-(NAS1739B()-(NAS1739E()-(
BACR15DA()CH()	5056-F BLIND 100° HEAD PULL THRU	NO EQUIVALENT	BACR15FP()E()R NAS1399B()-(NAS1739B()-(NAS1739E()-(MS20605B()T() MS20605B()W()
BACR15DR()-(NON-STRUCTURAL (PULL THRU TYPE), C1018 STEEL SLEEVE, CADMIUM PLATED, 100° HEAD, MAX TEMP 450°F (232°C)	CHERRY CCR264SS()-(ALLFAST AF5171()-(BACR15BA()AD()C D BACR15BA()D()C D BACR15DR()AC() BACR15GE()CW()
BACR15EB()-(BULBED CHERRYLOCK, SELF-PLUGGING, 5056 AL SLEEVE. MAX TEMP 250°F (121°C)	NO EQUIVALENT	BACR15FP()E()R NAS1739E NAS1739MW NAS1739B
BACR15FP()E()R	CHERRY-MAX SYSTEM, 5056 AL SLEEVE, CADMIUM PLATED, 100° HEAD, MAX TEMP 250°F (121°C)	ALLFAST AF3252()-(CHERRY CR3252()-(HUCK HR3252()-(NO ALTERNATIVE
NAS1399B()A() C	5056 AL SLEEVE, LOCKED SPINDLE, 100° HEAD, FULL SERRATED STEM, MAX TEMP 250°F (121°C)	CHERRY CR2272()-(ALLFAST RV1251()-(CHERRY CR2262()-(BACR15FP()E() B BACR15FP()E()R B NAS1399B()-(C NAS1399D()-(C E NAS1399D()A() C E NAS1739B B NAS1739E B
NAS1399B()-(C	5056 AL SLEEVE, LOCKED SPINDLE, 100° HEAD, PARTIAL SERRATED STEM, MAX TEMP 250°F (121°C)	CHERRY CR2262()-(ALLFAST AF2051()-(VOI-SHAN CR9262()A()	BACR15FP()E() B BACR15FP()E()R B NAS1399B()A() C NAS1399D()-(C E NAS1399D()A() C E NAS1739B B NAS1739E B

RIVET - BLIND - FLUSH HEAD
TABLE V

Fastener Substitution - Rivets
Figure 1 (Sheet 13 of 16)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
NAS1399C()-()	A-286 CRES SLEEVE, LOCKED SPINDLE, 100° HEAD, PARTIAL SERRATED STEM, MAX TEMP 250°F	CHERRY CR2662-()-() ALLFAST AF2041-()-()	NAS1399C()A()
NAS1399C()A() [C]	A-286 CRES SLEEVE, LOCKED SPINDLE, 100° HEAD, FULL SERRATED STEM, MAX TEMP 1200°F	CHERRY CR2672-()-() ALLFAST RV1241-()-() CHERRY CR2662-()-()	NAS1399C()-() [C]
NAS1399CW()-() [C]	A-286 CRES SLEEVE, CAD PLATED, LOCKED SPINDLE, 100° HEAD, PARTIAL SERRATED STEM, MAX TEMP 450°F	ALLFAST AF2041W-()-() CHERRY CR2662CW-()-()	NAS1399CW()A() [C]
NAS1399CW()A() [C]	A-286 CRES SLEEVE, CADMIUM PLATED, LOCKED SPINDLE, 100° HEAD, FULL SERRATED STEM, MAX TEMP 450°F	CHERRY CR2672CW-()-() ALLFAST RV1241W-()-() CHERRY CR2662W-()-()	NAS1399CW()-() [C]
NAS1399D()-() [C]	2017 AL SLEEVE, LOCKED SPINDLE, 100° HEAD, PARTIAL SERRATED STEM, MAX TEMP 250°F	CHERRY CR2162-()-() ALLFAST AF2001W-()-() VOI-SHAN CR9162-()A()	BACR15FP()E() [B]
			BACR15FP()E()R [B]
			NAS1399D()A() [C]
			NAS1739B [B]
			NAS1739E [B]
NAS1399D()A() [C]	2017 AL SLEEVE, LOCKED SPINDLE, 100° HEAD, FULL SERRATED STEM, MAX TEMP 250°F	CHERRY CR2172-()-() ALLFAST RV1201-()-() CHERRY CR2162-()-() VOI-SHAN CR9162-()A()	BACR15FP()E() [B]
			BACR15FP()E()R [B]
			NAS1739B()-() [B]
			NAS1399D()-() [C]
			NAS1739E()-() [B]
NAS1399M()-() [C]	MONEL SLEEVE, LOCKED SPINDLE, 100° HEAD, PARTIAL SERRATED STEM, MAX TEMP 900°F	CHERRY CR2562M-()-() ALLFAST AF2091-()-()	BACR15FP()M() [B]
			BACR15FP()M()R [B]
			NAS1399M()A() [C]
			NAS1739M [B]

RIVET - BLIND - FLUSH HEAD
TABLE V

Fastener Substitution - Rivets
Figure 1 (Sheet 14 of 16)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
NAS1399M()A() [C]	MONEL SLEEVE, LOCKED SPINDLE, 100° HEAD, FULL SERRATED STEM, MAX TEMP 900°F	CHERRY CR2572-()-() ALLFAST RV1291M-()-() CHERRY CR2562M-()-()	BACR15FP()M() [B]
			BACR15FP()M()R [B]
			NAS1399M-()-() [C]
			NAS1739M [B]
NAS1399MW-()-() [C]	MONEL SLEEVE, CADMIUM PLATED, LOCKED SPINDLE, 100° HEAD, PARTIAL SERRATED STEM, MAX TEMP 450°F	CHERRY CR2562-()-() ALLFAST AF2091W-()-()	NAS1739MW [B]
			NAS1399MW()A() [C]
NAS1399MW()A() [C]	MONEL SLEEVE, CADMIUM PLATED, LOCKED SPINDLE, 100° HEAD, FULL SERRATED STEM, MAX TEMP 450°F	ALLFAST RV1291-()-() CHERRY CR2572P-()-() CHERRY CR2562-()-()	NAS1399MW-()-() [C]
			NAS1739MW [B]
NAS1739B	5056 AL SLEEVE, 100° HEAD, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 250°F	CHERRY CR2248-()-()	BACR15FP()E()
			BACR15FP()E()R
			NAS1739E
NAS1739C	INCONEL 600 SLEEVE, 100° HEAD, MECHANICALLY LOCKED SPINDLE, BULBED	CHERRY CR2838-()-()	NO ALTERNATIVE
NAS1739E-()-()	5056 AL SLEEVE, 100° HEAD, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 250°F	ALLFAST AF2551-()-() CHERRY CR2238-()-() CHERRY CR3252-()-() BACR15FP()E()	BACR15FP()E()
			BACR15FP()E()R
NAS1739M	MONEL SLEEVE, 100° HEAD, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 900°F	ALLFAST AF2291-()-() CHERRY CR2538-()-()	BACR15FP()M()
			BACR15FP()M()R
NAS1739MW	MONEL SLEEVE, CADMIUM PLATED, 100° HEAD, MECHANICALLY LOCKED SPINDLE, BULBED, MAX TEMP 450°F	ALLFAST AF2291W-()-() CHERRY CR2538P-()-()	BACR15FP()MP() [M]

RIVET - BLIND - FLUSH HEAD
TABLE V

Fastener Substitution - Rivets
Figure 1 (Sheet 15 of 16)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER		FASTENER SUBSTITUTION	
PART NUMBER	DESCRIPTION	EQUIVALENT	ALTERNATIVE
BACR15BD()AD()	2117-T4 AL, ANODIZED	NO EQUIVALENT	<input type="checkbox"/>
BACR15BD()DD()	2024-T4 AL, ANODIZED	NO EQUIVALENT	<input type="checkbox"/>
BACR15GG()KE()	7050-T73 AL, ANODIZED	NO EQUIVALENT	<input type="checkbox"/>

RIVETS – SLUG
TABLE VI

Fastener Substitution - Rivets
Figure 1 (Sheet 16 of 16)

STRUCTURAL REPAIR MANUAL

NOTES

- REFER TO TABLE I FOR THE FASTENER SUBSTITUTION INDEX.
 - REFER TO SRM 51-40-02 FOR THE REMOVAL AND THE INSTALLATION OF FASTENERS.
 - THE SHEAR AND TENSION TYPE FASTENERS USE DIFFERENT TORQUE VALUES AND INSTALLATION TOOLS. REFER TO SRM 51-40-04.
 - REFER TO SRM 51-30-01 FOR THE NECESSARY PROTECTIVE TREATMENT FOR FASTENER INSTALLATION.
 - DO NOT USE CADMIUM PLATED FASTENERS IN TITANIUM OR GRAPHITE (CARBON FIBER) STRUCTURE.
- [A]** DO NOT USE ALLOY STEEL FASTENERS AS AN ALTERNATIVE FOR THE CORROSION RESISTANT STEEL (CRES) OR TITANIUM FASTENERS IN:
- AREAS WHERE ANTI-MAGNETIC FASTENERS ARE NECESSARY
 - GRAPHITE (CARBON FIBER) STRUCTURE
 - CRES STRUCTURE
- [B]** THESE BOLTS MUST HAVE A HOLE WITH A LARGER FILLET RELIEF UNDER THE BOLT HEAD. REFER TO SRM 51-40-05.
- USE THESE FASTENERS ONLY IF THERE IS NOT A HEIGHT LIMIT ON THE FASTENER HEAD.
- [C]** ASK THE BOEING COMPANY FOR FASTENER ALTERNATIVES.
- [D]** A WASHER WITH A COUNTERBORE THAT IS EQUIVALENT TO THE COUNTERBORE OF THE COLLAR MUST BE USED ON THE NUT SIDE IF NUTS ARE USED. NUTS CAN BE USED AS AN ALTERNATIVE FOR THE HEX-DRIVE BOLT COLLARS.
- [E]** WHEN A H-11 STEEL BOLT IS REMOVED FOR ANY REASON, ALWAYS REPLACE THE BOLT WITH AN ALTERNATIVE FASTENER.
- [F]** THESE FASTENERS ARE PERMITTED ONLY IN CLOSE REAM OR LARGER HOLES (NON-INTERFERENCE HOLES).
- [G]** WHEN A PH13-8Mo CRES BOLT IS REMOVED FOR ANY REASON, ALWAYS REPLACE THE BOLT WITH AN ALTERNATIVE FASTENER.
- [H]** WHEN A CADMIUM PLATED TITANIUM BOLT IS REMOVED FOR ANY REASON, ALWAYS REPLACE THE BOLT WITH AN ALTERNATIVE FASTENER.
- [I]** THIS FASTENER IS NOT PERMITTED IN AREAS WHERE THE TEMPERATURE IS MORE THAN 350°F (177°C).
- THIS FASTENER IS NOT PERMITTED IN AREAS WHERE ELECTRICAL CONDUCTIVITY IS REQUIRED AS GIVEN IN BAC5117.
- [J]** THIS FASTENER IS ONLY PERMITTED IN METAL-TO-METAL ASSEMBLIES. DO NOT USE THESE FASTENERS IN COMPOSITE-TO-COMPOSITE OR COMPOSITE-TO-METAL ASSEMBLIES.
- [K]** THIS FASTENER IS NOT PERMITTED IN AREAS WHERE THE TEMPERATURE IS MORE THAN 450°F (232°C).
- [L]** THE RECOMMEND FASTENERS IN ALUMINUM STRUCTURE ARE ALUMINUM PIGMENT (BMS 10-85) COATED TITANIUM, ALUMINUM PIGMENT (BMS 10-85) COATED A286, OR CADMIUM PLATED A286.
- NOTE:** THE CADMIUM-PLATED ALLOY STEEL FASTENERS ARE PERMITTED AS A STRUCTURAL ALTERNATIVE.
- HOWEVER, AN ALLOY-STEEL FASTENER, AND THE ADJACENT ALUMINUM STRUCTURE TOGETHER CAN CAUSE CORROSION.
- THEREFORE, THESE FASTENERS, THE EQUIVALENT, AND THE ALTERNATIVE MUST BE INSTALLED WET WITH THE CORRECT SEALANT.
- BOEING RECOMMENDS THAT YOU APPLY TWO COATS OF BMS 10-79 TYPE III PRIMER ON THE FASTENER HEAD.
- [M]** DO NOT USE CADMIUM PLATED FASTENERS AS AN ALTERNATIVE FOR BARE OR ALUMINUM COATED FASTENERS WHEN YOU INSTALL FASTENERS THROUGH THE MATERIALS THAT FOLLOW:
- TITANIUM STRUCTURE
 - GRAPHITE (CARBON FIBER) STRUCTURE.
- [N]** THIS FASTENER IS PERMITTED FOR FASTENERS THAT ARE 0.625 INCH OR LESS IN DIAMETER.
- [O]** THESE COLLARS CAN BE USED ON SURFACES THAT HAVE A SLOPE OF 7 DEGREES (OR LESS) ANGLE.
- [P]** THE PART WITH D-CODE (DRIVE NUT) IS RECOMMENDED.
- [Q]** ALLOY STEEL FASTENERS MUST BE REPLACED WITH ALLOY STEEL FASTENERS WHEN YOU ATTACH A SENSOR TARGET TO THE TARGET MOUNTING BRACKET AT CYLINDRICAL PROXIMITY SENSOR INSTALLATIONS.
- [R]** A WASHER IS NECESSARY FOR THIS TYPE OF INSTALLATION. REFER TO SRM 51-40-02.
- [S]** SUBSTITUTION IS PERMITTED FOR 0.3125 AND 0.375 DIAMETER FASTENERS ONLY.
- [T]** THE FASTENER MUST BE INSTALLED WITH TORQUE CONTROLLED TOOLING. REFER TO SRM 51-40-04.
- [U]** THIS FASTENER IS NOT PERMITTED IN AREAS WHERE THE TEMPERATURE IS MORE THAN 600°F (316°C).

Fastener Substitution - Bolts
Figure 2 (Sheet 1 of 67)

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STRUCTURAL REPAIR MANUAL

NOTES (CONTINUED)

- V** THIS SUBSTITUTION IS PERMITTED ONLY IF THE DIAMETER OF THE FASTENER IS 4 THRU 10.
- W** SUBSTITUTION IS NOT PERMITTED WHERE RE-TORQUING OF THE FASTENER IS NECESSARY.
- X** USE THE SAME NUT OR COLLAR THAT WAS USED ON THE INITIAL OR SPECIFIED REPAIR FASTENER.
- Y** APPLICABLE ONLY FOR DIAMETERS THAT ARE 0.250 INCH AND LARGER.
- Z** WHEN YOU REMOVE ALLOY STEEL BOLTS THAT HAVE A LAYER OF BMS 10-85 (NOT CAD PLATED) APPLIED, ALWAYS REPLACE THEM WITH AN ALTERNATIVE FASTENER.
- AA** THE MAXIMUM TEMPERATURE GIVEN IN THE DESCRIPTION IS FOR THE BOLT ONLY. THE MAXIMUM TEMPERATURE APPLICATION FOR THE BOLT/COLLAR COMBINATION MAY BE LESS, IF THERE ARE LIMITS PUT ON THE COLLAR.

THE FOLLOWING GUIDELINES ARE APPLICABLE TO THE COLLARS:

- ALUMINUM COLLARS HAVE A MAXIMUM TEMPERATURE OF 250°F (171°C)
- CADMIUM PLATED CRES COLLARS HAVE A MAXIMUM TEMPERATURE OF 450°F (232°C)
- UNPLATED CRES COLLARS HAVE A MAXIMUM TEMPERATURE OF 900°F (482°C)
- MONEL COLLARS HAVE A MAXIMUM TEMPERATURE OF 900°F (482°C).

Fastener Substitution - Bolts
Figure 2 (Sheet 2 of 67)



757-200
STRUCTURAL REPAIR MANUAL

TYPE OF FASTENER	LOCATION OF FASTENER	
	TABLE NUMBER	SHEET NUMBERS
BOLT - HEX DRIVE - PROTRUDING HEAD (SHEAR)	TABLE II	4 THRU 12
BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)	TABLE III	13 THRU 24
BOLT - HEX DRIVE - PROTRUDING HEAD (TENSION)	TABLE IV	25 THRU 29
BOLT - HEX DRIVE - FLUSH HEAD (TENSION)	TABLE V	30 THRU 34
BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD	TABLE VI	35 THRU 48
BOLT - RECESS DRIVE - FLUSH HEAD	TABLE VII	49 THRU 56
BOLT - RECESS DRIVE - PROTRUDING HEAD	TABLE VIII	57 THRU 59
BOLT - BLIND - PROTRUDING HEAD	TABLE IX	60 THRU 61
BOLT - BLIND - FLUSH HEAD	TABLE X	62 THRU 64
BOLT - TAPER SHANK - PROTRUDING HEAD	TABLE XI	65 THRU 67

BOLT FASTENER SUBSTITUTION INDEX
TABLE I

Fastener Substitution - Bolts
Figure 2 (Sheet 3 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30FM() Q AA	ALLOY STEEL, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30AG()	HI-SHEAR HL18PB	BACB30FM()A()	BACC30AG()
			SPS HL18PB	BACB30MY()K() I	BACC30AG()
			HUCK HL18PB	BACB30VN()K() I	BACC30BK()
			FAIRCHILD HL18PB	BACB30VT()K() I	BACC30BQ()
		BACC30M()	DEUTSCH HL18PB	BACB30FM()A() I	BACC30M()
			AIC HL18PB	BACB30MY()K() I	BACC30M()
			WEST COAST HL18PB	BACB30VT()K() I	BACC30BL()
					BACN10YZ() T
					BACN10ZV() T
BACB30FM()A() AA	A-286 CRES, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30AB()C	HI-SHEAR HL440UC	BACB30MY()K() I	BACC30AB()C
			SPS HL440UC	BACB30VT()K() I	BACC30BS()
		BACC30AB()S	HUCK HL440UC	BACB30MY()K() I	BACC30AB()S
			FAIRCHILD HL440UC	BACB30VT()K() I	BACC30BS()S
		BACC30AG()	DEUTSCH HL440UC	BACB30MY()K() I	BACC30AG()
			AIC HL440UC	BACB30VT()K() I	BACC30BQ()
		BACC30M()	WEST COAST HL440UC	BACB30MY()K() I	BACC30M()
				BACB30VT()K() I	BACC30BL()
BACB30FM()A()SU AA	A286 CRES, PASSIVATED, 95 KSI SHEAR, DRY FILM LUBRICATED, MAX TEMP 450°F (232°C)	BACC30AB()S	HI-SHEAR HL40DU	BACB30FM()A()U	BACC30AB()S
			SPS HL40DU	BACB30MB()A()SU	BACC30AB()S
			HUCK HL40DU	BACB30MB()A()U	BACC30AB()S
			DEUTSCH HL40DU		
			FAIRCHILD HL40DU		
			AIC HL40DU		
			WEST COAST HL40DU		

BOLT – HEX DRIVE – PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 4 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30FM()A()U AA	A286 CRES, PASSIVATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 900°F (482°C)	BACC30AB()P	HI-SHEAR HL40 SPS HL40 HUCK HL40 FAIRCHILD HL40 DEUTSCH HL40 AIC HL40 WEST COAST HL40	BACB30MB()A()U	BACC30AB()P
		BACC30AB()S		BACC30MB()A()U	BACC30AB()S
BACB30FM()AK() AA	A-286 CRES, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30AB()S	HI-SHEAR HL440AZ SPS HL440AZ HUCK HL440AZ FAIRCHILD HL440AZ DEUTSCH HL440AZ AIC HL440AZ WEST COAST HL440AZ	BACB30MY()K()	BACC30AB()S
		BACC30M()		BACB30MY()K()	BACC30M() BACN10XJ() T
BACB30FM()K() Q Z AA	ALLOY STEEL, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30M()	NO EQUIVALENT	BACB30FM()-() L M	BACC30M() BACN10XJ() T
				BACB30MY()K()	BACC30M() BACN10XJ() T
				BACB30VT()K()	BACC30BL() BACN10YZ() T
				BACB30FM()AK()	BACC30M() BACN10XJ() T
		BACC30AG()	NO EQUIVALENT	BACB30FM()-() L M	BACC30AG() BACN10ZZ()D T
				BACB30MY()K()	BACC30AG() BACN10ZZ()D T
				BACB30VT()K()	BACC30BQ()
				BACB30FM()AK()	BACC30AG() BACN10ZZ()D T

BOLT - HEX DRIVE - PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 5 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION					
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART			
BACB30GZ()-() AA	7075-T6 AL, ANODIZED, 44.5 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C)	BACC30P	HI-SHEAR HL22 FAIRCHILD HL22 WEST COAST HL22	NO ALTERNATIVE				
BACB30MY()-() H AA	6AL-4V TITANIUM CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30AB()-C	NO EQUIVALENT	BACB30FM()-AK() I	BACB30AB()-C BACN10YT()-CD T			
				BACB30MB()-AK() I	BACC30X() BACN10BH() BACN10YT()-CD T			
					BACB30MY()-K() I	BACC30AB()-C BACN10YT()-CD T		
						BACB30NX()-K() I	BACC30BH() BACC30X() BACN10YT()-CD T	
				BACB30VT()-K() I	BACC30BS()-			
				BACB30FM()-()-A L	BACC30AG() BACN10ZZ()-D T			
					BACB30FM()-A()	BACC30AG() BACN10ZZ()-D T		
				BACB30FM()-AK() I		BACC30AG() BACN10ZZ()-D T		
					BACB30MY()-K() I	BACC30AG() BACN10ZZ()-D T		
				BACB30VN()-K() I J		BACC30BK()-		
		BACB30VT()-K() I			BACC30BQ()-			

BOLT - HEX DRIVE - PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 6 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MY()C() H AA	6AL-4V TITANIUM, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30M()	NO EQUIVALENT	BACB30FM()-() A L	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() T
					BACN10YT()CD T
					BACN10ZZ()D T
				BACB30FM()A()	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() T
					BACN10ZZ()D T
				BACB30FM()AK() I	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() T
					BACN10YT()CD T
					BACN10ZZ()D T
				BACB30GW()A()	BACC30K()
					NAS1080E
				BACB30MB()-()	BACC30BH()
					BACC30X()
					BACN10YT()CD
				BACB30MB()A()	BACC30BH()
					BACC30X()
					BACN10YT()CD

BOLT – HEX DRIVE – PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 7 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MY()C() [H] [AA]	6AL-4V TITANIUM, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30M()	NO EQUIVALENT	BACB30MY()K() [I]	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() [T]
					BACN10YT()CD [T]
					BACN10ZZ()D [T]
				BACB30NX()K() [I]	BACC30BH() BACC30X() BACN10YT()CD [T]
				BACB30VN()K() [I] [J]	BACC30BK()
				BACB30VT()K() [I]	BACC30BL() BACC30BQ() BACN10YZ()
BACB30MY()K() [AA]	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30AB()C	HI-SHEAR HL10VAZ	BACB30VT()K()	BACC30BS()
		BACC30AB()S	SPS HL10VAZ	BACB30FM()AK()	BACC30AB()S
			HUCK HL10VAZ		BACN10YT()CS [T]
			FAIRCHILD HL10VAZ		BACN10YT()CSA [T]
			DEUTSCH HL10VAZ		
			AIC HL10VAZ	BACB30MB()AK()	BACC30X()S
			WEST COAST HL10VAZ		BACN10BH()S
				BACB30NM()K() [F]	BACN10GW()AS
					NAS1805-() [R]
				BACB30NX()K()	BACC30BH()S [R]
					BACC30X()S
		BACC30AG()	NO EQUIVALENT	BACB30FM()-() [A] [L] [M]	BACC30AG()
					BACN10ZZ()D [T]
				BACB30FM()A() [M]	BACC30AG()
					BACN10ZZ()D [T]
				BACB30FM()AK()	BACC30AG()
					BACN10ZZ()D [T]
				BACB30VN()K() [J]	BACC30BK()
				BACB30VT()K()	BACC30BQ()

BOLT - HEX DRIVE - PROTRUDING HEAD (SHEAR)

TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 8 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MY()K() AA	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30M()	HI-SHEAR HL10VAZ SPS HL10VAZ HUCK HL10VAZ FAIRCHILD HL10VAZ DEUTSCH HL10VAZ AIC HL10VAZ WEST COAST HL10VAZ	BACB30FM()-() A L M	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() T
					BACN10YT()CD T
					BACN10ZZ()D T
				BACB30FM()A() M	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACCN10XJ() T
					BACN10YT()CD T
					BACN10ZZ()D T
				BACB30FM()AK()	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() T
					BACN10YT()CD T
					BACN10ZZ()D T
				BACB30GW()A() J M	BACC30K()
					NAS1080E
				BACB30MB()-() A L M	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30MB()A() M	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30NX()K()	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30VN()K() J	BACC30BK()
				BACB30VT()K()	BACC30BL()
					BACN10YZ() T

BOLT - HEX DRIVE - PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 9 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MY()R() AA	6AL-4V TITANIUM, PHOSPHATE FLUORIDE COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 600°F (316°C)	BACC30AG()	HI-SHEAR HL10VRA	BACB30MY()K() I	BACC30AG()
		BACC30M()	SPS HL10VRA	BACB30MY()K() I	BACC30M()
			HUCK HL10VRA		BACN10XJ() T
			FAIRCHILD HL10VRA		
			DEUTSCH HL10VRA		
BACB30VT5HK() AA	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C) (ENLARGED V HEX)		AIC HL10VRA		
			WEST COAST HL10VRA		
			HI-SHEAR HST108AG	BACB30VT5K()	
			SPS HST108AG		
			AIC HST108AG		
BACB30VT()K() AA	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30BL()	FAIRCHILD VL310AG		
			HUCK VL310AG		
		BACC30BP()			
		BACC30BQ()			
		BACC30BS()S			
		BACN10YZ()			
		BACN10ZV()			
			HI-SHEAR HST10AG	BACB30MY()K()	BACC30AB()C
			SPS HST10AG		BACC30AG()
			AIC HST10AG		BACC30M()
			FAIRCHILD VL10AG	BACB30VN()K() J	BACC30BK() O
			HUCK VL10AG	BACB30VN()K() J	BACC30BK() O
BACB30XE()K()	6AL-4V TITANIUM AL COATED, 95 KSI SHEAR, LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED, SWAGE LOCKING	BACC30CG()		BACB30MY()K()	BACC30AG()
		BACC30CH()		BACB30VN()K() J	BACC30BK() O
				BACB30MY()K()	BACC30AB()S
		BACC30CK()		BACB30VT()K()	BACN10XJ() T
				BACB30VT()K()	BACN10XJ() T
			NO EQUIVALENT	BACB30VT()K()	BACC30BS()S
					BACC30BS()S WITH BACW10CA()CCU AND BACW10CA()PVU
				BACB30VT()K()	BACC30BL()

BOLT - HEX DRIVE - PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 10 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30YL()K()	NICKEL ALLOY 718, 125 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30CQ()C	HI-SHEAR HLT420AP AIC HLT420AP SPS HLT420AP	HLT420AP	HL791RD
		BACC30CQ()S		HLT420AP	HL791BF
HLT420-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB30YL()U()		
HLT420AP-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YL()K()		
HLT420PB-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YL()K() I	
HLT620-()-()	NICKEL ALLOY 718, 1/64 OVERSIZE, 125 KSI SHEAR, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB30YL()U()X		
HLT620AP-()-()	NICKEL ALLOY 718, 1/64 OVERSIZE, 125 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YL()K()X		

BOLT – HEX DRIVE – PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 11 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
HLT620PB-()-()	NICKEL ALLOY 718, 1/64 OVERSIZE, 125 KSI SHEAR, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YL()-K()-X I	
HLT714-()-()	NICKEL ALLOY 718, 1/32 OVERSIZE, 125 KSI SHEAR, PASSIVATED CETYL ALCOHOL LUBRICATED		BACB30YL()-U()-Y		
HLT714AP-()-()	NICKEL ALLOY 718, 1/32 OVERSIZE, 125 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YL()-K()-Y		
HLT714PB-()-()	NICKEL ALLOY 718, 1/32 OVERSIZE, 125 KSI SHEAR, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YL()-K()-Y I	
HL644AP-()-() G	PH13-8 Mo STAINLESS STEEL, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	HLT420AP-()-()	
HL860AP-()-()	6AL-4V TITANIUM, TITANIUM COMPOSITE APPLICATIONS, ALUMINUM PIGMENTED COATING, CETYL ETHYL LUBRICATED		BACB30VG()-K()-		

BOLT - HEX DRIVE - PROTRUDING HEAD (SHEAR)

TABLE II

Fastener Substitution - Bolts
Figure 2 (Sheet 12 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30FN()-() Q AA	ALLOY STEEL, 100° HEAD, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED MAX TEMP 450°F (232°C)	BACC30AG()	HI-SHEAR HL19PB	BACB30FN()A()	BACC30AG()
			SPS HL19PB	BACB30NW()K() I	BACC30AG()
			HUCK HL19PB	BACB30VU()K() I	BACC30BQ()
			DEUTSCH HL19PB	BACB30YP()K() I	BACC30BQ()
		BACC30M()	FAIRCHILD HL19PB	BACB30FN()A()	BACC30M()
			AIC HL19PB	BACB30NW()K() I	BACC30M()
			WEST COAST HL19PB	BACB30VU()K() I	BACC30BL()
					BACN1OYZ() T
					BACN1OZV() T
				BACB30YP()K() I	BACC30BL()
					BACN1OYZ() T
					BACN1OZV() T
BACB30FN()A() AA	A286 CRES, 100° HEAD, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED MAX TEMP 450°F (232°C)	BACC30AB()C	HI-SHEAR HL441UC	BACB30NW()K() I	BACC30AB()C
			SPS HL441UC	BACB30VU()K() I	BACC30BS()
			HUCK HL441UC	BACB30YP()K() I	BACC30BS()
		BACC30AB()S	DEUTSCH HL441UC	BACB30NW()K() I	BACC30AB()S
			FAIRCHILD HL441UC	BACB30YP()K() I	BACC30BS()S
			AIC HL441UC	BACB30VU()K() I	BACC30BS()S
		BACC30AG()	WEST COAST HL441UC	BACB30NW()K() I	BACC30AG()
				BACB30YP()K() I	BACC30BQ()
				BACB30VU()K() I	BACC30BQ()
		BACC30M()		BACB30NW()K() I	BACC30M()
				BACB30VU()K() I	BACC30BL()
					BACN1OYZ() T
				BACB30YP()K() I	BACC30BL()
					BACN1OYZ() T

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 13 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30FN()AK() AA	A286 CRES, 100° HEAD, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED MAX TEMP 350°F (177°C)	BACC30AB()C	HI-SHEAR HL441AZ	BACB30NW()K()	BACC30AB()C
		BACC30AB()S	SPS HL441AZ	BACB30VU()K()	BACC30BS()
			HUCK HL441AZ	BACB30YP()K()	BACC30BS()
			DEUTSCH HL441AZ	BACB30NW()K()	BACC30AB()S
			FAIRCHILD HL441AZ	BACB30VU()K()	BACC30BS()S
			AIC HL441AZ	BACB30YP()K()	BACC30BS()S
BACB30FN()A()SU	A286 CRES, PASSIVATED, 95 KSI SHEAR, DRY FILM LUBRICATED, 100° HEAD MAX TEMP 450°F (232°C)	BACC30AB()S	WEST COAST HL441AZ		
			WEST COAST WC131		
			AIC L-839C		
			HI-SHEAR HL41DU	BACB30FN()A()U	BACC30AB()S
			SPS HL41DU		
			HUCK HL41DU		
BACB30FN()A()U AA	A286 CRES, PASSIVATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° HEAD MAX TEMP 900°F (482°C)	BACC30AB()P	DEUTSCH HL41DU		
		BACC30AB()S	FAIRCHILD HL41DU		
			AIC HL41DU		
			WEST COAST HL41DU		
			HI-SHEAR HL41	NO ALTERNATIVE	
			SPS HL41		
			HUCK HL41		
			DEUTSCH HL41		
			FAIRCHILD HL41		
			AIC HL41		
			WEST COAST HL41		

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 14 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION			
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART	
BACB30FN()K() [Q][Z]	ALLOY STEEL, AL COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30AG()	NO EQUIVALENT	BACB30FN()A() [M]	BACC30AG()	
				BACB30NW()K()	BACC30AG()	
				BACB30VU()K()	BACC30BQ()	
				BACB30YP()K()	BACC30BQ()	
		BACC30M()		BACB30FN()A() [M]	BACC30M()	
				BACB30NW()K()	BACC30M()	
				BACB30VU()K()	BACC30BL()	
					BACN10YZ() [T]	
					BACN10ZV() [T]	
				BACB30YP()K()	BACC30BL()	
					BACN10YZ() [T]	
					BACN10ZV() [T]	
BACB30HA()-() [AA]	7075-T6 AL, ANODIZED, 44.5 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° HEAD, MAX TEMP 250°F (121°C)	BACC30P()	HI-SHEAR HL23 FAIRCHILD HL23 WESTCOAST HL23	NO ALTERNATIVE		
BACB30HA()R() [AA]	7075-T6 AL, ANODIZED, 44.5 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° REDUCED SHEAR HEAD, MAX TEMP 250°F (121°C)	BACC30P()R	HI-SHEAR HL505 FAIRCHILD HL505 WESTCOAST HL505	NO ALTERNATIVE		
BACB30ND()-() [Q][AA]	ALLOY STEEL, CADMIUM PLATED 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° (MS20426) HEAD, MAX TEMP 450°F (232°C)	BACC30AG()	HI-SHEAR HL525 SPS HL525 HUCK HL525 DEUTSCH HL525	BACB30ND()A()	BACC30AG()	
					BACN10ZZ()D [T]	
				BACB30NZ()K() [I]	BACC30AG()	
					BACN10ZZ()D [T]	
		BACC30M()		FAIRCHILD HL525 WEST COAST HL525	BACB30ND()A()	BACC30M()
					BACB30NZ()K() [I]	BACC30M()

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 15 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION			
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART	
BACB30ND() A() AA	A286 CRES, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° (MS20426) HEAD, MAX TEMP 450°F (232°C)	BACC30AG()	HI-SHEAR	HL445PB	BACB30ND() -() A L	BACC30AG()
			SPS	HL445PB		BACN10ZZ() D T
			HUCK	HL445PB	BACB30NZ() K() I	BACC30AG()
		BACC30M()	DEUTSCH	HL445PB		BACN10ZZ() D T
			FAIRCHILD	HL445PB	BACB30ND() -() A L	BACC30M()
			WEST COAST	HL445PB	BACB30NZ() K() I	BACC30M()
BACB30ND() A() U AA	A286 CRES, PASSIVATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° (MS20426) HEAD, MAX TEMP 900°F (482°C)	BACC30AB()P	HI-SHEAR	HL445	NO ALTERNATIVE	
SPS	HL445					
HUCK	HL445					
DEUTSCH	HL445					
FAIRCHILD	HL445					
WEST COAST	HL445					
BACB30NW() C() H AA	6AL-4V TITANIUM, 100° REDUCED HEAD, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30AB()C	NO EQUIVALENT	BACB30FN() -() A L	BACC30AB()C	
					BACN10YT() CD T	
				BACB30FN() A()	BACC30AB()C	
					BACN10YT() CD T	
				BACB30FN() AK() I	BACC30AB()C	
		BACC30AG()			BACN10YT() CD T	
				BACB30VU() K() I	BACC30BS()	
				BACB30YP() K() I	BACC30BS()	
				BACB30FN() -() A L	BACC30AG()	
					BACN10ZZ() D T	
				BACB30FN() A()	BACC30AG()	
					BACN10ZZ() D T	
				BACB30FN() AK() I	BACC30AG()	
					BACN10ZZ() D T	
				BACB30NW() K() I	BACC30AG()	
					BACN10ZZ() D T	
				BACB30TY() K() I J	BACC30BE()	
				BACB30VM() K() I J	BACC30BK()	
				BACB30VU() K() I	BACC30BQ()	
				BACB30YP() K() I	BACC30BQ()	

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 16 of 67)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NW()C() H AA	6AL-4V TITANIUM, 100° REDUCED HEAD, CADMIUM PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30M()	NO EQUIVALENT	BACB30FN()-() A L	BACC30AG()
					BACC30M()
				BACB30FN()A()	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() T
					BACN10YT()CD T
					BACN10ZZ()D T
				BACB30FN()AK() I	BACC30AB()C
					BACC30AG()
					BACC30M()
					BACN10XJ() T
					BACN10YT()CD T
					BACN10ZZ()D T
				BACB30NW()K() I	BACC30AG()
					BACN10ZZ()D T
				BACB30TY()K() I J	BACC30BE()
				BACB30VM()K() I J	BACC30BK()
				BACB30VU()K() I	BACC30BL()
					BACN10YZ() T
				BACB30YP()K() I	BACC30BL()
					BACN10YZ() T

BOLT – HEX DRIVE – FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 17 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NW()K() AA	6AL-4V TITANIUM, 100° REDUCED HEAD, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED	BACC30AB()C	HI-SHEAR HL11VAZ SPS HL11VAZ HUCK HL11VAZ DEUTSCH HL11VAZ FAIRCHILD HL11VAZ AIC HL11VAZ WEST COAST HL11VAZ	BACB30FN()-() A L M	BACC30AB()C BACN10YT()CD T
				BACB30FN()A() M	BACC30AB()C BACN10YT()CD T
				BACB30FN()AK()	BACC30AB()C BACN10YT()CD T
				BACB30VU()K()	BACC30BS()
				BACB30YP()K()	BACC30BS()
		BACC30AB()S		BACB30VU()K()	BACC30BS()S
				BACB30YP()K()	BACC30BS()S
				BACB30FN()-() A L M	BACC30AG() BACN10ZZ()D T
		BACC30AG()			
				BACB30FN()A() M	BACC30AG() BACN10ZZ()D T
				BACB30FN()AK()	BACC30AG() BACN10ZZ()D T
				BACB30TY()K() J	BACC30BE()
				BACB30VM()K() J	BACC30BK()
				BACB30VU()K()	BACC30BQ()
				BACB30YP()K()	BACC30BQ()
		BACC30M()		BACB30FN()-() A L M	BACC30AG() BACC30M()
				BACB30FN()A() M	BACC30AB()C BACC30AG() BACC30M() BACN10XJ() T BACN10YT()CD T BACN10ZZ()D T
				BACB30FN()AK()	BACC30AB()C BACC30AG() BACC30M() BACN10XJ() T BACN10YT()CD T BACN10ZZ()D T

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 18 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION							
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT		ALTERNATIVE	MATING PART				
BACB30NW()K() [AA]	6AL-4V TITANIUM, 100° REDUCED HEAD, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED	BACC30M()	HI-SHEAR SPS HUCK DEUTSCH FAIRCHILD AIC WEST COAST	HL11VAZ HL11VAZ HL11VAZ HL11VAZ HL11VAZ HL11VAZ HL11VAZ	BACB30TY()K() [J]	BACC30BE()				
					BACB30VM()K() [J]	BACC30BK()				
					BACB30VU()K()	BACC30BL()				
						BACN10YZ() [T]				
		BACN10YT()CS			BACB30VU()K()	BACC30BS()S [W]				
		BACN10YT()CD			BACB30YP()K()	BACC30BS()S [W]				
					BACB30VU()K()	BACC30BS() [W]				
					BACB30YP()K()	BACC30BS() [W]				
BACB30NW()R() [AA]	6AL-4V TITANIUM, 100° REDUCED HEAD, PHOSPHATE FLUORIDE COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED	BACC30AG()	HI-SHEAR SPS HUCK DEUTSCH FAIRCHILD AIC WEST COAST	HL11VRA HL11VRA HL11VRA HL11VRA HL11VRA HL11VRA HL11VRA	BACB30VU()K() [I]	BACC30BQ()				
		BACC30M()			BACB30YP()K() [I]	BACC30BQ()				
					BACB30VU()K() [I]	BACC30BL()				
						BACN10YZ() [T]				
					BACB30YP()K() [I]	BACC30BL()				
						BACN10YZ() [T]				
		BACB30NW()S() [AA]			6AL-4V TITANIUM, 100° REDUCED HEAD, PHOSPHATE FLUORIDE COATED, 95 KSI SHEAR, SOLID FILM LUBRICATED	BACC30AB()S	HI-SHEAR SPS HUCK DEUTSCH FAIRCHILD AIC WEST COAST	HL11VSY HL11VSY HL11VSY HL11VSY HL11VSY HL11VSY	BACB30VU()S()	BACC30BS()S
BACB30NZ()C() [H] [AA]	6AL-4V TITANIUM, CAD PLATED 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° (MS20426) HEAD, MAX TEMP 450°F (232°C)	BACC30M()	NO EQUIVALENT		BACB30ND()-() [A] [L]	BACC30M()				
					BACB30ND()A()	BACC30M()				
					BACB30NZ()K() [I]	BACC30M()				
		BACC30AG()			BACB30ND()-() [A] [L]	BACC30AG()				
					BACB30ND()A()	BACN10ZZ()D [T]				
						BACC30AG()				
					BACB30NZ()K() [I]	BACN10ZZ()D [T]				
						BACC30AG()				
		BACC30AB()C			BACB30ND()A()	BACC30AB()C				
					BACB30NZ()K() [I]	BACC30AB()C				

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)

TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 19 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NZ()K() AA	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° (MS20426) HEAD, MAX TEMP 350°F (177°C)	BACC30M()	HI-SHEAR HL523AZ SPS HL523AZ HUCK HL523AZ	BACB30ND()A() M	BACC30M()
			DEUTSCH HL523AZ FAIRCHILD HL523AZ WEST COAST HL523AZ AIC HL523AZ	BACB30ND()-() A L M	BACC30M()
		BACC30AG()		BACB30ND()A() M	BACC30AG()
					BACN10ZZ()D T
				BACB30ND()-() A L M	BACC30AG()
					BACN10ZZ()D T
		BACC30AB()C		BACB30ND()A() M	BACC30AB()C
BACB30VU5HK() AA	6AL-4V TITANIUM, 100° REDUCED HEAD, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED, (ENLARGED INTERNAL HEX)		HI-SHEAR HST109AG SPS HST109AG AIC HST109AG	BACB30VU5K()	
BACB30VU()K() AA	6AL-4V TITANIUM, 100° REDUCED HEAD, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED	BACC30BL()	HI-SHEAR HST11AG SPS HST11AG AIC HST11AG FAIRCHILD VL11AG HUCK VL11AG	BACB30NW()K()	BACC30M()
				BACB30VM()K() J	BACC30BK() O
				BACB30XT()K() J	BACC30BK() O
				BACB30YP()K()	BACC30BL()
		BACC30BP()		BACB30VM()K() J	BACC30BK() O
				BACB30XT()K() J	BACC30BK() O
				BACB30YP()K()	BACC30BP()
		BACC30BQ()		BACB30NW()K()	BACN10ZZ()D T
					BACC30AG()
				BACB30VM()K()	BACC30BK()
				BACB30XT()K()	BACC30BK()
				BACB30YP()K()	BACC30BQ()
		BACC30BS()		BACB30YP()K()	BACC30BS()
		BACC30BS()S		BACB30YP()K()	BACC30BS()S
		BACN10YZ()		BACC30NW()K()	BACN10YT()CD T
		BACN10ZV()		BACB30NW()K()	BACN10YT()CD T

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 20 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30XG()K()	6AL-4V TITANIUM, 100 DEGREES (MS20426) HEAD, AL COATED 95 KSI SHEAR LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED, SWAGE LOCKING	BACC30CG()	NO EQUIVALENT	BACB30NZ()K()	BACC30AB()S BACN10YR()CM D S
		BACC30CH()		BACB30NZ()K()	BACC30AB()S WITH BACW10CA()CCU AND BACW10CA()PVU
		BACC30CK()		BACB30NZ()K()	BACC30M() BACN10YR()CD D
BACB30XR()K()	6AL-4V TITANIUM, 130 DEGREES SHEAR HEAD, AL COATED LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED, SWAGE LOCKING	BACC30CG()	NO EQUIVALENT	BACB30WM()K()	BACC30BS()S BACN10YR()CM D
		BACC30CH()		BACB30WM()K()	BACC30BU()PW BACN10YR()CM WITH BACW10CA()CCU AND BACW10CA()PVU
BACB30YN()K()	NICKEL ALLOY 718, 125 KSI SHEAR, 100° REDUCED SHEAR HEAD	BACC30CQ()C	HI-SHEAR HLT421AP	HLT421AP	HL791RD
		BACC30CQ()S	AIC HLT421AP	HLT421AP	HL791BF
BACB30YP()K() AA	6AL-4V TITANIUM, 100° REDUCED SHEAR DOME HEAD, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED	BACC30BL()	AIR INDUSTRIES HST331 FAIRCHILD VL331 HI-SHEAR HST331 HUCK VL18	BACB30NW()K()	BACC30M() BACN10XJ() T
				BACB30VM()K() J	BACC30BK() O
				BACB30XT()K() J	BACC30BK() O
				BACB30VU()K()	BACC30BL() BACN10YZ() T
		BACC30BP()		BACB30VM()K() J	BACC30BK() O
				BACB30XT()K() J	BACC30BK() O
				BACB30VU()K()	BACC30BP()

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 21 of 67)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB3OYP()K() AA	6AL-4V TITANIUM, 100° REDUCED SHEAR DOME HEAD, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, LIGHTWEIGHT, CETYL ALCOHOL LUBRICATED	BACC3OBQ()	NO EQUIVALENT	BACB3ONW()K()	BACC3OAG()
					BACN1OZZ()D T
				BACB3OVM()K() J	BACC3OBK()
				BACB3OXT()K() J	BACC3OBK()
		BACC3OBS()		BACB3OVU()K()	BACC3OBQ()
		BACC3OBS()S		BACB3OVU()K()	BACC3OBS()
		BACN1OYZ()		BACB3OVU()K()	BACC3OBS()S
		BACN1OZV()		BACC3ONW()K()	BACN1OYT()CD
				BACB3ONW()K()	BACN1OYT()CD T
HLT421-()-() AA	NICKEL ALLOY 718, 125 KSI SHEAR, 100° HEAD, GRIT BLAST TOP OF HEAD, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB3OYN()U()	NO ALTERNATIVE	
HLT421AP-()-() AA	NICKEL ALLOY 718, 125 KSI SHEAR, 100° HEAD, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB3OYN()K()	NO ALTERNATIVE	
HLT421PB-()-() AA	NICKEL ALLOY 718, 125 KSI SHEAR, 100° HEAD, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB3OYN()K() I	

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 22 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
HLT621-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, 1/64 OVERSIZE, 100° HEAD, PASSIVATED CETYL ALCOHOL LUBRICATED		BACB30YN()U()X	NO ALTERNATIVE	
HLT621AP-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, 1/64 OVERSIZE, 100° HEAD, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YN()K()X	NO ALTERNATIVE	
HLT621PB-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, 1/64 OVERSIZE, 100° HEAD, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YN()K()X I	
HLT715-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, 1/32 OVERSIZE, 100° HEAD, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB30YN()U()Y		
HLT715AP-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, 1/32 OVERSIZE, 100° HEAD, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YN()K()Y		

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 23 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
HLT715PB-()-()	NICKEL ALLOY 718, 125 KSI SHEAR, 1/32 OVERSIZE, 100° HEAD, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB3OYN()K()Y I	
HL645AP-()-() G	PH13-8 Mo STAINLESS STEEL, 100° FLUSH HEAD, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB3OYN()K() HLT421AP-()-()	
HL645PB-()-() G	PH13-8 Mo STAINLESS STEEL, 100° FLUSH HEAD, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB3OYN()K() I HLT421AP-()-() I	
HL645TB-()-() G	PH13-8 Mo STAINLESS STEEL, 100° FLUSH HEAD, SOLID FILM, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB3OYN()K() I HLT421AP-()-() I	
HL859AP-()-()	6AL-4V TITANIUM, 156° FLUSH 3.5D HEAD, TITANIUM COMPOSITE APPLICATIONS, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED	HL97	NO EQUIVALENT	HL859AZ-()-()	HL97

BOLT - HEX DRIVE - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Bolts
Figure 2 (Sheet 24 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MB()-() [Q][AA]	ALLOY STEEL, 160 KSI TENSION, 95 KSI SHEAR, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30M()	HI-SHEAR HL1050PB SPS HL1050PB HUCK HL1050PB FAIRCHILD HL1050PB	BACB30MB()A()	BACC30M()
					BACN10XJ() [T]
				BACB30NX()K() [I]	BACC30M()
					BACN10XJ() [T]
		BACC30BH() OR BACC30X()	AIC HL1050PB WEST COAST HL1050PB	BACB30MB()A()	BACC30BH()
					BACC30X()
					BACN10YT()CD [T]
				BACB30NX()K() [I]	BACC30BH()
BACB30MB()A() [AA]	A286 CRES, 160 KSI TENSION, 95 KSI SHEAR, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30BH() OR BACC30X()	HI-SHEAR HL448UC SPS HL448UC HUCK HL448UC FAIRCHILD HL448UC AIC HL448UC WEST COAST HL448UC	BACB30NX()K() [I]	BACC30BH()
					BACC30X()
					BACN10YT()CD [T]
BACB30MB()A()U [AA]	A286 CRES, 160 KSI TENSION, 95 KSI SHEAR, PASSIVATED CETYL ALCOHOL LUBRICATED, MAX TEMP 900°F (482°C)	BACC30BH()P OR BACC30X()P	HI-SHEAR HL448 SPS HL448 HUCK HL448 FAIRCHILD HL448	BACB30NX()-()	BACC30BH()P
					BACC30X()P
					BACN10YT()CSA [T]
		BACC30BH()S OR BACC30X()S	AIC HL448 WEST COAST HL448	BACB30NX()-()	BACC30BH()S
					BACC30X()S
					BACN10YT()CSA [T]

BOLT - HEX DRIVE - PROTRUDING HEAD (TENSION)
TABLE IV

Fastener Substitution - Bolts
Figure 2 (Sheet 25 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MB()AK() AA	A286 CRES, 160 KSI TENSION, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30BH() OR BACC30X()	HI-SHEAR HL448AZ SPS HL448AZ HUCK HL448AZ FAIRCHILD HL448AZ AIC HL448AZ WEST COAST HL448AZ WEST COAST WC133	BACB30NX()K()	BACC30BH() BACC30X()
		BACC30BH()S OR BACC30X()S		BACB30NX()K()	BACC30BH()S BACC30X()S
BACB30MB()K() Q Z AA	ALLOY STEEL, AL COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30BH() OR BACC30X()	NO EQUIVALENT	BACB30NX()K()	BACC30BH() BACC30X()
		BACC30BH()S OR BACC30X()S		BACB30NX()K()	BACC30BH()S BACC30X()S
BACB30NX()K()	6AL-4V TITANIUM, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30BH() OR BACC30X()	HI-SHEAR HL1012AZ SPS HL1012AZ HUCK HL1012AZ FAIRCHILD HL1012AZ AIC HL1012AZ WEST COAST HL1012AZ	BACB30MB()-() A L M	BACC30BH() BACC30X() BACN10YT()CD T
				BACB30MB()A() M	BACC30BH() BACC30X() BACN10YT()CD T
				BACB30MB()AK()	BACC30BH() BACC30X() BACN10YT()CD T
				BACB30NX()K()	BACN10YT()CD T
		BACC30BH()S OR BACC30X()S		BACB30LE()K() B F	BACN10HR()CS R T
				BACB30MB()AK()	BACC30BH()S BACC30X()S
		BACC30BH()SW OR BACC30X()SW		BACB30LE()K() B F	BACN10HR()CS R T
				BACB30MB()AK()	BACC30BH()S BACC30X()S

BOLT - HEX DRIVE - PROTRUDING HEAD (TENSION)
TABLE IV

Fastener Substitution - Bolts
Figure 2 (Sheet 26 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB3ONX()C()	6AL-4V TITANIUM, 95 KSI SHEAR, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED MAX TEMP 450°F (232°C)	BACC3OX() OR BACC3OBH()	NO EQUIVALENT	BACB3OMB()-() A L	BACC3OBH() BACC3OX() BACN1OYT()CD T
				BACB3OMB()A()	BACC3OBH() BACC3OX() BACN3OYT()CD T
				BACB3OMB()AK() I	BACC3OBH() BACC3OX() BACN3OYT()CD T
				BACB3ONX()K() I	BACC3OBH() BACC3OX() BACN3OYT()CD T
BACB3OXH()K()	6AL-4V TITANIUM, LIGHTWEIGHT, AL COATED, CETYL ALCOHOL LUBRICATED, SWAGE LOCKING	BACC3OCG()	NO EQUIVALENT	BACB3ONX()K()	BACC3OAB()S BACN1OYR()CM D S
		BACC3OCH()		BACB3OVT()K() J	BACC3OBS()S
				BACB3ONX()K()	BACC3OAB()S WITH BACW1OCA()CCU AND BACW1OCA()PVU
		BACC3OCJ()		BACB3ONX()K()	BACC3OBH()S
		BACC3OCK()		BACB3ONX()K()	BACC3OM() BACN1OYR()CD D
				BACB3OVT()K() J	BACC3OBL() BACC3OBZ()
BACB3OXZ()K()	NICKEL ALLOY 718, LIGHTWEIGHT, PASSIVATED, AL COATED, CETYL ALCOHOL LUBRICATED, SWAGE LOCKING	BACC3OCG()	NO EQUIVALENT	BACB3OYK()K()	BACC3OAB()S BAC1OYR()CM D S
		BACC3OCJ()		BACB3OYK()K()	BACC3OCP()S

BOLT – HEX DRIVE – PROTRUDING HEAD (TENSION)
TABLE IV

Fastener Substitution - Bolts
Figure 2 (Sheet 27 of 67)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30YK()K()	NICKEL ALLOY 718, 125 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED	BACC30CP()C	HI-SHEAR HLT422AP AIC HLT422AP	HLT422AP	HLT792KK
		BACC30CP()S		HLT422AP	HLT792BT
HLT422-()-()	NICKEL ALLOY 718, GRIT BLAST TOP HEAD, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB30YK()U()		
HLT422AP-()-()	NICKEL ALLOY 718, ALLUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YK()K()		
HLT422PB-()-()	NICKEL ALLOY 718, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YK()K() I	
HLT622-()-()	NICKEL ALLOY 718, 1/64 OVERSIZE, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB30YK()U()X		
HLT622AP-()-()	NICKEL ALLOY 718, ALUMINUM PIGMENTED COATING, 1/64 OVERSIZE, CETYL ALCOHOL LUBRICATED		BACB30YK()K()X		
HLT622PB-()-()	NICKEL ALLOY 718, CADMIUM PLATED, 1/64 OVERSIZE, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YK()K()X I	

BOLT – HEX DRIVE – PROTRUDING HEAD (TENSION)
TABLE IV

Fastener Substitution - Bolts
Figure 2 (Sheet 28 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
HL646PB-()-() G	PH13-8Mo STAINLESS STEEL, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	HLT422AP-()-() I	
				BACB30YK()-K() I	
HL646TB-()-() G	PH13-8Mo STAINLESS STEEL, SOLID FILM, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	HLT422AP-()-() I	
				BACB30YK()-K() I	
HLT716-()-()	NICKEL ALLOY 718, PASSIVATED, 1/32 OVERSIZE, CETYL ALCOHOL LUBRICATED		BACB30YK()-U()-Y		
HLT716AP-()-()	NICKEL ALLOY 718, ALUMINUM PIGMENTED COATING, 1/32 OVERSIZE, CETYL ALCOHOL LUBRICATED		BACB30YK()-K()-Y		
HLT716PB-()-()	NICKEL ALLOY 718, CADMIUM PLATED, 1/32 OVERSIZE, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YK()-K()-Y I	

BOLT – HEX DRIVE – PROTRUDING HEAD (TENSION)
TABLE IV

Fastener Substitution - Bolts
Figure 2 (Sheet 29 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30JC()-() [Q][AA]	ALLOY STEEL, 100° (AN509) HEAD, 160 KSI TENSION, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED 450°F (232°C)	BACC30X() OR BACC30BH()	HI-SHEAR HL21PB	BACB30NY()-K()[I]	BACC30BH()
			SPS HL21PB		BACC30X()
		BACC30Z()	HUCK HL21PB	BACB30NY()-K()[I]	BACNYT()-CD [T]
			FAIRCHILD HL21PB		BACC30BH()P
BACB30JC()-A() [AA]	A286 CRES, 100° (AN509) HEAD, 160 KSI TENSION, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, MAX TEMP 450°F (232°C)	BACC30X() OR BACC30BH()	AIC HL21PB	BACB30NY()-K()[I]	BACC30X()P
			WEST COAST HL21PB		
			HI-SHEAR HL449UC	BACB30JC()-()-[A][L][M]	BACC30BH()
			SPS HL449UC		BACC30X()
BACB30JC()-AK() [AA]	A286 CRES, 100° (AN509) HEAD, 160 KSI TENSION, ALUMINUM COATED, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30X() OR BACC30BH()	HUCK HL449UC	BACB30JC()-A()[M]	BACN10YT()-CD [T]
			FAIRCHILD HL449UC		BACC30BH()
			AIC HL449UC	BACB30JC()-AK()	BACC30X()
			WEST COAST HL449UC		BACN10YT()-CD [T]
				BACB30NY()-K()	BACN10YT()-CD [T]
					BACC30BH()
					BACC30X()
					BACN10YT()-CD [T]
					BACN10YT()-CD [T]
					BACC30BH()
BACB30JC()-A()U	A286 CRES, PASSIVATED, 160 KSI TENSION, CETYL ALCOHOL LUBRICATED, 100° (AN509) HEAD, MAX TEMP 900°F (482°C)	BACC30X()P	HI-SHEAR HL49	BACB30LP()-U()[F]	NAS1805()-P [R][T]
			SPS HL49	BACB30LR()-U()[F]	NAS1805()-P [R][T]
			FAIRCHILD HL49		
			DEUTSCH HL49		
			WEST COAST HL49		

BOLT – HEX DRIVE – FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Bolts
Figure 2 (Sheet 30 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NY()C() H AA	6AL-4V TITANIUM, 160 KSI TENSION, CADMIUM PLATED, CETYL ALCOHOL, LUBRICATED MAX TEMP 450°F (232°C)	BACC30X() OR BACC30BH()	NO EQUIVALENT	BACB30JC()-() A L	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30JC()A()	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30JC()AK() I	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30NY()K() I	BACC30BH()
					BACC30X()
					BACN10YT()CD T
BACB30NY()K() AA	6AL-4V TITANIUM, 160 KSI TENSION, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 350°F (177°C)	BACC30X() OR BACC30BH()	HI-SHEAR HL1013VAZ SPS HL1013VAZ HUCK HL1013VAZ FAIRCHILD HL1013VAZ AIC HL1013VAZ WEST COAST HL1013VAZ	BACB30JC()-() A L M	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30JC()A() M	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30JC()AK()	BACC30BH()
					BACC30X()
					BACN10YT()CD T
				BACB30NY()K()	BACN10YT()CD T
BACB30XF()K()	6AL-4V TITANIUM, 100° HEAD, LIGHTWEIGHT, 95 KSI SHEAR, AL COATED, CETYL ALCOHOL LUBRICATED, SWAGE LOCKING	BACC30CG()	NO EQUIVALENT	BACB30NY()K()	BACC30AB()S
		BACC30CH()		BACB30NY()K()	NAS1805-() WITH BACW10CA()CCU AND BACW10CA()PVU
		BACC30CJ()		BACB30NY()K()	BACC30BH()S
		BACC30CK()		BACB30NY()K()	BACC30M()

BOLT - HEX DRIVE - FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Bolts
Figure 2 (Sheet 31 of 67)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30XY()K()	NICKEL ALLOY 718, 100° HEAD, LIGHTWEIGHT, PASSIVATED, AL COATED, CETYL ALCOHOL LUBRICATED, SWAGE LOCKING	BACC30CJ()	NO EQUIVALENT	BACB30YM()K()	BACC30CP()S
BACB30YM()K()	NICKEL ALLOY 718, 125 KSI SHEAR, 100° HEAD, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED	BACC30CP()C	HI-SHEAR HLT423AP	HLT423AP	HL792KK
		BACC30CP()S	AIC HLT423AP	HLT423AP	HL792BT
HLT423-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24694) HEAD, GRIT BLAST TOP OF HEAD, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB30YM()U()		
HLT423AP-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24694) HEAD, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YM()K()		
HLT423PB-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24694) HEAD, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YM()K() I	

BOLT – HEX DRIVE – FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Bolts
Figure 2 (Sheet 32 of 67)

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
HLT623-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24694) HEAD, 1/64 OVERSIZE, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB30YM()U()X		
HLT623AP-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24694) HEAD, 1/64 OVERSIZE, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED		BACB30YM()K()X		
HLT623PB-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24694) HEAD, 1/64 OVERSIZE, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30YM()K()X I	

BOLT – HEX DRIVE – FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Bolts
Figure 2 (Sheet 33 of 67)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
HLT717-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24649) HEAD, 1/32 OVERSIZE, PASSIVATED, CETYL ALCOHOL LUBRICATED		BACB3OYM()U()Y		
HLT717AP-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24694) HEAD, 1/32 OVERSIZE, ALUMINUM PIGMENTED CETYL ALCOHOL LUBRICATED		BACB3OYM()K()Y		
HLT717PB-()-()	NICKEL ALLOY 718, 100° FLUSH (MS24649) HEAD, 1/32 OVER- SIZE, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB3OYM()K()Y I	

BOLT – HEX DRIVE – FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Bolts
Figure 2 (Sheet 34 of 67)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30FD()-()	ALLOY STEEL, CADMIUM FLUOBORATE PLATED, 12 POINT HEAD, 180 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-()	
				BACB30LE()-K() I	
				BACB30US()-P()	
				BACB30US()-K() I	
BACB30GE()-()	HEX CLOSE TOL 160,000 PSI SHORT THREAD		NO EQUIVALENT	BACB30LE()-() B	
				BACB30LE()-K() B I	
				BACB30LJ()-()	
				BACB30LM()-()	
				BACB30LT()-()	
				BACB30MR()-K() B I	
				BACB30NE()-() A L	
				BACB30NF()-()	
				BACB30NM()-K() I	
				BACB30NR()-K() I V	
				BACB30US()-K() B I	
				BACB30US()-P() B	
				NAS6703 THRU NAS6720	
BACB30LE()-()	A286 CRES, CADMIUM PLATED, 12 POINT HEAD, LONG THREAD, 200 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-K() I	
				BACB30US()-K() I	
				BACB30US()-P()	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
Figure 2 (Sheet 35 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LE() DK()	A286 CRES, 12 POINT HEAD, 200 KSI TENSILE 110 KSI SHEAR, LONG THREAD ALUMINUM PIGMENTED COATING, MAX TEMP 350°F (177°C)	BACN10JD() OR BACN11N() OR MS14144	NO EQUIVALENT	BACB30US() K() D	X
BACB30LE() K()		BACN10HR() CD		BACB30LE() -() M	BACN10HR() CD R
				BACB30US() K()	BACN10HR() CD R
				BACB30US() P() M	BACN10HR() CD R
BACB30LE() U()	A286 CRES, PASSIVATED, 12 POINT HEAD, LONG THREAD, 200 KSI TENSION, MAX TEMP 900°F (482°C)		NO EQUIVALENT	BACB30US() -() U	
BACB30LJ() -()	A286 CRES, HEX HEAD, 95 KSI SHEAR, SHORT THREAD, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE() -() B	
				BACB30LE() K() B I	
				BACB30LM() -()	
				BACB30LT() -()	
				BACB30MR() K() B I	
				BACB30NM() K() I	
				BACB30NR() K() I	
				BACB30US() K() B I	
				BACB30US() P() B	
				NAS6703 THRU NAS6720	
BACB30LJ() D()	A286 CRES, HEX HEAD, 95 KSI SHEAR, SHORT THREAD, CADMIUM PLATED, DRILLED SHANK, MAX TEMP 450°F (232°C)	BACN10JD() OR BACN11N() OR MS14145	NO EQUIVALENT	BACB30LE() DK() B I	X
				BACB30LM() D()	X
				BACB30LT() D()	X
				BACB30NE() D() A	X
				BACB30US() K() D B I	X
				NAS6703D THRU NAS6720D	X

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
Figure 2 (Sheet 36 of 67)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LJ()U()	A286 CRES, PASSIVATED, HEX HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 900°F (482°C)		NO EQUIVALENT	BACB30LM()U()	
				BACB30LT()U()	
				BACB30LE()U() B	
				BACB30PN()-() B	
				BACB30US()-() B U	
				NAS6703U THRU NAS6720U	
BACB30LJ()SU())	A286 CRES, PASSIVATED, HEX HEAD, SHORT THREAD, 95 KSI SHEAR, DRY FILM LUBRICATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LJ()U()	
				BACB30LM()U()	
				BACB30LM()SU())	
				BACB30LT()U()	
				BACB30LE()U() B	
				BACB30PN()-() B	
				BACB30US()-() B	
				NAS6703U THRU NAS6720U	
BACB30LM()-()	A286 CRES, CADMIUM PLATED, HEX HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 450°F (232°C)		NAS6703 THRU NAS6720	BACB30LE()-() B	
				BACB30LE()K() B I	
				BACB30MR()K() B I	
				BACB30NM()K() I	
				BACB30US()K() B I	
BACB30LM()SU())	A286 CRES, PASSIVATED, HEX HEAD, LONG THREAD, 160 KSI TENSION, DRY FILM LUBRICATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()U() B	
				BACB30LM()U()	
				BACB30PN()-() B	
				BACB30US()-() B	
				NAS6703U THRU NAS6720U	
BACB30LM()U()	A286 CRES, PASSIVATED, HEX HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 900°F (482°C)		NAS6703U THRU NAS6720U	BACB30LE()U() B	
				BACB30PN()-() B	
				BACB30US()-() B U	
BACB30LT()-()	A286 CRES, CADMIUM PLATED, 12 POINT HEAD, SHORT THREAD, 110 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-() B	
				BACB30LE()K() B I	
				BACB30US()K() B I	
				BACB30US()P() B	
				BACB30LT()K() I	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
Figure 2 (Sheet 37 of 67)

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LT()DK()	A286 CRES, 12 POINT HEAD, 110 KSI SHEAR, SHORT THREAD, CLOSE TOLERANCE, DRILLED SHANK, ALUMINUM PIGMENTED COATING, MAX TEMP 350°F (177°C)	BACN10JD OR BACN11N() OR MS14145	NO EQUIVALENT	BACB30LT()D() <input type="checkbox"/>	<input checked="" type="checkbox"/>
				BACB30US()K()D <input type="checkbox"/>	<input checked="" type="checkbox"/>
BACB30LT()K()	A286 CRES, 12 POINT HEAD, 110 KSI SHEAR, SHORT THREAD, CLOSE TOLERANCE, ALUMINUM PIGMENTED COATING, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30LT()-() <input type="checkbox"/>	
				BACB30US()K() <input type="checkbox"/>	
				BACB30US()P() <input type="checkbox"/> <input type="checkbox"/>	
BACB30LT()U()	A286 CRES, 12 POINT HEAD, 110 KSI SHEAR, SHORT THREAD, CLOSE TOLERANCE, PASSIVATED, MAX TEMP 1200°F (649°C)	BACN10JC()CM OR BACN10YR()CM	NO EQUIVALENT	NO ALTERNATIVE	
BACB30LT()DU()		BACN10JD() OR BACN11N()			
BACB30MR()C() <input type="checkbox"/>	6AL-4V TITANIUM, CAD PLATED, 12 POINT, HEAD LONG THREADED. 95 KSI MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()K() <input type="checkbox"/>	
				BACB30MR()K() <input type="checkbox"/>	
				BACB30US()K() <input type="checkbox"/>	
				BACB30US()P()	
BACB30MR()K()	6AL-4V TITANIUM, 12 POINT HEAD, 95 KSI SHEAR, LONG THREAD, ALUMINUM PIGMENTED COATING, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30LE()-() <input type="checkbox"/>	
				BACB30LE()K()	
				BACB30US()K()	
				BACB30US()P() <input type="checkbox"/>	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
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757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MR()DK()	6AL-4V TITANIUM, 12 POINT HEAD, 95 KSI SHEAR, LONG THREAD, ALUMINUM PIGMENTED COATING, DRILLED SHANK, MAX TEMP 350°F (177°C)	BACN10JD() OR BACN11N() OR MS14144	NO EQUIVALENT	BACB30LE()DK()	<input checked="" type="checkbox"/>
				BACB30US()K()D	<input checked="" type="checkbox"/>
BACB30MT()-() <input checked="" type="checkbox"/>	H-11 STEEL BOLT, 12 POINT HEAD, 220 KSI TENSION, 125 KSI SHEAR		NO EQUIVALENT	BACB30US()K()	
BACB30MT()H() <input checked="" type="checkbox"/> BACB30MT()HK() <input checked="" type="checkbox"/> BACB30MT()HL() <input checked="" type="checkbox"/> BACB30MT()HT() <input checked="" type="checkbox"/>	H-11 STEEL BOLT, 12 POINT HEAD, 220 KSI TENSION, 125 KSI SHEAR DRILLED HEAD		NO EQUIVALENT	BACB30US()K()H	
BACB30MT()K() <input checked="" type="checkbox"/>	H-11 STEEL, ALUMINUM PIGMENTED COATING, 12 POINT HEAD, LONG THREAD, 220 KSI TENSION, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30US()K()	
				BACB30US()P() <input checked="" type="checkbox"/>	
BACB30MT()L() <input checked="" type="checkbox"/>	H-11 STEEL, ALUMINUM PIGMENTED COATING, 12 POINT HEAD, LONG THREAD, 220 KSI TENSION, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US()K() <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	
				BACB30US()P()	
BACB30MT()T() <input checked="" type="checkbox"/>	H-11 STEEL, DIFFUSED NICKEL-CADMIUM PLATED, 12 POINT HEAD, LONG THREAD, 220 KSI TENSION, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US()K() <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	
				BACB30US()P()	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NE()-()	ALLOY STEEL, CADMIUM PLATED, HEX HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 450°F (232°C)		NAS6603 THRU NAS6620	BACB30LE()-() B BACB30LE()-()K() B I BACB30LM()-() BACB30MR()-()K() B I BACB30NM()-()K() I BACB30US()-()K() B I BACB30US()-()P() B NAS6703 THRU NAS6720	
BACB30NF()-()	ALLOY STEEL, HEX HEAD, SHORT THREAD, 95 KSI SHEAR, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-() B BACB30LE()-()K() B I BACB30LJ()-() BACB30LM()-() BACB30LT()-() BACB30MR()-()K() B I BACB30NE()-()- A L BACB30NM()-()K() I BACB30NR()-()K() I V BACB30US()-()K() B I BACB30US()-()P() B NAS6603 THRU NAS6620 NAS6703 THRU NAS6720	
BACB30NH()-() G	PH13-8Mo CRES, CADMIUM PLATE, 12 POINT HEAD, LONG THREAD, 220 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30US()-()K() I	
BACB30NH()-()U() G	PH13-8Mo CRES, PASSIVATED, 12 POINT HEAD, LONG THREAD, 220 KSI TENSION, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US()-() BACB30US()-()K() I	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NH()SU() G	PH13-8Mo CRES, PASSIVATED, 12 POINT HEAD, LONG THREAD, 220 KSI TENSION, DRY FILM LUBRICATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30US()-(BACB30US()K() I	
BACB30NJ()-(E	H-11 STEEL, DIFFUSED NICKEL-CADMIUM PLATED, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US()K() B I BACB30US()P() B K	
BACB30NJ()K() E	H-11 STEEL, ALUMINUM PIGMENTED COATING, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30US()K() B BACB30US()P() B M	
BACB30NJ()L() E	H-11 STEEL, ALUMINUM PIGMENTED COATING, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US()K() B I BACB30US()P() B K	
BACB30NL()-(G	PH13-8Mo CRES, CADMIUM PLATED, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30US()K() B I BACB30US()P() B	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NL()SU() G	PH13-8Mo CRES, PASSIVATED, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR, DRY FILM LUBRICATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30US()-() B	
BACB30NL()U() G	PH13-8Mo CRES, PASSIVATED, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US()-() B	
BACB30NM()C() H	6AL-4V TITANIUM, CADMIUM PLATED, HEX HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()K() B I	
				BACB30MR()K() B I	
				BACB30NM()K() I	
				BACB30US()K() B I	
				BACB30US()P() B	
BACB30NM()K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, HEX HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30LE()-() B M	
				BACB30LE()K() B	
				BACB30MR()K() B	
				BACB30US()K() B	
				BACB30US()P() B M	
BACB30NR()C() H	6AL-4V TITANIUM, CADMIUM PLATED, HEX HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()K() B I	
				BACB30MR()K() B I	
				BACB30NM()K() I	
				BACB30NR()K() I	
				BACB30US()K() B I	
				BACB30US()P() B	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
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INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NR()K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, HEX HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30LE()-() <input type="checkbox"/> <input type="checkbox"/>	
				BACB30LE()K() <input type="checkbox"/>	
				BACB30LT()-() <input type="checkbox"/>	
				BACB30MR()K() <input type="checkbox"/>	
				BACB30NM()K()	
				BACB30US()K() <input type="checkbox"/>	
				BACB30US()P() <input type="checkbox"/> <input type="checkbox"/>	
BACB30PN()-()	INCONEL 718, 12 POINT HEAD, LONG THREAD, MAX TEMP 1200°F (649°C)		NO EQUIVALENT	BACB30LE()U()	
				BACB30US()K() <input type="checkbox"/>	
				BACB30US()-() <input type="checkbox"/>	
BACB30TR()HT() <input type="checkbox"/>	H-11STEEL, DIFFUSED NICKEL-CADMIUM PLATED, 220 KSI MIN TENSILE 125 KSI MIN SHEAR 12 POINT LOW PROFILE, DRILLED HEAD 600°F (316°C)		NO EQUIVALENT	BACB30US()K()H <input type="checkbox"/>	
				BACB30US()P()H <input type="checkbox"/>	
BACB30TR()K() <input type="checkbox"/>	H-11 STEEL, ALUMINUM PIGMENTED COATING, 12 POINT LOW PROFILE HEAD, 220 KSI TENSION, 125 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30US()K()	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30TR() L () E	H-11 STEEL, ALUMINUM PIGMENTED COATING, 12 POINT LOW PROFILE HEAD, 220 KSI TENSION, 125 KSI SHEAR, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US() K () I	
BACB30TR() T () E	H-11 STEEL, DIFFUSED NICKEL CADMIUM PLATED, 12 POINT LOW PROFILE HEAD, 220 KSI TENSION, 125 KSI SHEAR, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30US() K () I	
BACB30US() K ()	INCONEL 718, 12 POINT HEAD, LONG THREAD, 125 KSI SHEAR, BMS 10-85 COATED, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30US() P () M	
BACB30US() P ()	NICKEL ALLOY 718, 12 POINT HEAD, 220 KSI TENSILE, 125 KSI SHEAR, LONG THREAD, CADMIUM PLATED, MAX TEMP 450°F (232°C)	BACN10HR OR BACN10HR() CD	NO EQUIVALENT	BACB30US() K () I	BACN10HR() CD R

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
Figure 2 (Sheet 44 of 67)

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INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30UU()-()	INCONEL 718, PASSIVATED, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR, MAX TEMP 1200°F (649°C)		NO EQUIVALENT	BACB30US()-() B	
BACB30UU()-K()	INCONEL 718, ALUMINUM PIGMENTD COATING, 12 POINT HEAD, SHORT THREAD, 125 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30US()-K() B	
				BACB30US()-P() B M	
				BACB30UU()-P() M	
BACB30UU()-P()	NICKEL ALLOY 718, 12 POINT HEAD, 125 KSI SHEAR, SHORT THREAD, CLOSE TOLERANCE, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30US()-P() B	
				BACB30US()-K() B I	
				BACB30UU()-K() I	
BACB30XJ()-K()	6AL-4V TITANIUM, HEX HEAD, 150 KSI TENSILE, LONG THREAD, ALUMINUM PIGMENTED COATING	NAS1805()-L	NO EQUIVALENT	BACB30XL()-K() B	NAS1805()-L R

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
Figure 2 (Sheet 45 of 67)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30XL() K()	6AL-4V TITANIUM, 12 POINT HEAD, 150 KSI TENSILE, 90 KSI SHEAR, ALUMINUM PIGMENTED COATING, MAX TEMP 350°F (177°C)	NAS1805-() L	NO EQUIVALENT	NO ALTERNATIVE	
BACB30XN() K()	6AL-4V TITANIUM, HEX HEAD, 90 KSI SHEAR, SHORT THREAD, ALUMINUM PIGMENTED COATING		NO EQUIVALENT	BACB30XJ() K() BACB30XL() K() B	
BACB30ZB() -()	ALLOY STEEL, HEX HEAD, SHORT THREAD, CLOSE TOLERANCE CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE() -() B BACB30LE() K() B I BACB30LJ() -() BACB30LM() -() BACB30LT() -() BACB30NE() -() A L BACB30NF() -() BACB30NR() K() I V BACB30US() K() B I BACB30US() P() B NAS6603 THRU NAS6620 NAS6703 THRU NAS6720	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
Figure 2 (Sheet 46 of 67)

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
NAS1103 THRU NAS1120	ALLOY STEEL, HEX HEAD, SHORT THREAD, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-() B	
				BACB30LE()K() B I	
				BACB30LJ()-()	
				BACB30LM()-()	
				BACB30LT()-()	
				BACB30NE()-() A L	
				BACB30NF()-()	
				BACB30NR()K() I V	
				BACB30US()K() B I	
				BACB30US()P() B	
				BACB30ZB()-()	
				NAS6603 THRU NAS6620	
				NAS6703 THRU NAS6720	
NAS6603 THRU NAS6620	ALLOY STEEL, CADMIUM PLATED, HEX HEAD, LONG THREAD, 160 KSI TENSION MAX TEMP 450°F (232°C)		BACB30NE()-()	BACB30LE()-() B	
				BACB30LE()K() B I	
				BACB30LM()-()	
				BACB30MR()K() B I	
				BACB30NF()-()	
				BACB30NM()K() I	
				BACB30US()K() B I	
				BACB30US()P() B	
				NAS6703 THRU NAS6720	
NAS6703 THRU NAS6720	A286 CRES, CADMIUM PLATED, HEX HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 450°F (232°C)		BACB30LM()-()	BACB30US()P() B	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
Figure 2 (Sheet 47 of 67)

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
NAS6703A() THRU NAS6720A()	A-286 CRES, HEX HEAD, CLOSE TOLERANCE, 160 KSI TENSILE, 95 KSI SHEAR, LONG THREAD, UNDRILLED, ALUMINUM PIGMENTED COATING, NON-LOCKING		NO EQUIVALENT	BACB30LE()-() <input type="checkbox"/> <input type="checkbox"/>	
				BACB30LE()K() <input type="checkbox"/>	
				BACB30LM()-() <input type="checkbox"/>	
				BACB30MR()K() <input type="checkbox"/>	
				BACB30NM()K()	
				BACB30US()K() <input type="checkbox"/>	
				BACB30US()P() <input type="checkbox"/> <input type="checkbox"/>	
				NAS6703-() THRU NAS6720-() <input type="checkbox"/>	
NAS6703AD() THRU NAS6720AD()	A-286 CRES, HEX HEAD, CLOSE TOLERANCE, 160 KSI TENSILE, 95 KSI SHEAR, LONG THREAD, DRILLED, ALUMINUM PIGMENTED COATING, NON-LOCKING	BACN10JD() OR BACN11N() OR MS14144	NO EQUIVALENT	BACB30NM()DK()	<input checked="" type="checkbox"/>
				NAS6703D() THRU NAS6720D() <input type="checkbox"/> <input type="checkbox"/>	
NAS6703U THRU NAS6720U	A286 CRES, PASSIVATED, HEX HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 900°F (482°C)		BACB30LM()U()	BACB30LE()U() <input type="checkbox"/>	
				BACB30PN()-() <input type="checkbox"/>	
				BACB30US()-() <input type="checkbox"/> <input type="checkbox"/>	

BOLT – EXTERNAL WRENCHING – PROTRUDING HEAD
TABLE VI

Fastener Substitution - Bolts
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INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30AB-P()-()	ALLOY STEEL 100° CLOSE TOLERANCE 160 KSI PHILLIPS RECESS, SHORT THREAD, DRILLED, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LH()-D()	<input checked="" type="checkbox"/>
				BACB30LR()-D()	
				BACB30LU()-D()	
BACB30AB-P()-()A	ALLOY STEEL 100° CLOSE TOLERANCE 160 KSI PHILLIPS RECESS, SHORT THREAD, UNDRILLED, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LH()-()	
				BACB30LP()-()	
				BACB30LR()-()	
				BACB30LU()-()	
				BACB30MS()-K() <input type="checkbox"/>	
				BACB30NN()-K() <input type="checkbox"/>	
BACB30EL()-()	ALLOY STEEL, CADMIUM PLATED, HI-TORQUE RECESS, 100° REDUCED HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30EL()-C()	
				BACB30EL()-CN()	
				BACB30NU()-K() <input type="checkbox"/>	
				BACB30VF()-K() <input type="checkbox"/>	
				NAS8703 THRU NAS8712	
BACB30EL()-CN()	ALLOY STEEL, DIFFUSED-NICKEL CADMIUM PLATED, HI-TORQUE, SHORT THREAD, REDUCED HEAD, 95 KSI SHEAR, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30NU()-K() <input type="checkbox"/>	
				BACB30VF()-K() <input type="checkbox"/>	
				NAS8703 THRU NAS8712 <input type="checkbox"/>	
BACB30FA()-()P	ALLOY STEEL, CADMIUM PLATED, HI-TORQUE RECESS, SELF-LOCKING, 100° HEAD, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30FA()-R()P	

BOLT - RECESS DRIVE - FLUSH HEAD
TABLE VII

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30FB()-()	ALLOY STEEL CADMIUM PLATED, HI-TORQUE RECESS, 100° REDUCED HEAD LONG THREAD, 160 KSI TENSION MAX TEMP 450°F (232°C)		NO EQUIVALENT	NO ALTERNATIVE	
BACS12GP3K()	SCREW, 6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, CROSS RECESS, 100° HEAD, POINTED, FULL THREADED, MAX TEMP 350°F (177°C)		NO EQUIVALENT	<div>BACS12GM3()-() A L M</div> <div>BACS12GP3L()</div> <div>BACS12GR3L()</div>	
BACB30LH()-()	A286 CRES, CADMIUM PLATED, CROSS RECESS, 100° HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	<div>BACB30LP()-()</div> <div>BACB30LR()-()</div> <div>BACB30LU()-() A L</div> <div>BACB30MS()-() I</div> <div>BACB30NN()-() I</div>	
BACB30LH()-U()	A286 CRES, PASSIVATED, CROSS RECESS, 100° HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 900°F (482°C)		NO EQUIVALENT	<div>BACB30LP()-U()</div> <div>BACB30LR()-U()</div>	

BOLT - RECESS DRIVE - FLUSH HEAD
TABLE VII

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LL()-()	A286 CRES, CADMIUM PLATED, DOVETAIL RECESS, 100° REDUCED HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30EL()-() A L	
				BACB30EL()-()CN() A L	
				BACB30NU()-()K() I	
				BACB30UW()-()K() I	
				BACB30UW()-()P()	
				BACB30VF()-()K() I	
BACB30LL()-()U()	A286 CRES, PASSIVATED, DOVETAIL RECESS, 100° REDUCED HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 900°F (482°C)		NO EQUIVALENT	BACB30UW()-()-()	
BACB30LP()-()	A286 CRES, CAD CADMIUM PLATED, HI-TORQUE RECESS, 100° HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LR()-() N	
				BACB30LU()-() A L N	
				BACB30NN()-()K() I N	
BACB30LP()-()U()	A286 CRES, PASSIVATED, HI-TORQUE RECESS, 100° HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 900°F (482°C)		NO EQUIVALENT	BACB30LR()-()U() N	

BOLT – RECESS DRIVE – FLUSH HEAD
TABLE VII

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LR()-()	A286 CRES, 100° HEAD, CROSS RECESS, LONG THREAD, CLOSE TOLERANCE, CADMIUM PLATED, 160 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LP()-()	
				BACB30LU()-() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
				BACB30NN()-() <input type="checkbox"/>	
BACB30LR()-()	A286 CRES, 100° HEAD, CROSS RECESS, LONG THREAD, CLOSE TOLERANCE, ALUMINUM PIGMENTED COATING, 160 KSI TENSION, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30LP()-() <input type="checkbox"/>	
				BACB30LR()-() <input type="checkbox"/>	
				BACB30LU()-() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
				BACB30MS()-() <input type="checkbox"/>	
				BACB30NN()-()	
BACB30LR()-DK()		BACN10JD() OR BACN11N() OR MS14144		BACB30LR()-D() <input type="checkbox"/>	<input type="checkbox"/>
BACB30LR()-U()	A286 CRES, 100° HEAD, CROSS RECESS, LONG THREAD, CLOSE TOLERANCE, PASSIVATED, 160 KSI TENSION, MAX TEMP 900°F (482°C)		NO EQUIVALENT	BACB30LP()-U()	
BACB30LU()-()	ALLOY STEEL, 100° HEAD, CROSS RECESS, LONG THREAD, 95 KSI SHEAR, CLOSE TOLERANCE, ALUMINUM PIGMENTED COATING, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LP()-()	
				BACB30LR()-()	
				BACB30NN()-() <input type="checkbox"/>	

BOLT – RECESS DRIVE – FLUSH HEAD
TABLE VII

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MS() C() H	6AL-4V TITANIUM, 100° HEAD, DOVETAIL RECESS, LONG THREAD, CADMIUM PLATED, 160 KSI TENSION, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30MS() K() I	
				BACB30NN() K() I	
				BACB30WP() K() R I	
BACB30MS() K() C()	6AL-4V TITANIUM, 100° HEAD, DOVETAIL RECESS, LONG THREAD, ALUMINUM PIGMENTED COATING, 160 KSI TENSION, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30NN() K() C()	
				BACB30WP() K() R	
BACB30NN() C() H	6AL-4V TITANIUM, 100° HEAD, CROSS RECESS, LONG THREAD, CADMIUM PLATED, 160 KSI, TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30MS() K() I Y	
				BACB30NN() K() I	
				BACB30WP() K() R I	
BACB30NN() K() C()	6AL-4V TITANIUM, 100° HEAD, CROSS RECESS, LONG THREAD, ALUMINUM PIGMENTED COATING, 160 KSI TENSION, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30MS() K() Y	
				BACB30WP() K() R	

BOLT - RECESS DRIVE - FLUSH HEAD
TABLE VII

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30NU()C() H	6AL-4V TITANIUM, 100° REDUCED HEAD, DOVETAIL RECESS, SHORT THREAD, 95 KSI SHEAR, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30NU()K() I	
				BACB30VF()K() I	
BACB30NU()K()	6AL-4V TITANIUM, 100° REDUCED HEAD, DOVETAIL RECESS, SHORT THREAD, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30VF()K()	
BACB30NU()R()	6AL-4V TITANIUM, 100° REDUCED HEAD, DOVETAIL RECESS, SHORT THREAD, 95 KSI SHEAR, PHOSPHATE FLUORIDE COATED, CETYL ALCOHOL LUBRICATED		NO EQUIVALENT	BACB30NU()K() I	
				BACB30VF()K() I	
				BACB30VF()R()	
BACB30SW()-() E	H-11 STEEL, DIFFUSED NICKEL CADMIUM PLATED, 100° HEAD, HI-TORQUE, 125 KSI SHEAR, LONG THREAD		NO EQUIVALENT	C	
BACB30SW()K() E	H-11 STEEL, ALUMINUM PIGMENTED COATING, 100° HEAD, HI-TORQUE, 125 KSI SHEAR, LONG THREAD		NO EQUIVALENT	C	

BOLT – RECESS DRIVE – FLUSH HEAD
TABLE VII

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30TP3-()	ALLOY STEEL, CADMIUM PLATED, CROSS RECESS, 100° HEAD, POINTED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LH3-()	
				BACB30LP3-()	
				BACB30LU3-() A L	
				BACB30NN3K() I	
BACB30UR()K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 100° REDUCED HEAD, SHORT THREAD, OFFSET CRUCIFORM 95 KSI SHEAR		NO EQUIVALENT	BACB30VF()K()	
BACB30UR()R()	6AL-4V TITANIUM, PHOSPHATE FLOURIDE COATED, CETYL ALCOHOL LUBRICATED, 100° REDUCED HEAD, SHORT THREAD, OFFSET CRUCIFORM 95 KSI SHEAR		NO EQUIVALENT	BACB30VF()K() I	
				BACB30VF()R()	
BACB30UW()P()	NICKEL ALLOY 718, 100° REDUCED HEAD, DOVETAIL RECESS, 125 KSI SHEAR, SHORT THREAD, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30UW()K() I	

BOLT – RECESS DRIVE – FLUSH HEAD
TABLE VII

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB3QVF() K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, CROSS RECESS, 100° REDUCED HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	NO ALTERNATIVE	
BACB3QVF() R()	6AL-4V TITANIUM, 100° REDUCED HEAD, CROSS RECESS, 95 KSI SHEAR, SHORT THREAD, PHOSPHATE FLUORIDE COATED, CETYL, ALCOHOL LUBRICATED		NO EQUIVALENT	BACB3QVF() K() I	
BACB3QWP() P() R	NICKEL ALLOY 718, 100° HEAD, DOVETAIL RECESS, 125 KSI SHEAR, LONG THREAD, CADMIUM PLATED, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB3QWP() K() R I	
BACB3OXM() K()	6AL-4V TITANIUM, 100° HEAD, CROSS RECESS, 150 KSI TENSILE, LONG THREAD, ALUMINUM PIGMENTED COATING, MAX TEMP 350°F (177°C)	NAS1805-() L	NO EQUIVALENT	NO ALTERNATIVE	

BOLT – RECESS DRIVE – FLUSH HEAD
TABLE VII

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30EM-P()-()	ALLOY STEEL, DIFFUSED NICKEL-CADMIUM PLATED, DOVETAIL RECESS, CLOSE TOLERANCE, PAN HEAD, SHORT THREAD, 160 KSI TENSION, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30EM-P()L() A L	
				BACB30LK()-()	
				BACB30NT()K() I	
				NAS623()-() A L	
BACB30EM-P()L()	ALLOY STEEL, DIFFUSED NICKEL-CADMIUM PLATED, DOVETAIL RECESS, CLOSE TOLERANCE, PAN HEAD, LONG THREAD, 160 KSI TENSION, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30LE()K() B I	
				BACB30LM()-()	
				BACB30MR()K() B I	
				BACB30NM()K() I	
				BACB30US()K() B I	
				NAS6603 THRU NAS6620 L	
				NAS6703 THRU NAS6720	
BACB30LK()-()	A286 CRES, CADMIUM PLATED, CROSS RECESS, PAN HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-() B	
				BACB30LE()K() B I	
				BACB30LJ()-()	
				BACB30LM()-()	
				BACB30LT()-()	
				BACB30MR()K() B I	
				BACB30NE()-() A L	
				BACB30NM()K() I	
				BACB30US()K() B I	
				BACB30US()P() B	
				NAS6603 THRU NAS6620 A L	
				NAS6703 THRU NAS6720	

BOLT - RECESS DRIVE - PROTRUDING HEAD
TABLE VIII

Fastener Substitution - Bolts
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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LK()U()	A286 CRES, PASSIVATED, CROSS RECESS, PAN HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 900°F (482°C)		NO EQUIVALENT	BACB30LE()U() B	
				BACB30LJ()U()	
				BACB30LM()U()	
				BACB30LT()U()	
				BACB30US()-() B	
				NAS6703U THRU NAS6720U	
BACB30NT()C() H	6AL-4V TITANIUM, CAD PLATED, PHILLIPS RECESS SHORT THREADED. 95 KSI MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()K() B I	
				BACB30LK()-()	
				BACB30MR()K() B I	
				BACB30NJ()K() I	
				BACB30NM()K() I	
				BACB30NR()K() I	
BACB30NT()K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, CROSS RECESS, PAN HEAD, SHORT THREAD 95 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30LE()-() B M	
				BACB30LE()K() B	
				BACB30LJ()-() M	
				BACB30LK()-() M	
				BACB30LM()-() M	
				BACB30LT()-() M	
				BACB30MR()K() B	
				BACB30NE()-() A L M	
				BACB30NF()-() A L M	
				BACB30NM()K()	
				BACB30NR()K()	
				BACB30US()K() B	
				BACB30US()P() B M	
				NAS6603 THRU NAS6620 A L M	
				NAS6703 THRU NAS6720 M	

BOLT – RECESS DRIVE – PROTRUDING HEAD
TABLE VIII

Fastener Substitution - Bolts
Figure 2 (Sheet 58 of 67)

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
NAS623-()-()	SCREW, ALLOY STEEL, CADMIUM PLATED, PHILLIPS RECESS, PAN HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-() B	
				BACB30LE()K() B I	
				BACB30LJ()-()	
				BACB30LK()-()	
				BACB30LM()-()	
				BACB30LT()-()	
				BACB30MR()K() B I	
				BACB30NM()K() I	
				BACB30NR()K() I	
				BACB30NT()K() I	
NAS623-()-()W	SCREW, ALLOY STEEL, CADMIUM PLATED, PHILLIPS RECESS, PAN HEAD, SHORT THREAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LE()-() B	
				BACB30LE()K() B I	
				BACB30LJ()-()	
				BACB30LK()-()	
				BACB30LM()-()	
				BACB30LT()-()	
				BACB30MR()K() B I	
				BACB30NM()K() I	
				BACB30NR()K() I	
				BACB30NT()T() I	
				NAS623-()-() L	

BOLT – RECESS DRIVE – PROTRUDING HEAD
TABLE VIII

Fastener Substitution - Bolts
Figure 2 (Sheet 59 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LB()C()	A286 CRES SLEEVE, PASSIVATED, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	MS21141-()()	
BACB30LB()C()CD	A286 CRES SLEEVE, CADMIUM PLATED, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	MS21141-()()P	
BACB30LB()-()	ALLOY STEEL SLEEVE, CADMIUM PLATED, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	MS90354-()()	
BACB30UY()-()	6AL-4V TITANIUM, PHOSPHATE FLUORIDE COATED		NO EQUIVALENT	BACB30VL()-() P	
				BACB30VL()-()D	
				BACB30VL()C()D	

BOLT - BLIND - PROTRUDING HEAD
TABLE IX

Fastener Substitution - Bolts
Figure 2 (Sheet 60 of 67)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BAC30VL()-()	LOW PROFILE HEAD, SHEAR, LIGHTWEIGHT, 304 CRES SLEEVE, TITANIUM ALLOY NUT		NO EQUIVALENT	BACB30VL()-()D BACB30VL()C()D	
BACB30VL()-()D	LOW PROFILE HEAD, SHEAR, LIGHTWEIGHT, 304 CRES SLEEVE, TITANIUM ALLOY NUT, DISPOSABLE DRIVE NUT		NO EQUIVALENT	BACB30VL()-() P BACB30VL()C()D	
BACB30VL()C()D	LOW PROFILE HEAD, SHEAR, LIGHTWEIGHT, 304 CRES SLEEVE, A-286 SS NUT, DISPOSABLE DRIVE NUT		NO EQUIVALENT	BACB30VL()-() P BACB30VL()-()D	
MS21141-()()	A286 CRES SLEEVE, PASSIVATED, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX MAX TEMP 1200°F (649°C)		NO EQUIVALENT	BACB30LB()C()	
MS21141-()()P	A286 CRES SLEEVE, CADMIUM PLATED, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LB()C()CD	
MS90354-()()	ALLOY STEEL SLEEVE, CADMIUM PLATED, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LB()-()	

BOLT - BLIND - PROTRUDING HEAD
TABLE IX

Fastener Substitution - Bolts
Figure 2 (Sheet 61 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30LA()C()	A286 CRES SLEEVE, PASSIVATED, 100° HEAD, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 1200°F (649°C)		NO EQUIVALENT	MS21140-()C()	
BACB30LA()C()CD	A286 CRES SLEEVE, CADMIUM PLATED, 100° HEAD, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	MS21140-()C()P	
BACB30LA()-()	ALLOY STEEL SLEEVE, CADMIUM PLATED, 100° HEAD, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	MS90353-()C()	
BACB30UZ()-()	6AL-4V TITANIUM, PHOSPHATE FLUORIDE COATED, 130° HEAD		NO EQUIVALENT	BACB30VK()-() P	
				BACB30VK()-()D	
				BACB30VK()C()D	
BACB30VK()-()	CRES SLEEVE, 6AL-4V TITANIUM NUT, 130° HEAD, REDUCED SHEAR, LIGHTWEIGHT, PHOSPHATE FLUORIDE TREATED, PASSIVATED SLEEVE, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30VK()-()D	
				BACB30VK()C()D	

BOLT - BLIND - FLUSH HEAD
TABLE X

Fastener Substitution - Bolts
Figure 2 (Sheet 62 of 67)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30VK()-()D	CRES SLEEVE, 130° HEAD, REDUCED SHEAR, LIGHTWEIGHT, PHOSPHATE FLUORIDE TREATED, PASSIVATED SLEEVE, DISPOSABLE DRIVE NUT, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30VK()-() P	
				BACB30VK()-()D	
BACB30VK()-()C()D	CRES SLEEVE, A-286 CRES NUT, 130° HEAD, REDUCED SHEAR, LIGHTWEIGHT, PASSIVATED NUT AND SLEEVE, DISPOSABLE DRIVE NUT, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30VK()-() P	
				BACB30VK()-()D	
MS2114D()-()()	A286 CRES SLEEVE, PASSIVATED, 100° HEAD, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 1200°F (649°C)		NO EQUIVALENT	BACB30LA()-()C()	
MS2114D()-()()P	A286 CRES SLEEVE, CADMIUM PLATED, 100° HEAD, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LA()-()C()CD	

BOLT - BLIND - FLUSH HEAD
TABLE X

Fastener Substitution - Bolts
Figure 2 (Sheet 63 of 67)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
MS90353-() ()	ALLOY STEEL SLEEVE, CADMIUM PLATED, 100° HEAD, POSITIVE MECHANICAL LOCK, PULL TYPE, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30LA()-()	

BOLT - BLIND - FLUSH HEAD
TABLE X

Fastener Substitution - Bolts
Figure 2 (Sheet 64 of 67)



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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30MW()C() H	6AL-4V TITANIUM, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 95 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30MW()K() I	
				BACB30PB()-() A L	
				BACB30PB()A()	
				BACB30PB()AK() I	
				BACB30PE()-() A L	
				BACB30PE()A()	
				BACB30PE()AK() I	
BACB30MW()K()	6AL-4V TITANIUM, BMS 10-85 COATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 95 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30PB()-() A L M	
				BACB30PB()A() M	
				BACB30PB()AK()	
				BACB30PE()-() A L M	
				BACB30PE()A() M	
				BACB30PE()AK()	
BACB30PB()-()	ALLOY STEEL, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 108 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30BP()A()	
				BACB30PE()-() L	
				BACB30PE()A()	
				BACB30PE()AK() I	
				BACB30PB()AK() I	
BACB30PB()A()	A286 CRES, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 110 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30PE()A()	
				BACB30PE()AK() I	
				BACB30PB()AK() I	
BACB30PB()AK()	A286 CRES, BMS 10-85 COATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 110 KSI SHEAR, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30PB()A() M	
				BACB30PE()A() M	
				BACB30PE()AK()	

BOLT – TAPER SHANK – PROTRUDING HEAD
TABLE XI

Fastener Substitution - Bolts
Figure 2 (Sheet 65 of 67)

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30PB() K () Z	ALLOY STEEL, BMS 10-85 COATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 108 KSI SHEAR MAX TEMP 600° (316°)		NO EQUIVALENT	BACB30PB() - () K M	
				BACB30PB() A () K M	
				BACB30PB() AK () I	
				BACB30PE() - () K M	
				BACB30PE() A () K M	
				BACB30PE() AK () I	
BACB30PE() - ()	ALLOY STEEL, CADMIUM PLATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD, 180 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30PE() A ()	
				BACB30PE() AK () I	
BACB30PE() A ()	A286 CRES, CAD PLATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD, 200 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30PE() AK () I	
BACB30PE() AK ()	A286 CRES, BMS 10-85 COATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD, 200 KSI TENSION, MAX TEMP 350°F (177°C)		NO EQUIVALENT	BACB30PE() A () M	
BACB30PE() K () Z	ALLOY STEEL, BMS 10-85 COATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD, 180 KSI TENSION, MAX TEMP 600°F (316°C)		NO EQUIVALENT	BACB30PE() - () K M	
				BACB30PE() A () K M	
				BACB30PE() AK () I	

BOLT – TAPER SHANK – PROTRUDING HEAD

TABLE XI

Fastener Substitution - Bolts
Figure 2 (Sheet 66 of 67)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30KD()-()	ALLOY STEEL, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 108 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30KD()A()	
BACB30KD()A()	A286 CRES, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 110 KSI SHEAR, MAX TEMP 450°F (232°C)		NO EQUIVALENT	NO ALTERNATIVE	
BACB30MU()C() H	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 95 KSI SHEAR, MAX TEMP 450° (232°C)		NO EQUIVALENT	BACB30KD()-() A L	
				BACB30KD()A()	
				BACB30MU()K() I	
BACB30MU()K()	6AL-4V TITANIUM, BMS 10-85 COATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD, 95 KSI SHEAR, MAX TEMP 350° (177°C)		NO EQUIVALENT	BACB30KD()A() M	
				BACB30KD()-() A L M	
BACB30PD()A()	A286 CRES, CAD PLATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD, 200 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	NO ALTERNATIVE	
BACB30PD()-()	ALLOY STEEL, CAD PLATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD, 180 KSI TENSION, MAX TEMP 450°F (232°C)		NO EQUIVALENT	BACB30PD()A()	

BOLT – TAPER SHANK – FLUSH HEAD
TABLE XI

Fastener Substitution - Bolts
Figure 2 (Sheet 67 of 67)

STRUCTURAL REPAIR MANUAL

NOTES

- REFER TO TABLE I FOR THE FASTENER SUBSTITUTION INDEX.
- REFER TO SRM 51-40-02 FOR THE REMOVAL AND THE INSTALLATION OF FASTENERS.
- THE SHEAR AND TENSION TYPE FASTENERS USE DIFFERENT TORQUE VALUES AND INSTALLATION TOOLS. REFER TO SRM 51-40-04.
- REFER TO SRM 51-30-01 FOR THE NECESSARY PROTECTIVE TREATMENT FOR FASTENER INSTALLATION.
- DO NOT USE CADMIUM PLATED FASTENERS IN TITANIUM OR GRAPHITE (CARBON FIBER) STRUCTURE.

[A] APPLY A FILLET SEAL TO THE WET SIDE OF THE FASTENER INSIDE THE FUEL TANK. REFER TO SRM 51-20-05.

[B] DO NOT INSTALL THIS COLLAR OR NUT ON A SLOPED SURFACE.

[C] THIS FASTENER IS NOT PERMITTED IN AREAS WHERE THE TEMPERATURE IS MORE THAN 350°F (177°C)

THIS FASTENER IS NOT PERMITTED IN AREAS WHERE ELECTRICAL CONDUCTIVITY IS REQUIRED. REFER TO BAC5117.

[D] USE A SELF-ALIGNING COLLAR BACC30CH() WHEN THE COLLAR SIDE SLOPE IS MORE THAN 0.5 DEGREES.

[E] THIS FASTENER IS PERMITTED ONLY IN CLOSE REAM OR LARGER HOLES (NON-INTERFERENCE).

[F] DO NOT USE CADMIUM PLATED FASTENERS AS AN ALTERNATIVE FOR BARE OR ALUMINUM COATED FASTENERS WHEN YOU INSTALL FASTENERS THROUGH THE MATERIALS THAT FOLLOW:

- TITANIUM STRUCTURE
- GRAPHITE (CARBON FIBER) STRUCTURE

[G] THESE FASTENERS MUST BE INSTALLED WITH TORQUE-CONTROLLED TOOLING. REFER TO SRM 51-40-04.

[H] THE RECOMMENDED FASTENERS IN ALUMINUM STRUCTURE ARE TITANIUM WITH BMS 10-85 APPLIED, A-286 WITH BMS 10-85 APPLIED, OR CADMIUM-PLATED A-286.

- CADMIUM-PLATED ALLOY-STEEL FASTENERS ARE A STRUCTURALLY ACCEPTABLE ALTERNATIVE.
- HOWEVER, IN A CORROSIVE ENVIRONMENT THE CADMIUM PLATING, WHICH IS A SACRIFICIAL COATING, MAY DISAPPEAR ALLOWING THE ALLOY-STEEL FASTENER TO CORRODE.

- THIS MAY RESULT IN THE RUST-STREAKING OF THE SURROUNDING STRUCTURE AND THE INITIATION OF CORROSION OF ANY ADJACENT ALUMINUM STRUCTURE.

NOTE: ALL THESE FASTENERS, BOTH THE RECOMMENDED AND THE ALTERNATIVES, SHOULD BE INSTALLED WET WITH THE NECESSARY SEALANT MATERIAL.

[I] DO NOT USE ALLOY STEEL FASTENERS AS AN ALTERNATIVE FOR THE CORROSION RESISTANT STEEL (CRES) OR TITANIUM FASTENERS IN:

- AREAS WHERE ANTI-MAGNETIC FASTENERS ARE NECESSARY
- GRAPHITE (CARBON FIBER) STRUCTURE
- CRES STRUCTURE

[J] SPEAK TO THE BOEING COMPANY FOR FASTENER ALTERNATIVES

Fastener Substitution - Lockbolts
Figure 3 (Sheet 1 of 21)



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STRUCTURAL REPAIR MANUAL

TYPE OF LOCKBOLT FASTENER	LOCATION OF FASTENER	
	TABLE NUMBER	SHEET NUMBER
LOCKBOLT - PROTRUDING HEAD (SHEAR)	II	3 THROUGH 8
LOCKBOLT - FLUSH HEAD (SHEAR)	III	9 THROUGH 15
LOCKBOLT - PROTRUDING HEAD (TENSION)	IV	16 THROUGH 18
LOCKBOLT - FLUSH HEAD (TENSION)	V	19 THROUGH 21

LOCKBOLT FASTENER SUBSTITUTION INDEX
TABLE I

Fastener Substitution - Lockbolts
Figure 3 (Sheet 2 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30AR()-()	ALLOY STEEL, CADMIUM PLATED, 95 KSI SHEAR, LUBRICATED FLAT HEAD, STUMP TYPE, MAX TEMP 250°F (121°C)	BACC30K() OR NAS1080C()	NO EQUIVALENT	BACB30FM()-() H	BACC30AG() A BACC30M() A B BACN10XJ() A B G
				BACB30FM()A()	BACC30AG() A BACC30M() A B BACN10XJ() A B G
				BACB30GW()-()	BACC30K() NAS1080C()
				BACB30GW()A() H	BACC30K() NAS1080C()
				BACB30VN()K() C	BACC30BK()
				BACB30VT()K() C	BACC30BL() A B BACC30BQ() A BACN10YZ() A B G
BACB30CU()-()	ALLOY STEEL CAD PLATED 0.0156 OVERSIZE PULL TYPE GUN DRIVEN	BACC30K() OR NAS1080C()	NO EQUIVALENT	BACB30FP()-()	BACC30AG() A BACC30M() A B BACN10XJ() A B G
				BACB30MY()K()X C	BACC30AG() A BACC30M() A B BACN10XJ() A B G
				BACB30NX()K()X C	BACC30AG() A BACC30M() A B BACN10XJ() A B G

LOCKBOLT - PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Lockbolts
Figure 3 (Sheet 3 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION			
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART	
BACB30GW()-()	ALLOY STEEL, C.T. SHANK, 1.0 PINTAIL, (PULL TYPE, GUN DRIVEN), CADMIUM PLATED	BACC30K() OR NAS1080C()	NO EQUIVALENT	BACB30FM()-() H	BACC30AG() A	
					BACC30M() A B	
				BACB30FM()A()	BACC30AG() A	
					BACC30M() A B	
				BACB30MY>()K() C	BACC30AG() A	
					BACC30M() A B	
				BACB30VN>()K() C	BACC30BK()	
BACB30VT>()K() C				BACC30BL() A B		
				BACC30BQ() A		
				BACN10YZ()		
				A B G		
				BACC30BP() B		
	BACB30GW()A()	A-286 CRES, C.T. SHANK, 1.0 PINTAIL, (PULL TYPE, GUN DRIVEN), CADMIUM PLATED	BACC30K() NAS1080E()	NO EQUIVALENT	BACB30VN>()K() C	BACC30BK()
					BACB30VT>()K() C	BACC30BL()
					A B	
					BACC30BP() B	
					BACN10YZ()	
					A B G	
					BACC30BQ() A	
BACB30FM()A()				BACC30AB()C		
				A B		
				BACC30AG() A E		
	BACB30VN>()K() C	BACC30BK() E				
	BACB30VT>()K() C	BACC30BL()				
		A B E				
		BACC30BP() B E				
	BACC30BQ() A E					
	BACC30BS() A B					
	BACN10YZ()					
	A B G E					

LOCKBOLT – PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Lockbolts
Figure 3 (Sheet 4 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30GW()A()U	A286 CRES, PASSIVATED, 95 KSI SHEAR, LUBRICATED, PULLTYPE, MAX TEMP 900°F (482°C)	BACC30L()	NO EQUIVALENT	BACB30FM()A()U	BACC30AB()S A B
				BACB30MB()A()U	BACC30AB()S A B
BACB30GW()D()	ALLOY STEEL CAD PLATED LUBRICATED 95 KSI SHEAR MAX TEMP 450°F (232°C)	BACC30K() OR NAS1080C()	NO EQUIVALENT	BACB30FM()-() H I	BACC30AG() A BACC30M() A B
				BACB30FM()A()	BACC30AG() A BACC30M() A B
				BACB30MY()K() C	BACC30AG() A BACC30M() A B
				BACB30VN()K() C	BACC30BK()
				BACB30VT()K() C	BACC30BL() A B BACC30BQ() A BACN10YZ() A B G BACC30BP() B
BACB30GW()D()N	ALLOY STEEL, DIFFUSED NICKEL-CADMIUM PLATED, 95 KSI SHEAR, LUBRICATED, PULL TYPE, MAX TEMP 600°F (316°C)	NAS1080E	NO EQUIVALENT	J	

LOCKBOLT – PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Lockbolts
Figure 3 (Sheet 5 of 21)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30TZ()K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, PULL TYPE, MAX TEMP 250°F (121°C)	BACC30BE	NO EQUIVALENT	BACB30FM()-() F H I	BACC30AG() A B
					BACC30M() A B
					BACN10XJ() A B G
				BACB30FM()A() F	BACC30AG() A
					BACC30M() A B
					BACN10XJ() A B G
				BACB30MY()K()	BACC30AG() A
					BACC30M() A
					BACN10XJ() A B G
				BACB30VN()K()	BACC30BK()
BACB30UD()K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, STUMP TYPE, MAX TEMP 250°F (121°C)	BACC30K() OR BACC30BE()	NO EQUIVALENT	BACB30FM()-() F H I	BACC30AG() A
					BACC30M() A B
					BACN10XJ() A B G
				BACB30FM()A() F	BACC30AG() A
					BACC30M() A B
					BACN10XJ() A B G
				BACB30MY()K()	BACC30AG() A
					BACC30M() A B
					BACN10XJ() A B G
				BACB30VN()K()	BACC30BK()
				BACB30VT()K()	BACC30BP() B
					BACC30BQ() A
					BACC30BL() A B
					BACN10YZ() A B G

LOCKBOLT - PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Lockbolts
Figure 3 (Sheet 6 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB3QVN() K()	6AL-4V TITANIUM, 95 KSI SHEAR, LIGHTWEIGHT, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C)	BACC3OBK()	NO EQUIVALENT	BACB3OFM() -() F H I	BACC3OAG() A
					BACC3OM() A B
					BACN1OXJ() A B G
				BACB3OFM() A() F	BACC3OAG() A
					BACC3OM() A B
					BACN1OXJ() A B G
				BACB3OMY() K()	BACC3OAG() A
					BACC3OM() A B
					BACN1OXJ() A B G
				BACB3OVT() K()	BACC3OBL() A B
					BACC3OBP() B
					BACC3OBQ() A
					BACN1OYZ() A B G

LOCKBOLT – PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Lockbolts
Figure 3 (Sheet 7 of 21)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB3QVR()K()	6AL-4V TITANIUM, 95 KSI SHEAR, STUMP TYPE, LIGHTWEIGHT, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED MAX TEMP 250°F (121°C)	BACC3OBK()	NO EQUIVALENT	BACB3QFM()-() F H I	BACC3OAG() A
					BACC3OM() A B
					BACN10XJ() A B G
				BACB3QFM()A() F	BACC3OAG() A
					BACC3OM() A B
					BACN10XJ() A B G
				BACB3QMY()K()	BACC3OAG() A
					BACC3OM() A B
					BACN10XJ() A B G
				BACB3QVN()K()	BACC3OBK()
BACB3QXC()HK()	6AL-4V TITANIUM, 95 KSI SHEAR, AL COATED, CETYL ALCOHOL LUBRICATED, WITH SEALANT ESCAPE GROOVE, FOR USE IN COMPOSITES, MAX TEMP 250°F	BACC3OBN()L	NO EQUIVALENT	BACB3QXH()K()	BACC3OCG() D
				BACB3QNX()K()	BACC3OAB()S B
BACB3QXC()K()	6AL-4V TITANIUM, 95 KSI SHEAR, AL COATED, CETYL ALCOHOL LUBRICATED, FOR USE IN COMPOSITES, MAX TEMP 250°F	BACC3OBN()L	NO EQUIVALENT	BACB3QXH()K()	BACC3OCG() D
				BACB3QNX()K()	BACC3OAB()S B

LOCKBOLT - PROTRUDING HEAD (SHEAR)
TABLE II

Fastener Substitution - Lockbolts
Figure 3 (Sheet 8 of 21)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30CT()-()	ALLOY STEEL, CAD PLATED, 0.0156 OVERSIZE PULL TYPE GUN DRIVEN	NAS1080D()	NO EQUIVALENT	BACB30FQ()-()	BACC30M() <div>A</div> <div>B</div>
				BACB30FQ()-A()	BACC30M() <div>A</div> <div>B</div>
				BACB30NW()-K()-X <div>C</div>	BACC30M() <div>A</div> <div>B</div>
BACB30GQ()-()	7075-T6 AL PULL TYPE 100° HEAD GUN DRIVEN	NAS1080D()	NO EQUIVALENT	NAS1535 THRU 1542	NAS1080K()
BACB30GS()-()	7075-T6 AL STUMP TYPE 100° HEAD HAMMER DRIVEN	NAS1080D()	NO EQUIVALENT	NAS1535 THRU 1542	NAS1080K()
BACB30GY()-()	ALLOY STEEL, 100° HEAD, STEEL C.T. SHANK, 1.0 PINTAIL, (PULL TYPE, GUN DRIVEN), CADMIUM PLATED, CETYL ALCOHOL LUBRICATED	BACC30K() <div>OR</div> NAS1080C()	NO EQUIVALENT	BACB30VU()-K() <div>C</div> <div>D</div>	BACC30BL() <div>A</div> <div>B</div>
		NAS1080E			BACC30BP() <div>B</div>
					BACC30BQ() <div>A</div>
				BACN10YZ() <div>A</div> <div>B</div> <div>G</div>	
				BACC30BK()	
				BACB30XT()-K() <div>C</div> <div>D</div>	BACC30BL() <div>A</div> <div>B</div> <div>E</div>
				BACB30VU()-K() <div>C</div> <div>D</div>	BACC30BP() <div>B</div> <div>E</div>
					BACC30BQ() <div>A</div> <div>E</div>
					BACC30BS() <div>A</div> <div>B</div>
					BACN10YZ() <div>A</div> <div>B</div> <div>E</div> <div>G</div>
					BACC30BK() <div>E</div>
		BACB30XT()-K() <div>C</div> <div>D</div>			

LOCKBOLT - FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Lockbolts
Figure 3 (Sheet 9 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION			
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART	
BACB30GY()A()	A-286 CRES, 100° HEAD, STEEL C.T. SHANK, 1.0 PINTAIL, (PULL TYPE, GUN DRIVEN), CADMIUM PLATED, CETYL ALCOHOL LUBRICATED	BACC30K() OR NAS1080C()	NO EQUIVALENT	BACB30VU()K()	BACC30BL()	
					BACC30BP()	
					BACC30BQ()	
					BACN10YZ() A B G	
		NAS1080E		BACB30XT()K()	BACC30BK()	
				BACB30VU()K()	BACC30BL() A B E	
					BACC30BP()	B E
					BACC30BQ()	A E
					BACC30BS()	A B
					BACN10YZ() A B E G	
BACB30XT()K()	BACC30BK()					
BACB30GY()A()U	A286 CRES, PASSIVATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° HEAD, PULL TYPE, MAX TEMP 900°F (482°C)	BACC30L()	NO EQUIVALENT	BACB30FN()A()U	BACC30AB()S A B	
BACB30GY()D()N	ALLOY STEEL, NICKEL-CADMIUM PLATED, 95 KSI SHEAR, LUBRICATED, PULL TYPE, MAX TEMP 600°F (316°C)	NAS1080E	NO EQUIVALENT	J		

LOCKBOLT – FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Lockbolts
Figure 3 (Sheet 10 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30TY()K()	6AL-4V TITANIUM, ALUMINUM PIGMENTED COATING, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED, 100° HEAD, PULL TYPE, MAX TEMP 250°F (121°C)	BACC30BE()	NO EQUIVALENT	BACB30NW()K()	BACC30AG() BACC30M() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> BACN10XJ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				BACB30VU()K()	BACC30BL() <input type="checkbox"/> <input type="checkbox"/> BACC30BP() <input type="checkbox"/> <input type="checkbox"/> BACC30BQ() <input type="checkbox"/> <input type="checkbox"/> BACN10YZ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				BACB30XT()K()	BACC30BK() BACC30M() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				BACB30VU()K()	BACC30BP() <input type="checkbox"/> <input type="checkbox"/> BACC30BL() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> BACC30BQ() <input type="checkbox"/> <input type="checkbox"/> BACN10YZ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
BACB30UC()K()	6AL-4V TITANIUM, 100° REDUCED HEAD, STUMP TYPE, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED	NAS1080K()	NO EQUIVALENT	BACB30NW()K()	BACC30M() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
BACB30UC()K()A	6AL-4V TITANIUM, 100° REDUCED HEAD, STUMP TYPE, CHAMFERED STUMP END, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED	BACC30BE()	NO EQUIVALENT	BACB30VU()K()	BACC30BL() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> BACC30BP() <input type="checkbox"/> <input type="checkbox"/> BACC30BQ() <input type="checkbox"/> <input type="checkbox"/> BACN10YZ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				BACB30NW()K()	BACC30M() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				BACB30VU()K()	BACC30BL() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> BACC30BP() <input type="checkbox"/> <input type="checkbox"/> BACC30BQ() <input type="checkbox"/> <input type="checkbox"/> BACN10YZ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				BACB30VU()K()	BACC30BL() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> BACC30BP() <input type="checkbox"/> <input type="checkbox"/> BACC30BQ() <input type="checkbox"/> <input type="checkbox"/> BACN10YZ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

LOCKBOLT – FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Lockbolts
Figure 3 (Sheet 11 of 21)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB3OVM()K()	6AL-4V TITANIUM, 100° HEAD, LIGHTWEIGHT, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C)	BACC3OBK()	NO EQUIVALENT	BACB3ONW()K()	BACC3OM() <input type="checkbox"/> <input type="checkbox"/>
				BACB3OVM()K()	BACC3OBK()
				BACB3OVU()K()	BACC3OBL() <input type="checkbox"/> <input type="checkbox"/>
					BACC3OBP() <input type="checkbox"/>
					BACC3OBQ() <input type="checkbox"/>
					BACN1OYZ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
BACB3OVP()K()	6AL-4V TITANIUM, 100° HEAD, STUMP TYPE, LIGHTWEIGHT, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C)	BACC3OBK()	NO EQUIVALENT	BACB3ONW()K()	BACC3OM() <input type="checkbox"/> <input type="checkbox"/>
				BACB3OVM()K()	BACC3OBK()
				BACB3OVU()K()	BACC3OBL() <input type="checkbox"/> <input type="checkbox"/>
					BACC3OBP() <input type="checkbox"/>
					BACC3OBQ() <input type="checkbox"/>
					BACN1OYZ() <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
BACB3OWB()HK()	6AL-4V TITANIUM, 130° HEAD, LIGHTWEIGHT, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), WITH SEALANT ESCAPE GROOVE, FOR USE IN COMPOSITES	BACC3OBN()L	NO EQUIVALENT	NO ALTERNATIVE	

LOCKBOLT – FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Lockbolts
Figure 3 (Sheet 12 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30WB()K()	6AL-4V TITANIUM, 130° HEAD, LIGHTWEIGHT, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), FOR USE IN COMPOSITES	BACC30BN()L	NO EQUIVALENT	BACB30XR()K()	BACC30CG() D
BACB30WD()HK()	6AL-4V TITANIUM, 100° (MS24694) HEAD, LIGHTWEIGHT, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), WITH SEALANT ESCAPE GROOVE, FOR USE IN COMPOSITES	BACC30BN()L	NO EQUIVALENT	BACB30NY()K()	BACC30AB()S B
BACB30WD()K()	6AL-4V TITANIUM, 100° (MS24694) HEAD, LIGHTWEIGHT, 95 KSI SHEAR, AL COATED, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F, FOR USE IN COMPOSITES	BACC30BN()L	NO EQUIVALENT	BACB30XF()K()	BACC30CG() D
				BACB30NY()K()	BACC30AB()S B

LOCKBOLT – FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Lockbolts
Figure 3 (Sheet 13 of 21)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30WE()HK()	6AL-4V TITANIUM, 100° (MS24694) HEAD, LIGHTWEIGHT, 95 KSI SHEAR, STUMP TYPE, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), WITH SEALANT ESCAPE GROOVE, FOR USE IN COMPOSITES	BACC30BN()L	NO EQUIVALENT	BACB30WD()HK()	BACC30BN()L
BACB30XB()HK()	6AL-4V TITANIUM, 100° HEAD, LIGHTWEIGHT, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), WITH SEALANT ESCAPE GROOVE, FOR USE IN COMPOSITES	BACC30BN()L	NO EQUIVALENT	BACB30NZ()K()	BACC30AB()S B

LOCKBOLT – FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Lockbolts
Figure 3 (Sheet 14 of 21)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30XB()K()	6AL-4V TITANIUM, 100° HEAD, LIGHTWEIGHT, 95 KSI SHEAR, AL COATED, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), FOR USE IN COMPOSITES	BACC30BN()	NO EQUIVALENT	BACB30XG()K()	BACC30CG() D
				BACB30NZ()K()	BACC30AB()S B
BACB30XT()K()	6AL-4V TITANIUM, 100° HEAD, LIGHTWEIGHT, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250° (121°C)	BACC30BK()	NO EQUIVALENT	BACB30YP()K()	BACC30BL() A B
					BACC30BP() B
					BACC30BQ A
					BACN10YZ() A B G
BACB30YC()HK()	6AL-4V TITANIUM, 100° HEAD, LIGHTWEIGHT, STUMP TYPE, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), WITH SEALANT ESCAPE GROOVE, FOR USE IN COMPOSITES	BACC30BN()L	NO EQUIVALENT	BACB30XB()HK()	BACC30BN()L

LOCKBOLT – FLUSH HEAD (SHEAR)
TABLE III

Fastener Substitution - Lockbolts
Figure 3 (Sheet 15 of 21)

757-200 STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30DX()-()	8740 ALLOY STEEL, C.T. SHANK, 1.0 PINTAIL, (PULL TYPE, GUN DRIVEN), CADMIUM PLATED	NAS1080-() OR NAS1080P()	NO EQUIVALENT	BACB30NX())K() C	BACC30X() A B
		NAS1080R()		BACB30UB())K() C	BACC30BF()
				BACB30NX())K() C	BACC30X() A B
				BACB30UB())K() C E	BACC30BF()
BACB30DX()A()	A-286 CRES C.T. SHANK, 1.0 PINTAIL, (PULL TYPE, GUN DRIVEN), CADMIUM PLATED	NAS1080-() OR NAS1080P()	NO EQUIVALENT	BACB30NX())K() C	BACC30X() A B
		NAS1080R()		BACB30UB())K() C	BACC30BF()
				BACB30NX())K() C	BACC30X() A B
				BACB30UB())K() C E	BACC30BF()
BACB30DX()A()U	A-286 CRES C.T. SHANK, 1.0 PINTAIL, (PULL TYPE, GUN DRIVEN), PASSIVATED	BACC30Q()	NO EQUIVALENT	BACC30MB()A()U	BACC30X()S A B
BACB30DX()D()N	ALLOY STEEL, NICKEL-CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, PULL TYPE, MAX TEMP 900°F (482°C)		NO EQUIVALENT	J	
BACB30GP()-()	7075-T6 AL, ANODIZED, 77 KSI TENSION, LUBRICATED, PULL TYPE, MAX TEMP 250°F (121°C)	NAS1080D	NO EQUIVALENT	NAS1515 THRU NAS1532	NAS1080D
BACB30GR()-()	7075-T6 AL, CLOSE TOLERANCE SHANK, STUMP TYPE, MAX TEMP 250°F (121°C)	NAS1080D	NO EQUIVALENT	BACB30GP()-()	NAS1080D
				NAS1525 THRU NAS1532	NAS1080D

LOCKBOLT – PROTRUDING HEAD (TENSION)
TABLE IV

Fastener Substitution - Lockbolts
Figure 3 (Sheet 16 of 21)

757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30HC()-()	8740 ALLOY STEEL, CLOSE TOLERANCE SHANK, (STUMP TYPE, HAMMER DRIVEN), CADMIUM PLATED	NAS1080	NO EQUIVALENT	BACB30NX()-K()-C	BACC30X()-A-B
		NAS1080R		BACB30UB()-K()-C	BACC30BF()
				BACB30NX()-K()-C	BACC30X()-A-B
				BACB30UB()-K()-C-E	BACC30BF()
BACB30HC()-A()	A286 CRES, CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, CLOSE TOLERANCE SHANK, (STUMP TYPE, HAMMER DRIVEN), MAX TEMP 250°F (121°C)	NAS1080	NO EQUIVALENT	BACB30MB()-A()	BACC30X()-A-B
		NAS1080R		BACB30NX()-K()-C	BACC30X()-A-B
				BACB30UB()-K()-C	BACC30BF()
				BACB30MB()-A()	BACC30X()-A-B
				BACB30NX()-K()-C	BACC30X()-A-B
				BACB30UB()-K()-C-E	BACC30BF()
BACB30HC()-A()-U	A286 CRES, CADMIUM PASSIVATED, 160 KSI TENSION, LUBRICATED, CLOSE TOLERANCE SHANK, (STUMP TYPE, HAMMER DRIVEN), MAX TEMP 900°F (482°C)	BACC30Q()	NO EQUIVALENT	BACB30MB()-A()-U	BACC30X()-P-A-B

LOCKBOLT – PROTRUDING HEAD (TENSION)
TABLE IV

Fastener Substitution - Lockbolts
Figure 3 (Sheet 17 of 21)



**757-200
STRUCTURAL REPAIR MANUAL**

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30HC()D()N	ALLOY STEEL, NICKEL-CADIMUM PLATED, 160 KSI TENSION, LUBRICATED, CLOSE TOLERANCE SHANK, (STUMP TYPE, HAMMER DRIVEN), MAX TEMP 600°F (316°C)		NO EQUIVALENT	J	
BACB30UB()K()	6AL-4V TITANIUM, 160 KSI TENSION, 95 KSI SHEAR, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C)	BACC30BF()	NO EQUIVALENT	BACB30NX()K()	BACC30BH() A B BACC30X() A B BACN10YT()CD A B G
BACB30YD()HK()	6AL-4V TITANIUM, 95 KSI SHEAR, STUMP TYPE, LIGHTWEIGHT, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED, MAX TEMP 250°F (121°C), WITH SEALANT ESCAPE GROOVE, FOR USE IN COMPOSITES	BACC30BN()L	NO EQUIVALENT	BACB30XC()HK()	BACC30BN()L

LOCKBOLT – PROTRUDING HEAD (TENSION)
TABLE IV

**Fastener Substitution - Lockbolts
Figure 3 (Sheet 18 of 21)**

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STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30DY()-()	ALLOY STEEL, CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, 100° (MS20426) HEAD, PULL TYPE, MAX TEMP 250°F (121°C)	NAS1080	NO EQUIVALENT	BACB30DY()A()	NAS1080
		NAS1080P		BACB30DY()A()	NAS1080P
		NAS1080R		BACB30DY()A()	NAS1080R
BACB30DY()A()	A286 CRES, CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, 100° (MS20426) HEAD, PULL TYPE, MAX TEMP 250°F (121°C)		NO EQUIVALENT	NO ALTERNATIVE	
BACB30GQ()-()	7075-T6 AL, ANODIZED, 77 KSI TENSION, LUBRICATED, 100° (MS20426) HEAD, PULL TYPE, MAX TEMP 250°F (121°C)	NAS1080D	NO EQUIVALENT	NAS1535 THRU NAS1542	NAS1080D
BACB30GS()-()	7075-T6 AL, CLOSE TOLERANCE SHANK, STUMP TYPE, MAX TEMP 250°F (121°C)	NAS1080D	NO EQUIVALENT	BACB30GQ()-()	NAS1080D
				NAS1535 THRU NAS1542	NAS1080D

LOCKBOLT – FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Lockbolts
Figure 3 (Sheet 19 of 21)



757-200
STRUCTURAL REPAIR MANUAL

INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION		
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART
BACB30GX()-()	ALLOY STEEL, CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, 100° (AN509) HEAD, PULL TYPE, MAX TEMP 250°F (121°C)	NAS1080 OR NAS1080P OR NAS1080R	NO EQUIVALENT	BACB30JC()-() H	BACC30BH() A B
					BACC30X() A B
					BACN10YT()CD A B G
				BACB30JC()A()	BACC30BH() A B
					BACC30X() A B
					BACN10YT()CD A B G
BACB30GX()-()X	ALLOY STEEL, CAD PLATED, UNLUBRICATED 95 KSI SHEAR MAX TEMP 450°F (232°C)	NAS1080 OR NAS1080P OR NAS1080R	NO EQUIVALENT	J	
BACB30GX()D()N	ALLOY STEEL, DIFFUSED NICKEL-CADIUM PLATED, 160 KSI TENSION, LUBRICATED, 100° (AN509) HEAD, PULL TYPE, MAX TEMP 600°F (316°C)		NO EQUIVALENT	J	
BACB30HD()-()	ALLOY STEEL, CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, 100° (MS20426) HEAD, STUMP TYPE, MAX TEMP 250°F (121°C)	NAS1080	NO EQUIVALENT	BACB30DY()-()	NAS1080
				BACB30DY()A()	NAS1080
		NAS1080R		BACB30DY()-()	NAS1080R
				BACB30DY()A()	NAS1080R
BACB30HD()A()	A286 CRES, CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, 100° (AN509) HEAD, STUMP TYPE, MAX TEMP 250°F (121°C)	NAS1080	NO EQUIVALENT	BACB30DY()A()	NAS1080
		NAS1080R		BACB30DY()A()	NAS1080R
		BACC30Q()		BACB30DY()A()	BACC30Q()

LOCKBOLT – FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Lockbolts
Figure 3 (Sheet 20 of 21)

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INITIAL FASTENER OR SPECIFIED REPAIR FASTENER			FASTENER SUBSTITUTION					
PART NUMBER	DESCRIPTION	MATING PART	EQUIVALENT	ALTERNATIVE	MATING PART			
BACB30HG()-()	ALLOY STEEL, CADMIUM PLATED, 160 KSI TENSION, LUBRICATED, 100° (AN509) HEAD, STUMP TYPE, MAX TEMP 250°F (121°C)	NAS1080	NO EQUIVALENT	BACB30JC()-() <table border="1"><tr><td>H</td></tr></table>	H	BACC30X() <table border="1"><tr><td>A</td><td>B</td></tr></table>	A	B
		H						
		A		B				
				BACB30NY()-()K() <table border="1"><tr><td>C</td></tr></table>	C	BACC30X() <table border="1"><tr><td>A</td><td>B</td></tr></table>	A	B
		C						
A	B							
	BACB30UA()-()K() <table border="1"><tr><td>C</td></tr></table>	C	BACC30BF()					
C								
NAS1080R		BACB30JC()-()-() <table border="1"><tr><td>H</td></tr></table>	H	BACC30X() <table border="1"><tr><td>A</td><td>B</td></tr></table>	A	B		
		H						
A	B							
BACB30NY()-()K() <table border="1"><tr><td>C</td></tr></table>	C	BACC30X() <table border="1"><tr><td>A</td><td>B</td></tr></table>	A	B				
C								
A	B							
BACB30UA()-()K()	6AL-4V TITANIUM, 100° HEAD, 160 KSI TENSION, ALUMINUM PIGMENTED COATING, CETYL ALCOHOL LUBRICATED	BACC30BF()	NO EQUIVALENT	BACB30NY()-()K()	BACC30BH() <table border="1"><tr><td>A</td><td>B</td></tr></table>	A	B	
A	B							
					BACC30X() <table border="1"><tr><td>A</td><td>B</td></tr></table>	A	B	
A	B							
					BACN10YT()-()CD <table border="1"><tr><td>A</td><td>B</td><td>G</td></tr></table>	A	B	G
A	B	G						

LOCKBOLT – FLUSH HEAD (TENSION)
TABLE V

Fastener Substitution - Lockbolts
Figure 3 (Sheet 21 of 21)



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GENERAL - TORQUE VALUES

1. Applicability

- A. The torque values given in this section can be used for fasteners in structural repairs, (unless a Service Bulletin or Engineer Drawing shows a different torque value for the same fasteners in the same structure).
- B. Refer to the Airplane Maintenance Manual for torque values on other fasteners.

2. General

- A. The torque values for external wrenching bolts in metallic materials are given in Figure 1/GENERAL.
- B. The torque values for hex-drive bolts in metallic materials are given in Figure 2/GENERAL.
- C. The torque values for radius lead-in bolts in metallic materials are given in Figure 3/GENERAL.
- D. The torque values for fasteners in composite materials are given in Figure 4/GENERAL.
- E. Refer to 51-40-02, GENERAL for procedures on how to install bolts, washers, nuts, and locknuts.

3. References

Reference	Title
51-40-02, GENERAL	Fastener Installation and Removal

4. Torque Wrench Adapters and Extensions

- A. Torque wrench adapters and/or extensions are used when it is difficult to apply the torque wrench directly.
- B. When you use adapters and/or extensions, a corrected torque wrench reading is necessary. Follow the examples in Figure 5/GENERAL to find the corrected torque wrench reading.
- C. Only use adapters on rigid frame torque wrenches.
- D. Apply force to the torque wrench handle or handle extension, perpendicular to the handle and in its plane of rotation.



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STRUCTURAL REPAIR MANUAL

NUT PART NUMBER AND STYLE	BACN10JC (THREAD SIZES 1/2 THRU 1-1/2), BACN10JD, BACN11N AND MS14145 (CASTELLATED-THIN STYLE, ALL SIZES) MS21245 (HEX, SELF-LOCKING, THIN)	BACN10YJ (NYLON NUT)
BOLT HEAD STYLE	ALL	ALL
BOLT PART NUMBER	ALL	METAL BOLTS ONLY
THREAD SIZE AND BASIC MAJOR DIAMETER	TORQUE RANGE IN-LBS A	TORQUE RANGE IN-LBS A
	DRY OR LUBRICATED BOLT	DRY OR LUBRICATED BOLT
0.0860 2-56 OR 2-64	2.5 TO 4.5	—
0.1120 4-40 OR 4-48	6 TO 8	—
0.1380 6-32 OR 6-40	12 TO 15	—
0.1640 8-32 OR 8-36	15 TO 17	5 TO 6
0.1900 10-32	18 TO 25	6 TO 8
0.2500 1/4-28	30 TO 50	—
0.3125 5/16-24	60 TO 95	—
0.3750 3/8-24	95 TO 160	—
0.4375 7/16-20	220 TO 280	—
0.5000 1/2-20	290 TO 510	—
0.5625 9/16-18	480 TO 850	—
0.6250 5/8-18	660 TO 980	—
0.7500 3/4-16	1300 TO 2000	—
0.8750 7/8-14	1500 TO 3300	—
1.0000 1-12 OR 1-14	2200 TO 5300	—
1.1250 1-1/8-12	3000 TO 6200	—
1.2500 1-1/4-12	5400 TO 8600	—
1.3750 1-3/8-12	7000 TO 9000	—
1.5000 1-1/2-12	10,000 TO 12,000	—

NUT INSTALLATION TORQUE RANGE **E**TABLE I **D**

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5009.

- A** WHEN ANY BOLT IS TO BE INSTALLED BY WRENCHING THE HEAD, (FOR EXAMPLE: AS WHEN INSTALLING BOLT INTO PLATENUTS, CLIP-NUTS, BARREL-NUTS, INSERTS OR TAPPED HOLES), THE INSTALLATION TORQUE MUST BE WITHIN $\pm 10\%$ OF THE MAXIMUM OF THE SPECIFIED RANGE.
- B** WHEN AN UNLUBRICATED BOLT IS USED, USE THE DRY BOLT COLUMN FOR TORQUE VALUES. (THIS INCLUDES IF WET SEALANT IS ON THE BOLT THREADS).
- C** LUBRICATED BOLTS INCLUDE DRYFILM LUBRICATED (MIL-L-8937 OR MIL-L-46010) BOLTS AND BOLTS WITH ANTI-FRICTION COMPOUNDS SUCH AS EASE-OFF 990 OR BOSTIK NEVER-SEEZ ANTISEIZE COMPOUNDS, MIL-C-11796 OR ZIP-CHEM ZC-027L CORROSION PREVENTION COMPOUNDS, OR MIL-G-23827 GREASE APPLIED TO THE THREADS.

- D** SEE TABLE II FOR REDUCED SHEAR HEAD BOLTS.
- E** WHEN THE BOLT PART NUMBER AND THE NUT PART NUMBER SPECIFIED IN THE DRAWING OR REPAIR ARE IN DIFFERENT COLUMNS, USE THE INSTALLATION TORQUE FROM THE COLUMN WITH THE LESSER TORQUE VALUE.
- F** INSTALLATION TORQUE FOR 3/4-16 BACB30MR, BACB30XL, BACB30NM, BACB30XJ, BACB30MS, BACB30NN, BACB30XK, AND BACB30XM IS 1000 TO 2200 IN-LB FOR DRY BOLTS AND 1000 TO 2150 IN-LB FOR LUBED BOLTS. THE INSTALLATION TORQUE FOR ALL OTHER 3/4-16 BOLTS LISTED IN THE COLUMN IS 2400 TO 3500 IN-LB FOR DRY BOLTS AND 1700 TO 2150 IN-LB FOR LUBED BOLTS.

Torque Values for External Wrenching Bolts in Metallic Materials
Figure 1 (Sheet 1 of 4)

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STRUCTURAL REPAIR MANUAL

NUT PART NUMBER AND STYLE	BACN10HR (12 POINT) BACN10JG (12 POINT) BACN10HC (BARREL NUT) BACN10YN (12 POINT, VESPEL)	NAS1804 (12 POINT), NAS1805 (12 POINT), BACN10B (12 POINT), BACN10GW (12 POINT), BACN10JA (PLATE NUT), BACN10JB (PLATE NUT), BACN10RM (PLATE NUT), NAS577 (BARREL NUT), BACN10JD (CASTELLATED-THICK STYLE)			
BOLT HEAD STYLE	12 POINT	12 POINT	HEX	PAN	100 DEG
BOLT PART NUMBER	BACB30NH BACB30US BACB30MT BACB30TR — — — — — — — — —	BACB30FD BACB30LE BACB30MR BACB30XL BACB30PN MS21250 — — — — — — — — —	BACB30NM BACB30XJ BACB30NE BACB30LM NAS6603 THRU NAS6620 NAS6703 THRU NAS6720 NAS6803 THRU NAS6820	BACB20LN BACB30NS BACB30EM NAS1216 — — — — — — — — —	BACB30LP BACB30EM BACB30LU BACB30LR BACB30MS BACB30NN BACB30XK BACB30XM BACB30SW BACB30XA — — —
THREAD SIZE AND BASIC MAJOR DIAMETER	TORQUE RANGE IN-LBS A		TORQUE RANGE IN-LBS A		
	DRY BOLT B	LUBED BOLT C	DRY BOLT B	LUBED BOLT C	
0.0860 2-56 OR 2-64 0.1120 4-40 OR 4-48 0.1380 6-32 OR 6-40 0.1640 8-32 OR 8-36	— — — —	— — — —	— — — —	— — — —	
0.1900 10-32 0.2500 1/4-28 0.3125 5/16-24 0.3750 3/8-24	70 TO 100 90 TO 125 180 TO 250 300 TO 500	50 TO 60 70 TO 80 145 TO 180 275 TO 330	30 TO 35 60 TO 100 130 TO 200 220 TO 410	20 TO 25 50 TO 75 90 TO 125 150 TO 250	
0.4375 7/16-20 0.5000 1/2-20 0.5625 9/16-18 0.6250 5/8-18	510 TO 840 870 TO 1300 1300 TO 1800 1900 TO 2300	370 TO 440 500 TO 650 800 TO 1000 1350 TO 1650	370 TO 690 630 TO 1070 1000 TO 1470 1400 TO 1900	260 TO 425 440 TO 650 700 TO 920 1000 TO 1200	
0.7500 3/4-16 0.8750 7/8-14 1.0000 1-12 OR 1-14 1.1250 1-1/8-12	3300 TO 4300 5100 TO 6700 7000 TO 10900 9500 TO 13000	2800 TO 3300 3900 TO 4500 6200 TO 7000 8300 TO 9400	F 3700 TO 5500 5100 TO 8900 6900 TO 10700	F 2600 TO 3400 3600 TO 5500 4900 TO 6700	
1.2500 1-1/4-12 1.3750 1-3/8-12 1.5000 1-1/2-12	15800 TO 19200 20000 TO 24000 —	11000 TO 12000 16000 TO 17000 —	11500 TO 15700 — —	7500 TO 9700 — —	

NUT INSTALLATION TORQUE RANGE **E**

TABLE I **D** (CONT)

Torque Values for External Wrenching Bolts in Metallic Materials
Figure 1 (Sheet 2 of 4)



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NUT PART NUMBER AND STYLE	ALL PLATE-NUTS EXCEPT BACN10JA, BACN10JB, AND BACN10RM; ALL CLIP-NUTS, INSERTS, AND TAPPED HOLES; BACN10YR, NAS679, MS21042, MS21043 (HEX SELF LOCKING), BACN10JC (THREAD SIZES NO. 4 THRU 7/16 ONLY), BACN10JD (CASTELLATED - THICK STYLE SIZES 3/16 THRU 3/8 INCH), BACN11N AND MS14144 (CASTELLATED - THICK STYLE)				
BOLT HEAD STYLE	12 PT	HEX	PAN	100 DEG	SOCKET
BOLT PART NUMBER	BACB3OLT, BACB3ONL, BACB3OUU, BACB3ONJ	BACB3OLJ, BACB3ONR, BACB3ONF, BACS12BG, BACB3OPU, BACB3OPW, BACB3OXN, NAS563, NAS572, NAS1801, NAS1802, NAS6203 THRU NAS6220, NAS428, BACS12CB, BACS12GU	BACB3OLK, BACB3ONT, BACB30BE, BACS12BG, NAS1217, NAS1218, NAS600 THRU NAS623, BACS12CK, NAS8200 THRU BACS12FA	BACB3OPC, BACB3OLH, BACB3ORF, BACB3OSW, BACB3OWP, BACS12BP, BACS12ER, BACS12GM, BACS12GR, NAS514, NAS517, BACS12GP, BACB30TP, BACS12BF, BACS12GX	MS21262 MS24678 NAS1351 NAS1352
THREAD SIZE AND BASIC MAJOR DIA.	TORQUE RANGE IN-LBS A				
	DRY BOLT B		LUBED BOLT C		
0.0860 2-56 OR 2-64 0.1120 4-40 OR 4-48 0.1380 6-32 OR 6-40 0.1640 8-32 OR 8-36 0.1900 10-32	3.4 TO 4.5 6 TO 8 12 TO 15 15 TO 20 25 TO 35		3.4 TO 4.5 6 TO 8 12 TO 15 15 TO 17 20 TO 25		
0.2500 1/4-28 0.3125 5/16-24 0.3750 3/8-24 0.4375 7/16-20 0.5000 1/2-20	50 TO 80 100 TO 150 160 TO 240 250 TO 350 480 TO 790		50 TO 75 90 TO 125 150 TO 200 240 TO 300 440 TO 650		
0.5625 9/16-18 0.6250 5/8-18 0.7500 3/4-16 0.8750 7/8-14 1.0000 1-12 OR 1-14	800 TO 1150 1100 TO 1500 2300 TO 3000 2500 TO 4500 3700 TO 7500		700 TO 920 1000 TO 1200 1700 TO 2150 2600 TO 3400 3600 TO 5500		
1.1250 1-1/8-12 1.2500 1-1/4-12 1.3750 1-3/8-12 1.5000 1-1/2-12	5000 TO 9000 9000 TO 13000 — —		4900 TO 6700 7500 TO 9700 — —		

NUT INSTALLATION TORQUE RANGE **E**
TABLE I **D** (CONT)

Torque Values for External Wrenching Bolts in Metallic Materials
Figure 1 (Sheet 3 of 4)



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STRUCTURAL REPAIR MANUAL

NUT PART NUMBER AND STYLE	ALL
BOLT STYLE	100 DEGREE REDUCED SHEAR HEAD
PART NUMBER-BOLT	BACB30EL BACB30DP BACB30FB BACB30LL BACB30NU BACB30RF BACB30UW BACB30VF BACB30UR NAS1581 NAS1992 THRU NAS2000 NAS8703 THRU NAS8716 BACB30XD
THREAD SIZE AND BASIC MAJOR DIA.	TORQUE-RANGE IN-LBS A
	DRY BOLT B
0.0860 2-56 OR 2-64	--
0.1120 4-40 OR 4-48	--
0.1380 6-32 OR 6-40	--
0.1640 8-32 OR 8-36	10 TO 18
0.1900 10-32	18 TO 25
0.2500 1/4-28	30 TO 40
0.3125 5/16-24	90 TO 100
0.3750 3/8-24	95 TO 105
0.4375 7/16-20	150 TO 170
0.5000 1/2-20	220 TO 245
0.5625 9/16-18	290 TO 325
0.6250 5/8-18	395 TO 435
0.7500 3/4-16	645 TO 720
0.8750 7/8-14	1040 TO 1150
1.0000 1-12 OR 1-14	1560 TO 1730
1.1250 1-1/8-12	--
1.2500 1-1/4-12	--
1.3750 1-3/8-12	--
1.5000 1-1/2-12	--

REDUCED SHEAR HEAD BOLTS
TABLE II

Torque Values for External Wrenching Bolts in Metallic Materials
Figure 1 (Sheet 4 of 4)



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STRUCTURAL REPAIR MANUAL

FASTENER DIAMETER AND THREAD SIZE (INCH)	TORQUE RANGE (POUND-INCH)					
	SHEAR-TYPE HEX DRIVE BOLTS:					TENSION-TYPE HEX DRIVE BOLTS:
	B O L T	BACB30YP BACB30VT BACB30VU		BACB30FM BACB30FN BACB30MY BACB30NW BACB30ND BACB30NZ BACB30YL BACB30YN HL360 HL834 HL420 HL421		BACB30JC BACB30MB BACB30NX BACB30NY BACB30YK BACB30YM HLT422 HLT423
N U T	BACN10YZ BACN10ZV	MS21043 BACN10JC MS21042 NAS1291 NAS679 BACN10YR	MS21043 BACN10JC BACN10XJ MS21042 NAS1291 KFN305 KFN600 H600 NAS679 KFN511 BACN10YR BACN10YT BACN10TN BACN11E	BACN10WM	KFN609 BACN10ZZ	NAS1804 NAS1805 BACN10GW KFN305 BACN10MT KFN511 MS21042 BACN10YT BACN11E
	TORQUE INCH-POUNDS					
5/32-32 3/16-32 1/4-28 5/16-24 3/8-24 7/16-20 1/2-20 9/16-18 5/8-18 3/4-16	15-25 25-35 60-80 110-140 160-200	15-25 25-35 60-80 130-160 200-240 270-330 370-430 500-575 625-700 900-1000	60-80 125-145 200-210	15-25 23-28 60-75 120-150 180-210 270-330 370-430	25-35 30-40 80-95 150-200 260-360 390-480 640-800 740-900 800-1000 1300-1650	

TORQUE VALUES FOR LOCKNUTS ON HEX DRIVE BOLTS
TABLE I

Torque Values for Hex-Drive Bolts in Metallic Materials
Figure 2



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STRUCTURAL REPAIR MANUAL

NOMINAL THREAD SIZE	INSTALLATION TORQUE (INCH-POUNDS)				NUTS ON BACB30WQ AND BACB30WR BOLTS	
	NUTS ON BACB30PT BOLTS					
	EXCEPT BACN10WM		BACN10WM			
	NOMINAL	RANGE	NOMINAL	RANGE	NOMINAL	RANGE
0.1900-32	N/A	N/A	N/A	N/A	30	25-35
0.2500-28	70	60-80	80	60-100	90	75-105
0.3125-24	135	125-145	145	125-165	155	135-175
0.3750-24	218	200-235	230	200-260	245	220-270
0.4375-20	N/A	N/A	N/A	N/A	340	310-370

TABLE I

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5060.
- TORQUE VALUES IN THIS FIGURE CAN BE USED UNLESS AN APPLICABLE ENGINEER DRAWING SHOWS DIFFERENTLY.

Torque Values for Radius Lead-In Bolts in Metallic Materials
Figure 3

757-200 STRUCTURAL REPAIR MANUAL

NOMINAL FASTENER DIAMETER (INCH)	PIN	TORQUE, INCH-POUNDS				
		SHEAR-TYPE HEX DRIVE PINS:				TENSION- TYPE HEX DRIVE PINS:
		BACB30VT BACB30VU BACB30YP	BACB30FM BACB30FN BACB30MY BACB30NW BACB30NZ	BACB30ND BACB30YL BACB30YN		BACB30JC BACB30MB BACB30NX BACB30NY BACB30YK BACB30YM
	NUT	MS21043 BACN10JC MS21042 NAS1291 KFN305 NAS679 BACN10YR BACN10YZ BACN10ZV	MS21043 BACN10JC BACN10XJ MS21042 NAS1291 KFN305 KFN600 H600 NAS679 KFN511 BACN10YR BACN11E	BACN10WM	KFN609 BACN10ZZ	NAS1804 NAS1805 BACN10GW KFN305 BACN10MT KFN511 MS21042 BACN10YT
5/32 3/16		15 TO 25 25 TO 36		---	---	25 TO 35 30 TO 40
1/4 5/16		60 TO 80 130 TO 160		60 TO 80 125 TO 145	60 TO 75 120 TO 150	80 TO 95 150 TO 200
3/8 7/16		200 TO 240 270 TO 330		200 TO 300 ---	180 TO 210 ---	260 TO 360 390 TO 480
1/2 9/16		370 TO 430 500 TO 575		---	---	640 TO 800 740 TO 900
5/8 3/4		625 TO 700 900 TO 1000		---	---	800 TO 1000 1300 TO 1650

LOCKNUT TORQUE VALUES **A**
TABLE I

NOTES:

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5063.

A WHEN PIN OR BOLT PART NUMBER AND NUT PART NUMBER SPECIFIED ON THE DRAWING APPEAR IN DIFFERENT COLUMNS, USE THE INSTALLATION TORQUE FROM THE COLUMN WITH THE LOWER TORQUE VALUE.

B INSTALLATION TORQUE FOR 3/4-16 BACB30MR, BACB30XL, BACB30NM, BACB30XJ, BACB30MS, BACB30NN, BACB30XK AND BACB30XM IS 1000-2200 IN-LB. THE INSTALLATION TORQUE FOR ALL OTHER 3/4-16 BOLTS LISTED IN THIS COLUMN IS 2400 TO 3500 IN-LB.

C THIS TABLE DOES NOT APPLY TO INSTALLATIONS WHERE A NUT, BOLT HEAD, OR WASHER BEARS DIRECTLY ON UNREINFORCED (EXAMPLE: NYLON) THERMOPLASTIC MATERIALS.

Torque Values for Fasteners in Composite Materials
Figure 4 (Sheet 1 of 2)



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STRUCTURAL REPAIR MANUAL

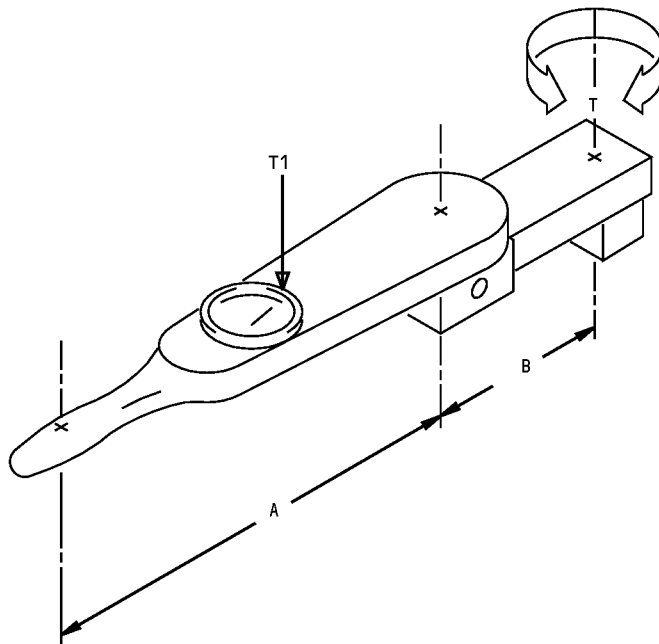
NUT NUMBER AND STYLE		BACN10HR (12 POINT) BACN10HC (BARREL NUT)	NAS1804 (12 POINT) NAS1805 (12 POINT) BACN10JA (PLATE NUT) BACN10JB (PLATE NUT) NAS577 (BARREL NUT) BACN10JD (CASTELLATED-THICK STYLE 0.4375 THRU 1.250)			
BOLT HEAD STYLE		12 POINT	12 POINT	HEX	PAN	100 DEG
BOLT PART NUMBER		BACB30US	BACB30LE BACB30MR BACB30XL BACB30PN MS21250	BACB30NM BACB30XJ BACB30LM NAS6603 THRU NAS6620 NAS6703 THRU NAS6720 NAS6803 THRU NAS6820	NAS1216	BACB30LP BACB30LU BACB30LR BACB30MS BACB30NN BACB30XK BACB30XM S12GP
THREAD SIZE AND BASIC MAJOR DIAMETER		IN-LBS	IN-LBS			
0.1900 0.2500 0.3125 0.3750	10-32 1/4-28 5/16-24 3/8-24	50 TO 70 90 TO 125 180 TO 250 300 TO 500	30 TO 35 65 TO 100 130 TO 200 220 TO 410			
0.4375 0.5000 0.5625 0.6250	7/16-20 1/2-20 9/16-18 5/8-18	510 TO 840 870 TO 1300 1300 TO 1800 1900 TO 2300	370 TO 690 630 TO 1070 1000 TO 1470 1400 TO 1900			
0.7500 0.8750 1.0000 1.1250 1.2500 1.3750	3/4-16 7/8-14 1-12 OR 1-14 1-1/8-12 1-1/4-12 1-3/8-12	3300 TO 4300 5100 TO 6700 7000 TO 10900 9500 TO 13000 15800 TO 19200 20000 TO 24000	B 3700 TO 5500 5100 TO 8900 6900 TO 10700 11500 TO 15700 ---			

INSTALLATION TORQUE RANGE – TENSION BOLTS A C
TABLE II

Torque Values for Fasteners in Composite Materials
Figure 4 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL



A = LENGTH OF TORQUE WRENCH

B = LENGTH OF ADAPTER, AND EXTENSION BETWEEN ADAPTER AND TORQUE WRENCH IF USED.

T = ACTUAL TORQUE ON NUT

T1 = INDICATED TORQUE ON WRENCH (CORRECTED TORQUE WRENCH READING)

FOR THE FOLLOWING EXAMPLES ASSUME THAT:

A = 10 IN.

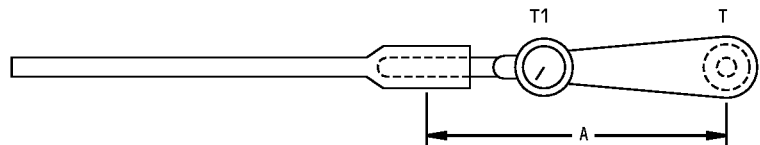
B = 10 IN.

C = 10 IN.

T = 150 POUND-INCHES

USING HANDLE EXTENSION ONLY
NO CORRECTION IS NECESSARY

$$T1 = T$$



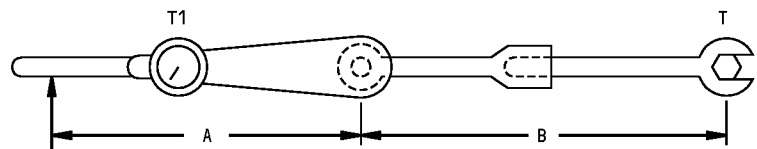
METHOD I

USING ADAPTER WITH EXTENSION BETWEEN
ADAPTER AND WRENCH BOTH IN LINE WITH
WRENCH. A CORRECTION IS NECESSARY

$$T1 = \frac{T \times A}{A + B}$$

$$T1 = \frac{150 \times 10}{10 + 10}$$

$$T1 = 75 \text{ POUND-INCHES}$$



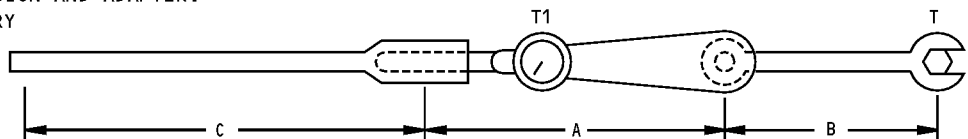
METHOD II

USING BOTH HANDLE EXTENSION AND ADAPTER.
A CORRECTION IS NECESSARY

$$T1 = \frac{T \times (A + C)}{(A + B + C)}$$

$$T1 = \frac{150 \times (10 + 10)}{(10 + 10 + 10)}$$

$$T1 = 100 \text{ POUND-INCHES}$$



METHOD III

Torque Wrench Adapters and Extensions
Figure 5 (Sheet 1 of 2)

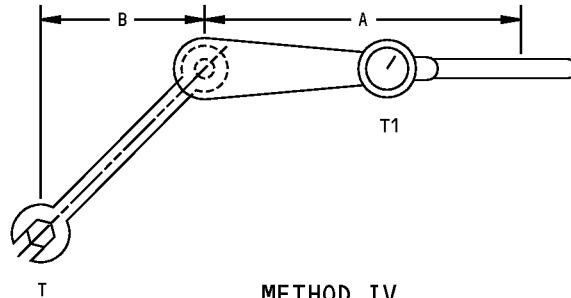
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STRUCTURAL REPAIR MANUAL

USING ADAPTER AT ANGLE OTHER THAN 90°. A CORRECTION IS NECESSARY

$$T1 = \frac{T \times A}{A + B}$$

$$T1 = \frac{150 \times 10}{10 + 10}$$

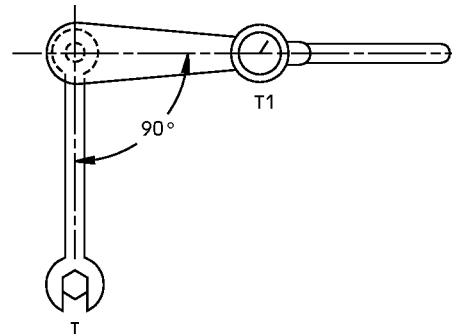
$$T1 = 75 \text{ POUND-INCHES}$$



METHOD IV

USING ADAPTER AT RIGHT ANGLE TO THE WRENCH. NO CORRECTION IS NECESSARY.

$$T1 = T$$



METHOD V

Torque Wrench Adapters and Extensions
Figure 5 (Sheet 2 of 2)



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - FASTENER HOLE SIZES

1. Applicability

A. This subject gives the hole size data for repair fasteners used in metallic and composite structures.

2. General

A. See Figure 1/GENERAL for an index of fastener hole data and cross references to Boeing Process Specifications.

B. Bolts, lockbolts, hex-drive bolts, and radius lead-in bolts can be installed in different types of holes. Some of the tables in this subject give hole sizes for the different types of holes. Refer to Paragraph 4./GENERAL for hole definitions.

3. References

Reference	Title
51-40-02, GENERAL	Fastener Installation and Removal
51-40-08, GENERAL	Countersinking
51-40-09, GENERAL	Coldworking of Holes for Fatigue Improvement
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure

4. Hole Definitions

A. Clearance Fit - A hole with size limits larger than the shank diameter of the fastener to be installed. The installed fastener will always have a clearance between the shank and the mating structure. These types of holes are used with removable fasteners.

(1) Close Ream - A hole that permits a minimum clearance between the fastener shank and the mating structure. This type of hole has the tightest tolerance of all holes used for removable fasteners.

(2) Class I - A hole that has sufficient clearance to permit easy removal of the fastener, but will also permit sufficient shear load transfer in the joint. This is the most used type of hole for removable fastener installations.

(3) Class II - A hole that is larger than a Class I hole. This is the most used type of hole for nutplate installations.

(4) Class III - A hole that is larger than a Class II hole. This hole is not used frequently in structural repairs.

B. Interference Fit - A hole with size limits that are smaller than the shank diameter of the fastener to be installed. The installed fastener will always have an interference between the shank and the mating structure. An Interference Fit hole will always have a permanent fastener installed in it.

C. Transition Fit - A hole with size limits that are very close to the shank diameter of the fastener to be installed. The installed fastener can have an interference, or it can have a clearance between the shank and the mating structure. A Transition Fit hole will always have a permanent fastener installed in it.



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TYPE OF FASTENER HOLE	FIGURE	PROCESS SPECIFICATION
GENERAL INFORMATION	2	BAC5004
SOLID RIVETS	3	BAC5004-1
PERMANENT STRAIGHT SHANK FASTENERS	4	BAC5004-2
BLIND RIVETS AND BOLTS	5	BAC5004-3
BOLTS	6	BAC5009
FLUID-TIGHT FASTENERS	7	BAC5047
RADIUS LEAD-IN BOLTS	8	BAC5060
HOLES IN COMPOSITES	9	BAC5063

INDEX FOR 51-40-05 AND CROSS REFERENCE TO BOEING PROCESS SPECIFICATIONS

NOTES

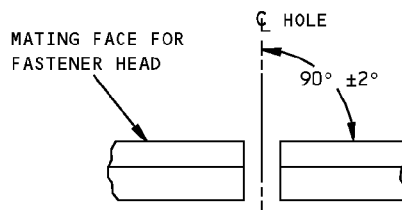
- REFER TO SRM 51-40-08 FOR BACR15FV AND MS14218 RIVET HOLE SIZES.
- REFER TO SRM 51-40-09 FOR REAMED AND FINISHED HOLE SIZES IN COLD WORKED HOLES.

Boeing Process Specification References
Figure 1

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ACCEPTABLE	NOT ACCEPTABLE
<ol style="list-style-type: none"> 1. Circumferential scratches which are a minimum of 1/16 inch or 10% of the part thickness from the surface of the part, whichever is smaller. 2. Spiral scratches which are a minimum of 1/16 inch or 25% of the part thickness from the surface of the part, whichever is smaller. 3. Longitudinal scratches not more than 50% of length of hole in any one part and which neither starts nor ends within 1/16 inch or 25% of the part thickness from the surface of the part, whichever is smaller. 4. Surface roughness which does not exceed 125 microinches Ra. 	<ol style="list-style-type: none"> 1. Scratches, nicks or cuts intersecting a part surface or exceeding limits specified as acceptable.

SURFACE DEFECT CRITERIA FOR FASTENER HOLES
TABLE I



HOLES FOR ALL PROTRUDING AND FLUSH HEAD FASTENERS MUST BE WITHIN 2° OF PERPENDICULAR TO THE FACE ON WHICH THE FASTENER HEAD BEARS

HOLE ALIGN CHECK
DETAIL I

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATIONS BAC5004, BAC5009, BAC5047, AND BAC5060.
- THE DATA IN THIS FIGURE APPLIES TO FIGURES 3 THRU 8. REFER TO SRM 51-70-16 FOR SIMILAR INFORMATION FOR HOLES IN COMPOSITE STRUCTURE.

General Information for Fastener Holes in Metal Structure Figure 2

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NOMINAL RIVET DIAMETER	RECOMMENDED PILOT DRILL SIZE	STANDARD RIVETS				BACR15GF, NAS1097, BACR15CE RIVETS			
		RECOMMENDED DRILL		HOLE DIAMETER LIMITS		RECOMMENDED DRILL		HOLE DIAMETER LIMITS	
		NO.	SIZE	MIN	MAX	NO.	SIZE	MIN	MAX
1/16	—	51	(0.067)	0.066	0.072	—	—	—	—
3/32	—	40	(0.098)	0.098	0.103	40	(0.098)	0.098	0.103
1/8	3/32	30	(0.128)	0.128	0.135	30	(0.128)	0.128	0.134
5/32	1/8	20	(0.161)	0.159	0.171	21	(0.159)	0.159	0.165
3/16	1/8	10	(0.194)	0.191	0.202	11	(0.191)	0.190	0.196
1/4	1/8	F	(0.257)	0.254	0.265	F	(0.257)	0.255	0.261
5/16	1/8	0	(0.316)	0.316	0.327	0	(0.316)	0.316	0.323
3/8	1/8	V	(0.377)	0.377	0.390	V	(0.377)	0.377	0.385

STANDARD HOLE SIZES FOR SOLID RIVETS
(EXCEPT FOR BACR15FV, MS14218 AND NASM-83459 RIVETS)
TABLE I A

ORIGINAL RIVET DIAMETER	(-6) 3/16		(-8) 1/4		(-10) 5/16		(-12) 3/8	
OVERSIZE RIVET DIAMETER (1/64 OVERSIZE)	(-61) 13/64		(-81) 17/64		-----		-----	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
BACR15GF	0.205	0.209	0.268	0.272	—	—	—	—
OVERSIZE RIVET DIAMETER (1/64 OVERSIZE)	(-7) 7/32		(-9) 9/32		(-11) 11/32		(-13) 13/32	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
BACR15GF BACR15DS	0.223	0.229	0.286	0.293	—	—	—	—
BACR15BA BACR15BB BACR15FT MS20426 MS20470 NAS1242	0.221	0.233	0.284	0.296	0.346	0.358	0.407	0.421

OVERSIZE HOLE DIMENSIONS FOR SOLID RIVETS
(EXCEPT FOR BACR15FV, MS14218 AND NASM-83459 RIVETS)
TABLE II A

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-1.
- THIS DATA APPLIES TO NON FLUID-TIGHT RIVETS.
- HOLE DIAMETERS IN THIS FIGURE CAN BE USED UNLESS AN APPLICABLE ENGINEER DRAWING SHOWS DIFFERENTLY.

A REFER TO SRM 51-40-08 FOR CONTERSINK AND HOLE DIMENSIONS FOR BACR15FV AND MS14218 RIVETS. NASM-83459 RIVETS ARE NOT USED ON THIS AIRPLANE.

Solid Rivet Fastener Holes
Figure 3

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NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-2.
- THIS DATA APPLIES TO PERMANENT TYPE, NONFLUID TIGHT, STRAIGHT SHANK FASTENERS (LOCKBOLTS AND HEX-DRIVE BOLTS).
- HOLE DIAMETERS IN THIS FIGURE CAN BE USED UNLESS AN APPLICABLE ENGINEER DRAWING SHOWS DIFFERENTLY.
- SEE TABLE I FOR INITIAL HOLE SIZES. SEE TABLES II AND III FOR OVERSIZE FASTENERS.
- CLOSE REAM HOLE DIAMETERS ARE APPLICABLE TO THE FOLLOWING STRUCTURES:
 - TITANIUM
 - STEEL
 - ALUMINUM AND TITANIUM
 - ALUMINUM AND STEEL.
- SEE DETAIL I AND TABLE IV FOR FINISHED HOLE SPECIFICATIONS FOR PROTRUDING HEAD FASTENERS. REFER TO SRM 51-40-08 FOR EQUIVALENT COUNTERSINK FASTENER SPECIFICATIONS.

A FOR 5/32 (0.164) INCH DIAMETER BACB30DX, BACB30DY, BACB30GP, AND BACB30GQ FASTENERS, THE HOLE DIAMETER LIMITS ARE 0.162 TO 0.165 INCH.

B IF THE EDGE MARGIN IS LESS THAN TWO DIAMETERS, TELL AN ENGINEER WHO HAS THE AUTHORITY TO DO AN ANALYSIS AND MAKE A DECISION.

- C** OVERSIZE FASTENER IS NOT AVAILABLE
- D** USE A 3/16 FASTENER IN A STANDARD SIZE HOLE.
- E** FOR PROPER INSTALLATION HOLE DIAMETER, REFER TO THE ENGINEERING DRAWING OR SERVICE BULLETIN TO FIND THE INITIAL HOLE SIZE.
- F** IF THE EDGE MARGIN IS LESS THAN 2.5 DIAMETERS, TELL AN ENGINEER WHO HAS THE AUTHORITY TO DO AN ANALYSIS AND MAKE A DECISION.
- G** TELL AN ENGINEER WHO HAS THE AUTHORITY TO DO AN ANALYSIS AND MAKE A DECISION.
- H** MAKE THE RADIUS BLEND SMOOTHLY WITH THE SHANK DIAMETER.
- I** FOR 1/64 OVERSIZE, ADD 0.016 INCH TO EACH OF THE MIN AND MAX DIAMETERS.
FOR 1/32 OVERSIZE, ADD 0.031 INCH TO EACH OF THE MIN AND MAX DIAMETERS.
- J** THE CHAMFER IS NOT NECESSARY FOR 5/32 THRU 3/8 INCH DIAMETER FASTENERS IF THEY ARE INSTALLED IN HOLES THAT ARE NOT COLDWORKED.

Permanent Straight Shank Fastener Holes
Figure 4 (Sheet 1 of 5)



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NOMINAL FASTENER DIAMETER	HOLE DIAMETER LIMITS FOR ALUMINUM STRUCTURES (INCH) (TRANSITION FIT)	HOLE DIAMETER LIMITS FOR TITANIUM AND STEEL STRUCTURES, AND COMBINATIONS WITH ALUMINUM (INCH) (CLOSE REAM)
5/32 (0.164) -5	0.161 TO 0.164 A	0.1635 TO 0.1645
3/16 (0.190) -6	0.187 TO 0.190	0.1895 TO 0.1905
1/4 (0.250) -8	0.247 TO 0.250	0.2495 TO 0.2505
5/16 (0.313) -10	0.309 TO 0.313	0.3120 TO 0.3130
3/8 (0.375) -12	0.371 TO 0.375	0.3745 TO 0.3755
7/16 (0.438) -14	0.434 TO 0.438	0.4370 TO 0.4380
1/2 (0.500) -16	0.496 TO 0.500	0.4995 TO 0.5005
9/16 (0.563) -18	0.559 TO 0.563	0.5620 TO 0.5630
5/8 (0.625) -20	0.621 TO 0.625	0.6245 TO 0.6255
3/4 (0.750) -24	0.746 TO 0.750	0.7495 TO 0.7505
7/8 (0.875) -28	0.871 TO 0.875	0.8745 TO 0.8755
1 (1.000) -32	0.996 TO 1.000	0.9995 TO 1.0005

INITIAL FASTENER HOLE DIAMETER LIMITS
TABLE I

Permanent Straight Shank Fastener Holes
Figure 4 (Sheet 2 of 5)



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		INITIAL FASTENER NOMINAL DIAMETER								
		(-5)	(-6)	(-8)	(-10)	(-12)	(-14)	(-16)	(-18)	(-20)
		0.164	0.190	0.250	0.313	0.375	0.438	0.500	0.563	0.625
		INITIAL HOLE SIZE								
TRANSITION		0.164	0.190	0.250	0.313	0.375	0.438	0.500	0.563	0.625
FIT		0.161	0.187	0.247	0.309	0.371	0.434	0.496	0.559	0.621
CLOSE		0.1645	0.1905	0.2505	0.3130	0.3755	0.4380	0.5005	0.5630	0.6255
REAM		0.1635	0.1895	0.2495	0.3120	0.3745	0.4370	0.4995	0.5620	0.6245
NOMINAL OVERSIZE	HOLE SIZES FOR OVERSIZE REPLACEMENT FASTENERS									
1/64	TRANSITION	C	0.203	0.266	0.328	0.391	0.453	0.516	0.579	0.641
	FIT		0.200	0.263	0.325	0.388	0.450	0.513	0.575	0.637
	CLOSE	C	0.2036	0.2661	0.3286	0.3911	0.4536	0.5161	0.5786	0.6411
	REAM		0.2026	0.2651	0.3276	0.3901	0.4526	0.5151	0.5776	0.6401
1/32 B	TRANSITION	D	0.219	0.281	0.344	0.406	0.469	0.531	0.595	0.657
	FIT		0.216	0.278	0.341	0.403	0.466	0.528	0.591	0.653
	CLOSE	D	0.2192	0.2817	0.3442	0.4067	0.4692	0.5317	0.5942	0.6567
	REAM		0.2182	0.2807	0.3432	0.4057	0.4682	0.5307	0.5932	0.6557
3/64 B	TRANSITION	C	0.235	0.297	0.360	0.422	0.486	0.547	0.609	0.672
	FIT		0.232	0.294	0.357	0.419	0.482	0.544	0.606	0.669
	CLOSE	C	0.2349	0.2973	0.3599	0.4224	0.4848	0.5474	0.6099	0.6724
	REAM		0.2339	0.2963	0.3589	0.4214	0.4838	0.5464	0.6089	0.6714

**OVERSIZE FASTENER HOLE DIAMETER LIMITS (TRANSITION FIT AND CLOSE REAM)
TABLE II**

**Permanent Straight Shank Fastener Holes
Figure 4 (Sheet 3 of 5)**

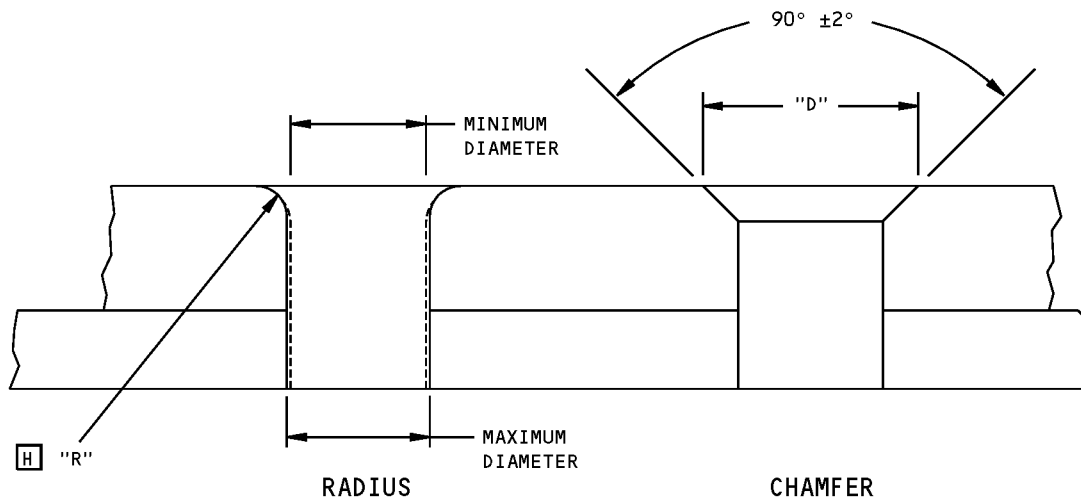
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NOMINAL AND OVERSIZE FASTENER	HOLE SIZE-INITIAL AND OVERSIZE INTERFERENCE FIT E				NOMINAL AND OVERSIZE	HOLE SIZE-INITIAL AND OVERSIZE INTERFERENCE FIT E			
	0.0000 TO 0.0030	0.0005 TO 0.0035	0.0005 TO 0.0045	0.0010 TO 0.0040		0.0000 TO 0.0030	0.0005 TO 0.0035	0.0005 TO 0.0045	0.0010 TO 0.0040
5/32 (-5)	0.1605 0.1625	0.1600 0.1620	0.1590 0.1620	0.1595 0.1615	7/16 (-14)	0.4340 0.4360	0.4335 0.4355	0.4325 0.4355	0.4330 0.4350
1/64	C	C	C	C	1/64 F	0.4496 0.4516	0.4491 0.4511	0.4481 0.4511	0.4486 0.4506
1/32 G	D	D	D	D	1/32 G	0.4652 0.4672	0.4647 0.4667	0.4637 0.4667	0.4642 0.4662
3/16 (-6)	0.1865 0.1885	0.1860 0.1880	0.1850 0.1880	0.1855 0.1875	1/2 (-16)	0.4965 0.4985	0.4960 0.4980	0.4950 0.4980	0.4955 0.4975
1/64 F	0.1996 0.2016	0.1991 0.2011	0.1981 0.2011	0.1986 0.2006	1/64 F	0.5121 0.5141	0.5116 0.5136	0.5106 0.5136	0.5111 0.5131
1/32 G	0.2152 0.2172	0.2147 0.2167	0.2137 0.2167	0.2142 0.2162	1/32 G	0.5277 0.5297	0.5272 0.5292	0.5262 0.5292	0.5267 0.5287
1/4 (-8)	0.2465 0.2485	0.2460 0.2480	0.2450 0.2480	0.2455 0.2475	9/16 (-18)	0.5585 0.5605	0.5580 0.5600	0.5570 0.5600	0.5575 0.5595
1/64 F	0.2621 0.2641	0.2616 0.2636	0.2606 0.2636	0.2611 0.2631	1/64 F	0.5741 0.5761	0.5736 0.5766	0.5726 0.5756	0.5731 0.5751
1/32 G	0.2777 0.2797	0.2772 0.2792	0.2762 0.2792	0.2767 0.2787	1/32 G	0.5897 0.5917	0.5892 0.5912	0.5882 0.5912	0.5887 0.5907
5/16 (-10)	0.3090 0.3110	0.3085 0.3105	0.3075 0.3105	0.3080 0.3100	5/8 (-20)	0.6210 0.6230	0.6205 0.6225	0.6195 0.6225	0.6200 0.6220
1/64 F	0.3246 0.3266	0.3241 0.3261	0.3231 0.3261	0.3236 0.3256	1/64 F	0.6366 0.6386	0.6361 0.6381	0.6351 0.6381	0.6356 0.6376
1/32 G	0.3402 0.3422	0.3397 0.3417	0.3387 0.3417	0.3392 0.3412	1/32 G	0.6522 0.6542	0.6517 0.6537	0.6507 0.6537	0.6512 0.6532
3/8 (-12)	0.3715 0.3735	0.3710 0.3730	0.3700 0.3730	0.3705 0.3725	3/4 (-24)	0.7460 0.7480	0.7455 0.7475	0.7445 0.7475	0.7450 0.7470
1/64 F	0.3871 0.3891	0.3866 0.3886	0.3856 0.3886	0.3861 0.3881	1/64 F	0.7616 0.7636	0.7611 0.7631	0.7601 0.7631	0.7606 0.7626
1/32 G	0.4027 0.4047	0.4012 0.4042	0.4012 0.4042	0.4017 0.4037	1/32 G	0.7772 0.7792	0.7767 0.7787	0.7757 0.7787	0.7762 0.7782

OVERSIZE FASTENER HOLE DIAMETER LIMITS (INTERFERENCE FIT)
TABLE III

Permanent Straight Shank Fastener Holes
Figure 4 (Sheet 4 of 5)

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DETAIL I

NOMINAL FASTENER DIAMETER	IN ALL METAL STRUCTURE		IN ALUMINUM AND MAGNESIUM STRUCTURE			IN ALL OTHER METAL STRUCTURE		
	"R" RADIUS		"D" I J CHAMFER DIA		MIN SHEET THICKNESS TO BE CHAMFERED OR RADIUS	"D" I CHAMFER DIA		MIN SHEET THICKNESS TO BE CHAMFERED OR RADIUS
	MIN	MAX	MIN	MAX		MIN	MAX	
5/32	0.025	0.035	0.188	0.208	0.060	0.218	0.233	0.107
3/16			0.214	0.234	0.060	0.242	0.257	0.127
1/4			0.274	0.294	0.060	0.300	0.320	0.150
5/16	0.030	0.040	0.343	0.363	0.060	0.372	0.392	0.183
3/8			0.406	0.426	0.060	0.435	0.455	0.209
7/16			0.468	0.488	0.060	0.497	0.517	0.236
1/2			0.531	0.551	0.060	0.560	0.580	0.253
9/16	0.040	0.050	0.606	0.626	0.075	0.657	0.677	0.320
5/8			0.668	0.688	0.075	0.719	0.739	0.320
3/4	0.045	0.055	0.800	0.820	0.085	0.856	0.876	0.353
7/8	0.050	0.060	0.931	0.951	0.090	0.993	1.013	0.387
1	0.060	0.070	1.069	1.089	0.105	1.142	1.162	0.453

FILLET RELIEF LIMITS FOR PROTRUDING HEAD
HEX-DRIVE BOLT AND LOCKBOLT HOLES

TABLE IV

Permanent Straight Shank Fastener Holes Figure 4 (Sheet 5 of 5)



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STRUCTURAL REPAIR MANUAL

HOLE DIAMETERS FOR NAS 1738, NAS 1739, BACR15FP AND BACR15FR		
NOMINAL FASTENER DIAMETER	MINIMUM HOLE SIZE (INCH)	MAXIMUM HOLE SIZE (INCH)
1/8 5/32 3/16	0.143 0.176 0.205	0.146 0.180 0.209
ALL OTHER BLIND RIVETS		
NOMINAL FASTENER DIAMETER	MINIMUM HOLE SIZE (INCH)	MAXIMUM HOLE SIZE (INCH)
3/32 1/8 5/32 3/16 1/4	0.097 0.129 0.160 0.192 0.256	0.101 0.132 0.164 0.196 0.261

HOLE SIZES FOR BLIND RIVETS
TABLE I

NOMINAL FASTENER DIAMETER	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
5/32	0.165	0.168
3/16	0.199	0.202
1/4	0.260	0.263
5/16	0.312	0.315
3/8	0.375	0.378
7/16	0.437	0.441

HOLE SIZES FOR BLIND BOLTS BACB30AY,
BACB30CC, AND BACB30JG
TABLE II

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING SPECIFICATION BAC5004-3.
- REFER TO TABLE I FOR BLIND RIVETS AND TABLES II THRU IV FOR BLIND BOLTS.

Holes for Blind Rivets and Bolts
Figure 5 (Sheet 1 of 2)

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NOMINAL FASTENER DIAMETER	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
5/32	0.164	0.167
3/16	0.199	0.202
1/4	0.260	0.263
5/16	0.312	0.315
3/8	0.374	0.377
7/16	0.437	0.441
1/2	0.500	0.504

HOLE SIZES FOR BLIND BOLTS MS90353,
MS90354, MS21140, AND MS21141
TABLE III

INITIAL FASTENER	1/64 OVERSIZE FASTENER		LIMITS	NOMINAL FASTENER DIAMETER				
				5/32	3/16	1/4	5/16	3/8
				INITIAL HOLE SIZE				
			MIN	0.164	0.199	0.260	0.312	0.374
			MAX	0.167	0.202	0.263	0.315	0.377
MS21140-() () MS21140-() ()P MS21141-() () MS21141-() ()P MS90353-() () MS90354-() ()	BACB30VJ() () BACB30VJ() ()CD BACB30VH() () BACB30VH() ()CD BACB30VJ() () BACB30VH() ()	OB100-EU() () OB100-EU() ()CD OBP-EU() () OBP-EU() ()CD OB100-T() () OBP-T() ()	LIMITS	1/64 OVERSIZE				
			MIN	0.180	0.215	0.276	0.328	0.390
			MAX	0.183	0.218	0.279	0.331	0.393

OVERSIZE FASTENERS AND HOLE SIZES FOR OVERSIZE BLIND BOLTS
TABLE IV

Holes for Blind Rivets and Bolts
Figure 5 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL

TYPE OF FASTENER HOLE	TABLE
CLOSE REAM HOLES	I
CLASS I HOLES	II
CLASS II HOLES	III
CLASS III HOLES	IV

INDEX FOR FIGURE 6

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5009.
- REFER TO THE ENGINEER DRAWING OR SERVICE BULLETIN. USE THE SAME HOLE TYPE (CLOSE REAM, CLASS I, CLASS II, OR CLASS III) AS SPECIFIED IN THE ENGINEER DRAWING, SERVICE BULLETIN, OR SRM REPAIR. REFER TO TABLES I THRU IV FOR OVERSIZE HOLE DIMENSIONS.
- SEE DETAIL I AND TABLE V FOR FILLET RELIEF SPECIFICATIONS FOR PROTRUDING HEAD FASTENERS. REFER TO SRM 51-40-08 FOR EQUIVALENT COUNTER-SINK FASTENER SPECIFICATIONS.

A MAKE THE RADIUS BLEND SMOOTHLY WITH THE SHANK DIAMETER.

B FOR OVERSIZE BOLTS, ADD 0.010 INCH TO EACH VALUE.

EXAMPLE: IF INITIAL "R" IS 0.041 TO 0.051 INCH, THEN THE "R" VALUES FOR OVERSIZE FASTENERS ARE 0.051 TO 0.061 INCH.

C FOR OVERSIZE BOLTS, MULTIPLY THE MAXIMUM RADIUS FROM THE INITIAL BOLT TIMES TWO AND ADD THE MAXIMUM SHANK DIAMETER OF THE OVERSIZE BOLT. THE SPECIFIED TOLERANCE IS -0.000/+0.020 INCH.

EXAMPLE: IF THE INITIAL "R" IS 0.041 TO 0.051 INCH AND THE OVERSIZE SHANK DIAMETER IS 0.2804 TO 0.2814 INCH, THEN THE CALCULATION IS $(0.051 \times 2) + 0.2814 - 0.000/+0.020 = 0.3834$ TO 0.3854 INCH.

D IF THE EDGE MARGIN IS LESS THAN TWO DIAMETERS, TELL AN ENGINEER WHO HAS THE AUTHORITY TO DO AN ANALYSIS AND MAKE A DECISION.

Holes for Bolts
Figure 6 (Sheet 1 of 11)



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STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	3/16 (0.1900)	1/4 (0.2500)	5/16 (0.3125)	3/8 (0.3750)	7/16 (0.4375)	
CLOSE REAM HOLE								
--	INITIAL HOLE SIZE	MAX	0.1905	0.2505	0.3130	0.3755	0.4380	
		MIN	0.1895	0.2495	0.3120	0.3745	0.4370	
BACB30G	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AC	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30J	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AJ	1/32 (0.0312)	MAX	--	0.2814	0.3439	0.4064	0.4689	
		MIN	--	0.2804	0.3429	0.4054	0.4679	
BACB30DK	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30EG NAS2903 THRU 2920 NAS1243 THRU 1250 NAS1703 THRU 1710	1/64 (0.0156)	MAX	0.2036	0.2661	0.3286	0.3911	0.4536	
		MIN	0.2026	0.2651	0.3276	0.3901	0.4526	
BACB30EH NAS3003 THRU 3020 NAS1253 THRU 1260 NAS1603 THRU 1620	1/32 (0.0312)	MAX	0.2192	0.2817	0.3442	0.4067	0.4692	
		MIN	0.2182	0.2807	0.3432	0.4057	0.4682	
X CODE	1/64 (0.0156)	MAX	0.2036	0.2661	0.3286	0.3911	0.4536	
		MIN	0.2026	0.2651	0.3276	0.3901	0.4526	
Y CODE	1/32 (0.0312)	MAX	0.2192	0.2817	0.3442	0.4067	0.4692	
		MIN	0.2182	0.2807	0.3432	0.4057	0.4682	
BACB30TL	4/64 (0.0625)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
	5/64 (0.0781)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLOSE REAM HOLE (INCHES)
TABLE I D

Holes for Bolts
Figure 6 (Sheet 2 of 11)



757-200
STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	1/2 (0.5000)	9/16 (0.5625)	5/8 (0.6250)	3/4 (0.7500)	7/8 (0.8750)	
CLOSE REAM HOLE								
--	INITIAL HOLE SIZE	MAX	0.5005	0.5630	0.6255	0.7505	0.8755	
		MIN	0.4995	0.5620	0.6245	0.7495	0.8745	
BACB30G	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AC	1/64 (0.0156)	MAX	--	--	--	0.7673	--	
		MIN	--	--	--	0.7663	--	
BACB30J	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AJ	1/32 (0.0312)	MAX	0.5313	0.5943	0.6567	0.7815	0.9063	
		MIN	0.5303	0.5933	0.6557	0.7805	0.9053	
BACB30DK	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30EG NAS2903 THRU 2920 NAS1243 THRU 1250 NAS1703 THRU 1710	1/64 (0.0156)	MAX	0.5161	0.5786	0.6411	0.7661	0.8911	
		MIN	0.5151	0.5776	0.6401	0.7651	0.8901	
BACB30EH NAS3003 THRU 3020 NAS1253 THRU 1260 NAS1603 THRU 1620	1/32 (0.0312)	MAX	0.5317	0.5942	0.6567	0.7817	0.9067	
		MIN	0.5307	0.5932	0.6557	0.7807	0.9057	
X CODE	1/64 (0.0156)	MAX	0.5161	0.5786	0.6411	0.7661	0.8911	
		MIN	0.5151	0.5776	0.6401	0.7561	0.8901	
Y CODE	1/32 (0.0312)	MAX	0.5317	0.5942	0.6567	0.7817	0.9067	
		MIN	0.5307	0.5932	0.6557	0.7807	0.9057	
BACB30TL	4/64 (0.0625)	MAX	--	--	0.6880	--	0.9380	
		MIN	--	--	0.6870	--	0.9370	
	5/64 (0.0781)	MAX	--	--	0.7036	--	0.9536	
		MIN	--	--	0.7026	--	0.9526	

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLOSE REAM HOLE (INCHES)
TABLE I D

Holes for Bolts
Figure 6 (Sheet 3 of 11)



757-200
STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	1 (1.0000)	1-1/8 (1.1250)	1-1/4 (1.2500)	1-3/8 (1.3750)	1-1/2 (1.5000)
CLOSE REAM HOLE							
—	INITIAL HOLE SIZE	MAX	1.0005	1.1260	1.2510	1.3760	1.5010
		MIN	0.9995	1.1245	1.2495	1.3745	1.4995
BACB30G	1/64 (0.0156)	MAX	—	—	—	1.3924	1.5174
		MIN	—	—	—	1.3909	1.5159
BACB30AC	1/64 (0.0156)	MAX	—	—	—	—	—
		MIN	—	—	—	—	—
BACB30J	1/32 (0.0312)	MAX	—	—	—	1.4079	1.5330
		MIN	—	—	—	1.4064	1.5315
BACB30AJ	1/32 (0.0312)	MAX	1.0315	1.1570	1.2820	1.4070	1.5320
		MIN	1.0305	1.1555	1.2805	1.4055	1.5305
BACB30DK	1/32 (0.0312)	MAX	1.0317	1.1572	1.2822	1.4072	1.5322
		MIN	1.0307	1.1557	1.2807	1.4057	1.5307
BACB30EG NAS2903 THRU 2920 NAS1243 THRU 1250 NAS1703 THRU 1710	1/64 (0.0156)	MAX	1.0161	1.1416	1.2666	—	—
		MIN	1.0151	1.1401	1.2651	—	—
BACB30EH NAS3003 THRU 3020 NAS1253 THRU 1260 NAS1603 THRU 1620	1/32 (0.0312)	MAX	1.0317	1.1572	1.2822	—	—
		MIN	1.0307	1.1557	1.2807	—	—
X CODE	1/64 (0.0156)	MAX	1.0161	1.1416	1.2666	1.3916	1.5166
		MIN	1.0151	1.1401	1.2651	1.3901	1.5151
Y CODE	1/32 (0.0312)	MAX	1.0317	1.1572	1.2822	1.4072	1.5322
		MIN	1.0307	1.1557	1.2807	1.4057	1.5307
BACB30TL	4/64 (0.0625)	MAX	1.0630	—	—	1.4385	—
		MIN	1.0620	—	—	1.4370	—
	5/64 (0.0781)	MAX	1.0786	—	—	1.4541	—
		MIN	1.0776	—	—	1.4526	—

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLOSE REAM HOLE (INCHES)
TABLE I D

Holes for Bolts
Figure 6 (Sheet 4 of 11)



757-200
STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	3/16 (0.1900)	1/4 (0.2500)	5/16 (0.3125)	3/8 (0.3750)	7/16 (0.4375)	
CLASS I HOLE								
--	INITIAL HOLE SIZE	MAX	0.194	0.254	0.316	0.379	0.442	
		MIN	0.190	0.250	0.312	0.375	0.437	
BACB30G	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AC	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30J	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AJ	1/32 (0.0312)	MAX	--	0.285	0.347	0.409	0.473	
		MIN	--	0.281	0.343	0.405	0.468	
BACB30DK	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30EG NAS2903 THRU 2920 NAS1243 THRU 1250 NAS1703 THRU 1710	1/64 (0.0156)	MAX	0.207	0.270	0.332	0.395	0.458	
		MIN	0.203	0.266	0.328	0.391	0.453	
BACB30EH NAS3003 THRU 3020 NAS1253 THRU 1260 NAS1603 THRU 1620	1/32 (0.0312)	MAX	0.223	0.285	0.348	0.410	0.474	
		MIN	0.219	0.281	0.344	0.406	0.469	
X CODE	1/64 (0.0156)	MAX	0.207	0.270	0.332	0.395	0.458	
		MIN	0.203	0.266	0.328	0.391	0.453	
Y CODE	1/32 (0.0312)	MAX	0.223	0.285	0.348	0.410	0.473	
		MIN	0.219	0.281	0.344	0.406	0.468	
BACB30TL	4/64 (0.0625)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
	5/64 (0.0781)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLASS I HOLE (INCHES)
TABLE II D

Holes for Bolts
Figure 6 (Sheet 5 of 11)



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STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	1/2 (0.5000)	9/16 (0.5625)	5/8 (0.6250)	3/4 (0.7500)	7/8 (0.8750)	
CLASS I HOLE								
--	INITIAL HOLE SIZE	MAX	0.505	0.567	0.630	0.757	0.882	
		MIN	0.500	0.562	0.625	0.750	0.875	
BACB30G	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AC	1/64 (0.0156)	MAX	--	--	--	0.774	--	
		MIN	--	--	--	0.767	--	
BACB30J	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AJ	1/32 (0.0312)	MAX	0.536	0.598	0.661	0.785	0.913	
		MIN	0.531	0.593	0.656	0.781	0.906	
BACB30DK	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30EG NAS2903 THRU 2920 NAS1243 THRU 1250 NAS1703 THRU 1710	1/64 (0.0156)	MAX	0.521	0.583	0.646	0.773	0.898	
		MIN	0.516	0.578	0.641	0.766	0.891	
BACB30EH NAS3003 THRU 3020 NAS1253 THRU 1260 NAS1603 THRU 1620	1/32 (0.0312)	MAX	0.536	0.598	0.661	0.788	0.913	
		MIN	0.531	0.593	0.656	0.781	0.906	
X CODE	1/64 (0.0156)	MAX	0.521	0.583	0.646	0.773	0.898	
		MIN	0.516	0.578	0.641	0.766	0.891	
Y CODE	1/32 (0.0312)	MAX	0.536	0.598	0.661	0.788	0.913	
		MIN	0.531	0.593	0.656	0.781	0.906	
BACB30TL	4/64 (0.0625)	MAX	--	--	0.6925	--	0.9445	
		MIN	--	--	0.6875	--	0.9375	
	5/64 (0.0781)	MAX	--	--	0.7081	--	0.9601	
		MIN	--	--	0.7031	--	0.9531	

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLASS I HOLE (INCHES)
TABLE II D

Holes for Bolts
Figure 6 (Sheet 6 of 11)



757-200
STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	1 (1.0000)	1-1/8 (1.1250)	1-1/4 (1.2500)	1-3/8 (1.3750)	1-1/2 (1.5000)
CLASS I HOLE							
—	INITIAL HOLE SIZE	MAX	1.010	1.135	1.260	1.385	1.510
		MIN	1.000	1.125	1.250	1.375	1.500
BACB30G	1/64 (0.0156)	MAX	—	—	—	1.421	1.546
		MIN	—	—	—	1.391	1.516
BACB30AC	1/64 (0.0156)	MAX	—	—	—	—	—
		MIN	—	—	—	—	—
BACB30J	1/32 (0.0312)	MAX	—	—	—	1.417	1.542
		MIN	—	—	—	1.407	1.532
BACB30AJ	1/32 (0.0312)	MAX	1.041	1.166	1.291	1.416	1.541
		MIN	1.031	1.156	1.281	1.406	1.531
BACB30DK	1/32 (0.0312)	MAX	1.041	1.166	1.291	1.416	1.541
		MIN	1.031	1.156	1.281	1.406	1.531
BACB30EG NAS2903 THRU 2920 NAS1243 THRU 1250 NAS1703 THRU 1710	1/64 (0.0156)	MAX	1.025	1.150	1.275	—	—
		MIN	1.016	1.141	1.266	—	—
BACB30EH NAS3003 THRU 3020 NAS1253 THRU 1260 NAS1603 THRU 1620	1/32 (0.0312)	MAX	1.041	1.166	1.291	—	—
		MIN	1.031	1.156	1.281	—	—
X CODE	1/64 (0.0156)	MAX	1.025	1.150	1.275	1.400	1.525
		MIN	1.016	1.141	1.266	1.391	1.516
Y CODE	1/32 (0.0312)	MAX	1.041	1.166	1.291	1.416	1.541
		MIN	1.031	1.156	1.281	1.406	1.531
BACB30TL	4/64 (0.0625)	MAX	1.0725	—	—	1.4475	—
		MIN	1.0625	—	—	1.4375	—
	5/64 (0.0781)	MAX	1.0881	—	—	1.4631	—
		MIN	1.0787	—	—	1.4531	—

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLASS I HOLE (INCHES)
TABLE II D

Holes for Bolts
Figure 6 (Sheet 7 of 11)



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STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	3/16 (0.1900)	1/4 (0.2500)	5/16 (0.3125)	3/8 (0.3750)	7/16 (0.4375)	
CLASS II HOLE								
--	INITIAL HOLE SIZE	MAX	0.199	0.261	0.327	0.391	0.457	
		MIN	0.190	0.250	0.313	0.375	0.438	
BACB30G	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AC	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30J	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AJ	1/32 (0.0312)	MAX	--	0.292	0.357	0.422	0.488	
		MIN	--	0.281	0.343	0.406	0.469	
BACB30DK	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
X CODE	1/64 (0.0156)	MAX	0.213	0.277	0.343	0.407	0.471	
		MIN	0.203	0.266	0.329	0.391	0.454	
Y CODE	1/32 (0.0312)	MAX	0.228	0.292	0.358	0.420	0.486	
		MIN	0.219	0.281	0.344	0.406	0.469	
BACB30TL	4/64 (0.0625)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
	5/64 (0.0781)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLASS II HOLE (INCHES)
TABLE III D

Holes for Bolts
Figure 6 (Sheet 8 of 11)



757-200
STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	1/2 (0.5000)	9/16 (0.5625)	5/8 (0.6250)	3/4 (0.7500)	7/8 (0.8750)	
CLASS II HOLE								
--	INITIAL HOLE SIZE	MAX	0.521	0.583	0.645	0.773	0.898	
		MIN	0.500	0.563	0.625	0.750	0.875	
BACB30G	1/64 (0.0156)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AC	1/64 (0.0156)	MAX	--	--	--	0.790	--	
		MIN	--	--	--	0.767	--	
BACB30J	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
BACB30AJ	1/32 (0.0312)	MAX	0.552	0.614	0.676	0.804	0.926	
		MIN	0.531	0.594	0.656	0.781	0.906	
BACB30DK	1/32 (0.0312)	MAX	--	--	--	--	--	
		MIN	--	--	--	--	--	
X CODE	1/64 (0.0156)	MAX	0.537	0.599	0.661	0.789	0.914	
		MIN	0.516	0.579	0.641	0.766	0.891	
Y CODE	1/32 (0.0312)	MAX	0.552	0.614	0.676	0.804	0.929	
		MIN	0.531	0.594	0.656	0.781	0.906	
BACB30TL	4/64 (0.0625)	MAX	--	--	0.7075	--	0.9605	
		MIN	--	--	0.6875	--	0.9375	
	5/64 (0.0781)	MAX	--	--	0.7231	--	0.9761	
		MIN	--	--	0.7031	--	0.9531	

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLASS II HOLE (INCHES)
TABLE III D

Holes for Bolts
Figure 6 (Sheet 9 of 11)

757-200 STRUCTURAL REPAIR MANUAL

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	1 (1.0000)	1-1/8 (1.1250)	1-1/4 (1.2500)	1-3/8 (1.3750)	1-1/2 (1.5000)
CLASS II HOLE							
---	INITIAL HOLE SIZE	MAX	1.026	1.155	1.280	1.405	1.530
		MIN	1.000	1.125	1.250	1.375	1.500
BACB30G	1/64 (0.0156)	MAX	---	---	---	1.421	1.546
		MIN	---	---	---	1.391	1.516
BACB30AC	1/64 (0.0156)	MAX	---	---	---	---	---
		MIN	---	---	---	---	---
BACB30J	1/32 (0.0312)	MAX	---	---	---	1.437	1.562
		MIN	---	---	---	1.407	1.532
BACB30AJ	1/32 (0.0312)	MAX	1.057	1.186	1.311	1.437	1.561
		MIN	1.031	1.156	1.281	1.406	1.531
BACB30DK	1/32 (0.0312)	MAX	1.057	1.186	1.311	1.436	1.561
		MIN	1.031	1.156	1.281	1.406	1.531
X CODE	1/64 (0.0156)	MAX	1.042	1.173	1.296	1.421	1.546
		MIN	1.016	1.141	1.266	1.391	1.516
Y CODE	1/32 (0.0312)	MAX	1.057	1.186	1.311	1.436	1.561
		MIN	1.031	1.156	1.281	1.406	1.531
BACB30TL	4/64 (0.0625)	MAX	1.0885	---	1.4675	---	---
		MIN	1.0625	---	1.4375	---	---
	5/64 (0.0781)	MAX	1.1041	---	1.4831	---	---
		MIN	1.0781	---	1.4531	---	---

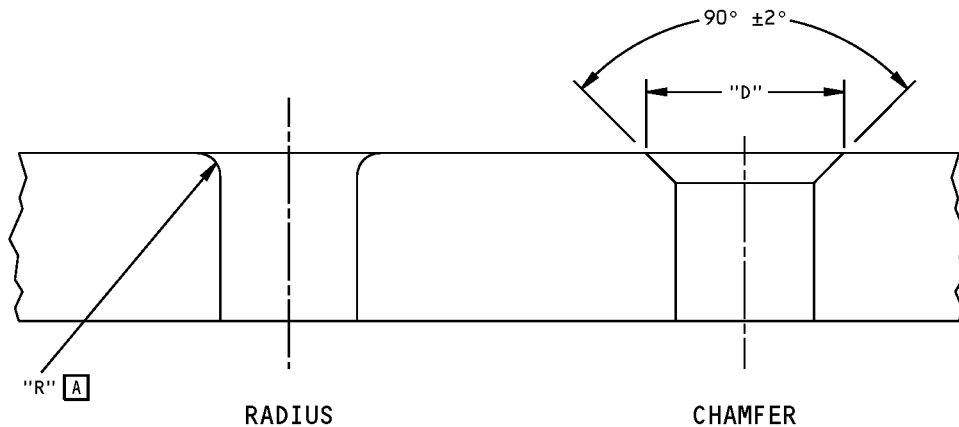
HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLASS II HOLE (INCHES)
TABLE III **D**

OVERSIZE FASTENER	NOMINAL OVERSIZE	LIMIT	3/4 (0.7500)	7/8 (0.8750)	1 (1.0000)	1-1/8 (1.1250)	1-1/4 (1.2500)	1-3/8 (1.3750)	1-1/2 (1.5000)
CLASS III HOLE									
---	INITIAL HOLE SIZE	MAX	0.797	0.922	1.047	1.172	1.297	1.422	1.547
		MIN	0.778	0.903	1.028	1.153	1.278	1.403	1.528
BACB30G	1/64 (0.0156)	MAX	---	---	---	---	---	1.438	1.563
		MIN	---	---	---	---	---	1.419	1.544
BACB30AC	1/64 (0.0156)	MAX	0.814	---	---	---	---	---	---
		MIN	0.795	---	---	---	---	---	---
BACB30J	1/32 (0.0312)	MAX	---	---	---	---	---	1.454	1.560
		MIN	---	---	---	---	---	1.435	1.479

HOLE SIZES FOR OVERSIZE REPLACEMENT BOLTS – CLASS III HOLE (INCHES)
TABLE IV **D**

Holes for Bolts
Figure 6 (Sheet 10 of 11)

757-200 STRUCTURAL REPAIR MANUAL



DETAIL I

NOMINAL FASTENER DIAMETER	BACB30FD, BACB30LE, BACB30MR, BACB30MT, BACB30NH, BACB30PN, BACB30TR, BACB30UG, BACB30US, BACB30XL MS21250		ALL OTHER PROTRUDING HEAD BOLTS	
	"R" B RADIUS	"D" C CHAMFER DIA	"R" B RADIUS	"D" C CHAMFER DIA
3/16	0.041-0.051	0.272-0.292	0.020-0.030	0.230-0.250
1/4	0.041-0.051	0.332-0.352	0.020-0.030	0.290-0.310
5/16	0.041-0.051	0.394-0.414	0.020-0.030	0.352-0.372
3/8	0.057-0.067	0.489-0.509	0.025-0.035	0.425-0.445
7/16	0.057-0.067	0.551-0.571	0.025-0.035	0.487-0.507
1/2	0.057-0.067	0.614-0.634	0.030-0.040	0.560-0.580
9/16	0.057-0.067	0.676-0.696	0.035-0.045	0.632-0.652
5/8	0.073-0.083	0.771-0.791	0.040-0.050	0.705-0.725
3/4	0.073-0.083	0.896-0.916	0.045-0.055	0.840-0.860
7/8	0.073-0.083	1.021-1.041	0.050-0.060	0.975-0.995
1	0.073-0.083	1.146-1.166	0.060-0.070	1.120-1.140
1 1/8	0.073-0.083	1.271-1.291	0.070-0.080	1.265-1.285
1 1/4	0.089-0.099	1.428-1.448	0.075-0.085	1.400-1.420
1 3/8	0.089-0.099	1.553-1.573	--	--
1 1/2	0.089-0.099	1.678-1.698	--	--
1 3/4	0.089-0.099	1.928-1.948	--	--

FILLET RELIEF LIMITS FOR PROTRUDING HEAD STRAIGHT SHANK
BOLT HOLES WHEN A COUNTERSINK WASHER IS NOT USED UNDER THE BOLT HEAD
TABLE V

Holes for Bolts
Figure 6 (Sheet 11 of 11)



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STRUCTURAL REPAIR MANUAL

NOMINAL RIVET DIAMETER	FINISHED HOLE DIAMETER
0.125 (1/8)	0.127 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.156 (5/32)	0.159 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.1875 (3/16)	0.190 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.219 (7/32)	0.222 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.250 (1/4)	0.253 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.281 (9/32)	0.285 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.3125 (5/16)	0.315 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.344 (11/32)	0.348 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.3750 (3/8)	0.378 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.406 (13/32)	0.411 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$
0.4375 (7/16)	0.441 $\begin{smallmatrix} +0.003 \\ -0.000 \end{smallmatrix}$

HOLE SIZES FOR FLUID-TIGHT RIVETS
TABLE I

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5047.
- HOLE DIAMETERS IN THIS FIGURE CAN BE USED UNLESS AN APPLICABLE ENGINEER DRAWING SHOWS DIFFERENTLY.
- HOLES AND COUNTERSINKS MUST BE 90 DEGREES TO THE PART SURFACE, ± 2 DEGREES.

Fluid Tight Fastener Holes
Figure 7

757-200

STRUCTURAL REPAIR MANUAL

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5060.
 - HOLE DIAMETERS IN THIS FIGURE CAN BE USED UNLESS AN APPLICABLE ENGINEER DRAWING SHOWS DIFFERENTLY.
 - SEE DETAIL I AND TABLE VI FOR FINISHED HOLE SPECIFICATIONS FOR PROTRUDING HEAD FASTENERS. REFER TO 51-40-08 FOR EQUIVALENT COUNTERSINK FASTENER SPECIFICATIONS.
 - SEE TABLES I AND II FOR BACB30PT BOLTS. SEE TABLES III THRU V FOR BACB30WQ AND BACB30WR BOLTS.
- A** IT IS NOT NECESSARY TO COLD WORK A HOLE FOR A FIRST OVERSIZE BOLT IF THE INITIAL HOLE WAS A CLASS I, HIGH INTERFERENCE, (SLEEVE OR SLEEVELESS) COLD WORKED HOLE. BUT IF THE INITIAL HOLE WAS A 1/64 INCH UNDERSIZE, CLASS I, SLEEVE, HIGH INTERFERENCE, COLD WORKED HOLE, THEN A HOLE FOR A FIRST OVERSIZE BOLT MUST BE COLD WORKED AGAIN. REFER TO SRM 51-40-09 FOR SLEEVE AND SLEEVELESS COLD WORKING PROCEDURES.
- B** COLD WORK THE HOLE AS A CLASS I, HIGH INTERFERENCE HOLE, AS SPECIFIED IN SRM 51-40-09.
- C** HOLES FOR FIRST AND SECOND OVERSIZE FASTENERS MUST HAVE THE SAME BOLT INTERFERENCE AS SPECIFIED FOR THE INITIAL HOLE.
- D** ADD 0.0096 TO BOTH THE MINIMUM AND MAXIMUM CHAMFER DIAMETERS FOR FIRST OVERSIZE BOLTS. ADD 0.0252 INCH TO BOTH THE MINIMUM AND MAXIMUM CHAMFER DIAMETERS FOR SECOND OVERSIZE BOLTS.
- E** IF COLD WORKING IS NECESSARY FOR AN OVER-SIZE HOLE, THEN USE THE MANDREL-TO-HOLE INTERFERENCE AS SPECIFIED IN THE ENGINEER DRAWING.

NOMINAL THREAD SIZE	BOLT PART NUMBER	HOLE DIAMETER	
		MINIMUM	MAXIMUM
WING UPPER SURFACE			
0.2500-28	BACB30PT	0.2520	0.2540
0.3125-24		0.3145	0.3165
0.3750-24		0.3770	0.3790
WING LOWER SURFACE			
0.2500-28	BACB30PT	0.2510	0.2530
0.3125-24		0.3135	0.3155
0.3750-24		0.3760	0.3780

STANDARD HOLE SIZES FOR BACB30PT 70 DEGREE
RADIUS LEAD-IN BOLTS
TABLE I

Holes for Radius Lead-In Bolts
Figure 8 (Sheet 1 of 6)



757-200
STRUCTURAL REPAIR MANUAL

NOMINAL THREAD SIZE	FIRST OVERSIZE		SECOND OVERSIZE	
	HOLE DIAMETER		HOLE DIAMETER	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
WING UPPER SURFACE				
0.2500-28	0.2616	0.2636	0.2772	0.2792
0.3125-24	0.3241	0.3261	0.3397	0.3417
0.3750-24	0.3866	0.3886	0.4022	0.4042
WING LOWER SURFACE				
0.2500-28	0.2591	0.2616	0.2747	0.2772
0.3125-24	0.3216	0.3241	0.3372	0.3397
0.3750-24	0.3841	0.3866	0.3997	0.4022

OVERSIZE HOLE DIMENSIONS FOR BACB30PT
70 DEGREE RADIUS LEAD-IN BOLTS
TABLE II

NOMINAL THREAD SIZE	BOLT PART NUMBER	HOLE DIAMETER		COLD WORKED HOLE DIAMETER	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
WING UPPER SURFACE AND UPPER CHORD TO WEB					
0.1900-32	BACB30WQ AND BACB30WR	0.1928	0.1948	0.1933	0.1953
0.2500-28		0.2526	0.2546	0.2531	0.2551
0.3125-24		0.3151	0.3171	0.3156	0.3176
0.3750-24		0.3776	0.3796	0.3781	0.3801
0.4375-20		0.4401	0.4421	0.4406	0.4426
WING LOWER SURFACE AND LOWER CHORD TO WEB					
0.1900-32	BACB30WQ AND BACB30WR	0.1913	0.1933	0.1933	0.1953
0.2500-28		0.2511	0.2531	0.2531	0.2551
0.3125-24		0.3136	0.3156	0.3156	0.3176
0.3750-24		0.3761	0.3781	0.3781	0.3801
0.4375-20		0.4386	0.4406	0.4406	0.4426

STANDARD HOLE SIZES FOR BACB30WQ AND
BACB30WR 100 DEGREE RADIUS LEAD-IN BOLTS
TABLE III

Holes for Radius Lead-In Bolts
Figure 8 (Sheet 2 of 6)



757-200
STRUCTURAL REPAIR MANUAL

NOMINAL THREAD SIZE	FIRST OVERSIZE HOLE DIAMETER A		SECOND OVERSIZE HOLE DIAMETER B	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
WING UPPER SURFACE AND UPPER CHORD TO WEB				
0.1900-32	0.2029	0.2049	0.2185	0.2205
0.2500-28	0.2627	0.2647	0.2783	0.2803
0.3125-24	0.3252	0.3272	0.3408	0.3428
0.3750-24	0.3877	0.3897	0.4033	0.4053
0.4375-20	0.4502	0.4522	0.4658	0.4678
WING LOWER SURFACE AND LOWER CHORD TO WEB				
0.1900-32	0.2029	0.2049	0.2185	0.2205
0.2500-28	0.2627	0.2647	0.2783	0.2803
0.3125-24	0.3252	0.3272	0.3408	0.3428
0.3750-24	0.3877	0.3897	0.4033	0.4053
0.4375-20	0.4502	0.4522	0.4658	0.4678

OVERSIZE HOLE DIMENSIONS FOR BACB30WQ AND BACB30WR
100 DEGREE RADIUS LEAD-IN BOLTS IN COLD WORKED HOLES
TABLE IV **E**

Holes for Radius Lead-In Bolts
Figure 8 (Sheet 3 of 6)



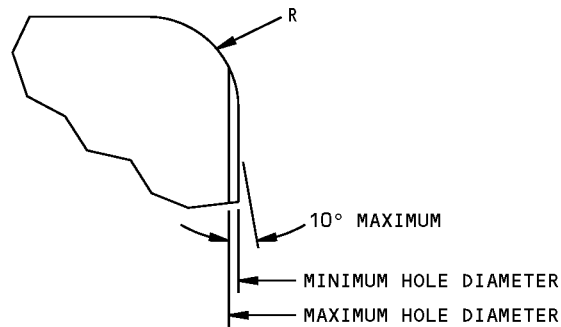
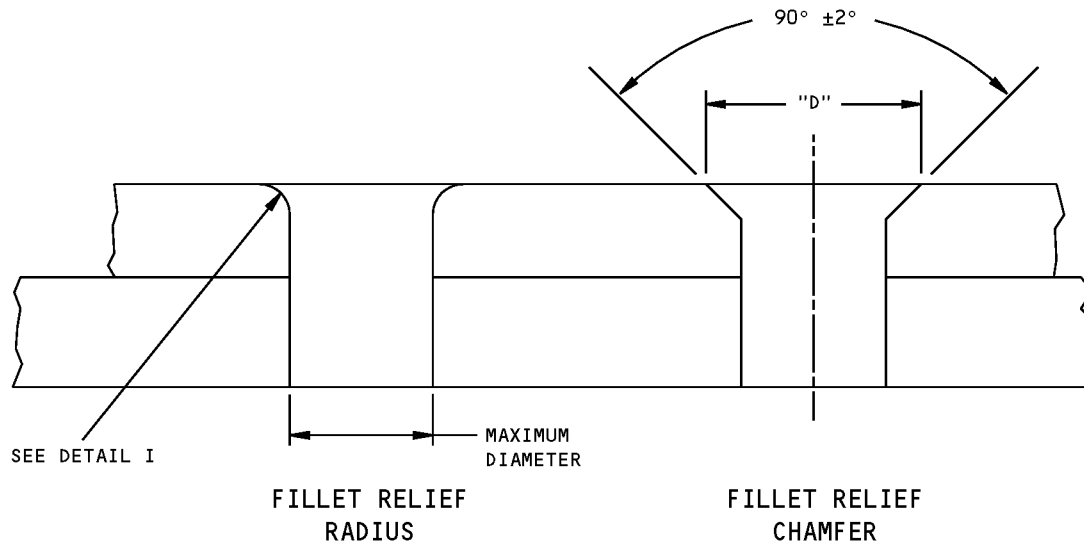
757-200
STRUCTURAL REPAIR MANUAL

BOEING STANDARD NUMBER	BOLT INTERFACE	INITIAL OVERSIZE HOLE DIAMETER		FIRST OVERSIZE HOLE DIAMETER \square		SECOND OVERSIZE HOLE DIAMETER \square	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
3	0.0005 TO 0.0035	0.1925	0.1948	0.2021	0.2044	0.2177	0.2200
	0.0010 TO 0.0035	0.1925	0.1943	0.2021	0.2039	0.2177	0.2195
	0.0010 TO 0.0040	0.1920	0.1943	0.2016	0.2039	0.2172	0.2195
	0.0020 TO 0.0050	0.1910	0.1933	0.2006	0.2029	0.2162	0.2185
4	0.0005 TO 0.0035	0.2525	0.2546	0.2621	0.2642	0.2777	0.2798
	0.0010 TO 0.0035	0.2525	0.2541	0.2621	0.2637	0.2777	0.2793
	0.0010 TO 0.0040	0.2520	0.2541	0.2616	0.2637	0.2772	0.2793
	0.0020 TO 0.0050	0.2510	0.2531	0.2606	0.2627	0.2762	0.2783
5	0.0005 TO 0.0035	0.3150	0.3171	0.3246	0.3267	0.3402	0.3423
	0.0010 TO 0.0035	0.3150	0.3166	0.3246	0.3262	0.3402	0.3418
	0.0010 TO 0.0040	0.3145	0.3166	0.3241	0.3262	0.3397	0.3418
	0.0020 TO 0.0050	0.3135	0.3156	0.3231	0.3252	0.3387	0.3408
6	0.0005 TO 0.0035	0.3775	0.3796	0.3871	0.3892	0.4027	0.4048
	0.0010 TO 0.0035	0.3775	0.3791	0.3871	0.3887	0.4027	0.4043
	0.0010 TO 0.0040	0.3770	0.3791	0.3866	0.3887	0.4022	0.4043
	0.0020 TO 0.0050	0.3760	0.3781	0.3856	0.3877	0.4012	0.4033
7	0.0005 TO 0.0035	0.4400	0.4421	0.4487	0.4517	0.4652	0.4673
	0.0010 TO 0.0035	0.4400	0.4416	0.4487	0.4512	0.4652	0.4668
	0.0010 TO 0.0040	0.4395	0.4416	0.4482	0.4512	0.4647	0.4668
	0.0020 TO 0.0050	0.4385	0.4406	0.4472	0.4502	0.4637	0.4658
8	0.0005 TO 0.0035	0.5020	0.5041	0.5107	0.5137	0.5272	0.5293
	0.0010 TO 0.0035	0.5020	0.5036	0.5107	0.5132	0.5272	0.5288
	0.0010 TO 0.0040	0.5015	0.5036	0.5102	0.5132	0.5267	0.5288
	0.0020 TO 0.0050	0.5005	0.5026	0.5092	0.5122	0.5257	0.5278

OVERSIZE HOLE DIMENSIONS FOR BACB30WQ AND BACB30WR 100 DEGREE
RADIUS LEAD-IN BOLTS IN NON COLD WORKED HOLES
TABLE V

Holes for Radius Lead-In Bolts
Figure 8 (Sheet 4 of 6)

757-200 STRUCTURAL REPAIR MANUAL



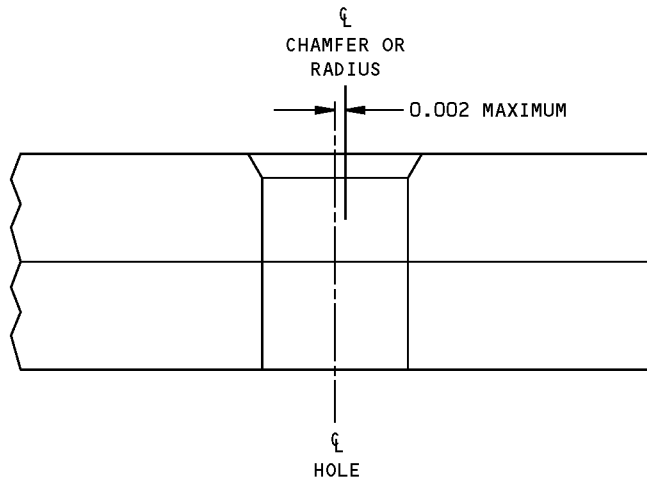
DETAIL I

NOMINAL THREAD SIZE	PROTRUDING HEAD				
	"R" RADIUS		"D" CHAMFER DIA \boxed{D}		MIN SHEET THICKNESS TO BE CHAMFERED OR RADIUS
	MIN	MAX	MIN	MAX	
0.1900-32	0.015	0.025	0.226	0.236	0.060
0.2500-28	0.015	0.025	0.286	0.296	0.060
0.3125-24	0.020	0.030	0.358	0.368	0.060
0.3750-24	0.020	0.030	0.421	0.431	0.060
0.4375-20	0.020	0.030	0.483	0.493	0.080

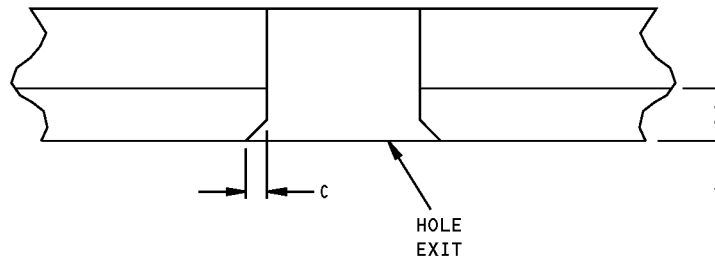
FILLET RELIEF LIMITS FOR PROTRUDING HEAD RADIUS LEAD-IN BOLT HOLES
TABLE VI

Holes for Radius Lead-In Bolts
Figure 8 (Sheet 5 of 6)

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STRUCTURAL REPAIR MANUAL



**CONCENTRICITY SPECIFICATION
DETAIL II**



THICKNESS T	RADIUS OR CHAMFER C AT HOLE EXIT
UP TO 0.091	0.005
OVER 0.091	0.010

**DEBURR SPECIFICATION
DETAIL III**

**Holes for Radius Lead-In Bolts
Figure 8 (Sheet 6 of 6)**



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STRUCTURAL REPAIR MANUAL

SUBJECT	TABLE
SOLID ALUMINUM RIVETS	I
NON-ALUMINUM RIVETS	II
BLIND RIVETS	III
SEMI-TUBULAR AND HOLLOW ENDED RIVETS	IV
BOLTS	V AND VI
LOCKBOLTS AND HEX-DRIVE FASTENERS	VII AND VIII
BLIND BOLTS	IX, X, AND XI

INDEX FOR FIGURE 9

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5063.
- HOLE DIAMETERS IN THIS FIGURE CAN BE USED UNLESS AN APPLICABLE ENGINEER DRAWING SHOWS DIFFERENTLY.
- REFER TO SRM 51-70-16 FOR MORE INFORMATION ON HOLE SPECIFICATIONS.
- HOLES AND COUNTERSINKS MUST BE 90° TO THE PART SURFACE, $\pm 2^\circ$.

A DO NOT USE ALUMINUM FASTENERS IN COMPOSITE STRUCTURE THAT HAS CARBON FIBER (GRAPHITE) MATERIAL UNLESS ALLOWED BY THE ENGINEER DRAWING. CARBON MATERIAL CAN CAUSE ALUMINUM FASTENERS TO CORRODE.

B THIS TABLE DOES NOT APPLY TO NICKEL ALLOY MS16535 RIVETS. SEE TABLE II FOR NICKEL ALLOY MS16535 RIVETS.

C INFORMATION IN THIS TABLE APPLIES TO THE BOLTS THAT FOLLOW:

- BACB30VK
- BACB30VL
- BACB30XS
- PLT1055
- PLT1058
- PLT1064
- PLT1069
- PLT1070
- PLT220
- PLT221
- PLT270
- PLT271
- MS21140
- MS21141

Fastener Hole Sizes in Composites
Figure 9 (Sheet 1 of 7)

757-200 STRUCTURAL REPAIR MANUAL

RIVET TYPE A	NOMINAL RIVET DIA (INCH)	HOLE SIZE (INCH)					
		ARAMID/EPOXY TAPE OR FABRIC		ARAMID/EPOXY WITH ALUMINUM OR FIBERGLASS WITH AND WITHOUT ALUMINUM		THERMOPLASTIC	
		MIN	MAX	MIN	MAX	MIN	MAX
BACR15CE, BACR15GF	3/32	0.098	0.103	0.098	0.103	0.098	0.103
	1/8	0.130	0.137	0.130	0.135	0.128	0.134
	5/32	0.161	0.169	0.159	0.167	0.159	0.165
	3/16	0.192	0.200	0.192	0.198	0.190	0.196
	1/4	0.255	0.261	0.255	0.261	0.255	0.261
BACR15BA, BACR15BB, BACR15FT	3/32	0.098	0.103	0.098	0.103	0.098	0.103
	1/8	0.130	0.137	0.128	0.135	0.128	0.135
	5/32	0.161	0.173	0.159	0.171	0.159	0.165
	3/16	0.193	0.204	0.191	0.202	0.191	0.202
	1/4	0.254	0.265	0.254	0.265	0.254	0.265

HOLE SIZES FOR SOLID ALUMINUM RIVETS
TABLE I

RIVET TYPE A	NOMINAL RIVET DIA (INCH)	HOLE SIZE (INCH)					
		CARBON FIBER/ EPOXY (CFRP) TAPE OR FABRIC		ARAMID/EPOXY FABRIC		ARAMID/EPOXY WITH ALUMINUM OR FIBERGLASS WITH AND WITHOUT ALUMINUM	
		MIN	MAX	MIN	MAX	MIN	MAX
MS16535 (NICKEL ALLOY, SEMI- TUBULAR)	3/32	0.091	0.095	0.093	0.098	0.091	0.095
	1/8	0.125	0.129	0.127	0.132	0.125	0.129
	5/32	0.148	0.152	0.150	0.155	0.148	0.152
	3/16	0.191	0.195	0.192	0.197	0.190	0.195
CSR903B	3/32	0.098	0.102	—	—	—	—
	1/8	0.129	0.133				
	5/32	0.159	0.163				
	3/16	0.191	0.195				

HOLE SIZES FOR NON-ALUMINUM RIVETS
TABLE II

Fastener Hole Sizes in Composites
Figure 9 (Sheet 2 of 7)



757-200
STRUCTURAL REPAIR MANUAL

RIVET TYPE	NOMINAL FASTENER DIAMETER	HOLE SIZE (INCH)	
		MINIMUM	MAXIMUM
BACR15DA, BACR15DR, BACR15GE, NAS1398, NAS1399	3/32 1/8 5/32 3/16	0.098 0.129 0.160 0.192	0.101 0.132 0.164 0.196
BACR15FR, BACR15FP,	1/8 5/32 3/16	0.143 0.176 0.205	0.146 0.180 0.209

HOLE SIZES FOR BLIND RIVETS
TABLE III

NOMINAL FASTENER DIAMETER	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
5/32	0.159	0.162
3/16	0.190	0.193
7/32	0.224	0.227

HOLE SIZES FOR SEMI-TUBULAR MS16535 **B**
AND HOLLOW-ENDED BACR15GA RIVETS
TABLE IV

Fastener Hole Sizes in Composites
Figure 9 (Sheet 3 of 7)



757-200
STRUCTURAL REPAIR MANUAL

NOMINAL FASTENER DIAMETER	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
3/32	0.114	0.117
1/8	0.140	0.143
5/32	0.164	0.167
3/16	0.190	0.193
1/4	0.250	0.253
5/16	0.312	0.315
3/8	0.375	0.378
7/16	0.437	0.440
1/2	0.500	0.503
9/16	0.562	0.565
5/8	0.625	0.628
3/4	0.750	0.753
7/8	0.875	0.878
1	1.000	1.003

HOLE SIZES FOR BOLTS (REMOVABLE FASTENERS)
TABLE V

NOMINAL FASTENER DIAMETER	FIRST OVERSIZE		SECOND OVERSIZE	
	MIN	MAX	MIN	MAX
3/32	--	--	0.140	0.143
1/8	--	--	0.164	0.167
5/32	--	--	0.190	0.193
3/16	0.203	0.206	0.219	0.222
1/4	0.266	0.269	0.281	0.284
5/16	0.328	0.331	0.344	0.347
3/8	0.390	0.394	0.406	0.409
7/16	0.453	0.456	0.468	0.471
1/2	0.516	0.519	0.531	0.534
9/16	0.578	0.581	0.593	0.596
5/8	0.641	0.644	0.656	0.659
3/4	0.766	0.769	0.781	0.784
7/8	0.891	0.894	0.906	0.909
1	1.016	1.019	1.031	1.034

HOLE SIZES (INCH) FOR OVERSIZE (REMOVABLE FASTENERS) BOLTS
TABLE VI

Fastener Hole Sizes in Composites
Figure 9 (Sheet 4 of 7)



757-200
STRUCTURAL REPAIR MANUAL

NOMINAL FASTENER DIAMETER	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
5/32	0.164	0.167
3/16	0.190	0.193
1/4	0.250	0.253
5/16	0.312	0.315
3/8	0.375	0.378
7/16	0.437	0.440
1/2	0.500	0.503
9/16	0.562	0.565
5/8	0.625	0.628
3/4	0.750	0.753

HOLE SIZES FOR LOCKBOLTS AND HEX-DRIVE FASTENERS
TABLE VII

NOMINAL FASTENER DIAMETER	FIRST OVERSIZE		SECOND OVERSIZE	
	MIN	MAX	MIN	MAX
5/32	--	--	0.190	0.193
3/16	0.203	0.206	0.218	0.221
1/4	0.265	0.268	0.281	0.284
5/16	0.328	0.331	0.343	0.346
3/8	0.390	0.393	0.406	0.409
7/16	0.453	0.456	0.468	0.471
1/2	0.515	0.518	0.531	0.534
9/16	0.577	0.580	0.593	0.596
5/8	0.640	0.643	0.655	0.658
3/4	0.765	0.768	0.780	0.783
7/8	0.890	0.893	0.905	0.908
1	1.015	1.018	1.030	1.033

OVERSIZE HOLE SIZES FOR LOCKBOLTS AND HEX-DRIVE FASTENERS
TABLE VIII

Fastener Hole Sizes in Composites
Figure 9 (Sheet 5 of 7)



757-200
STRUCTURAL REPAIR MANUAL

NOMINAL FASTENER DIAMETER	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
5/32	0.1655	0.1680
3/16	0.1995	0.2020
1/4	0.2605	0.2630
5/16	0.3125	0.3150
3/8	0.3755	0.3780

HOLE SIZES FOR BLIND BOLTS
TABLE IX

OVERSIZE REPLACEMENT FASTENER		LIMITS	INITIAL NOMINAL FASTENER DIAMETER		
			-5 (5/32)	-6 (3/16)	-8 (1/4)
			INITIAL HOLE SIZE (INCH)		
		MIN	0.1655	0.1995	0.2605
		MAX	0.1680	0.2020	0.2630
		--	HOLE SIZES FOR OVERSIZE REPLACEMENT FASTENERS		
1/64	PLT221	MIN	--	0.2160	0.2770
	PLT271	MAX	--	0.2180	0.2790
1/32	PLT1069	MIN	--	0.2310	0.2920
	PLT1055	MAX	--	0.2330	0.2940
1/32	BACB30VL	MIN	0.1995	0.2285	0.2905
	BACB30VK	MAX	0.2020	0.2310	0.2930

HOLE SIZES (INCH) FOR OVERSIZE BLIND BOLTS EXCEPT MS21140 AND MS21141
TABLE X

Fastener Hole Sizes in Composites
Figure 9 (Sheet 6 of 7)



757-200
STRUCTURAL REPAIR MANUAL

OVERSIZE REPLACEMENT FASTENER			LIMITS	INITIAL NOMINAL FASTENER DIAMETER				
				5/32	3/16	1/4	5/16	3/8
			INITIAL HOLE SIZE (INCH)					
			MIN	0.164	0.199	0.260	0.312	0.374
			MAX	0.167	0.202	0.263	0.315	0.377
			--	HOLE SIZES FOR OVERSIZE REPLACEMENT FASTENERS				
1/64	BACB30VJ()C()	OB100-EU()C()	MIN	0.180	0.215	0.276	0.328	0.390
	BACB30VJ()CD()	OB100-EU()C()CD						
	BACB30VH()C()	OBP-EU()C()	MAX	0.183	0.218	0.279	0.331	0.393
	BACB30VH()CD()	OBP-EU()C()CD						

OVERSIZE FASTENERS AND HOLE SIZES
FOR MS21140 AND MS21141 BLIND BOLTS
TABLE XI

Fastener Hole Sizes in Composites
Figure 9 (Sheet 7 of 7)



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GENERAL - FASTENER EDGE MARGINS

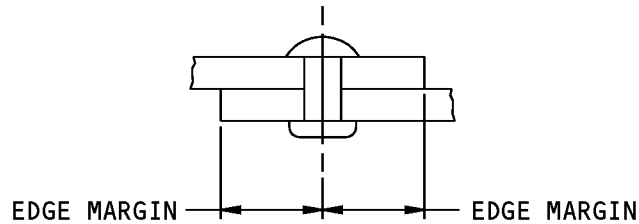
1. References

Reference	Title
51-40-05, GENERAL	Fastener Hole Sizes
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure

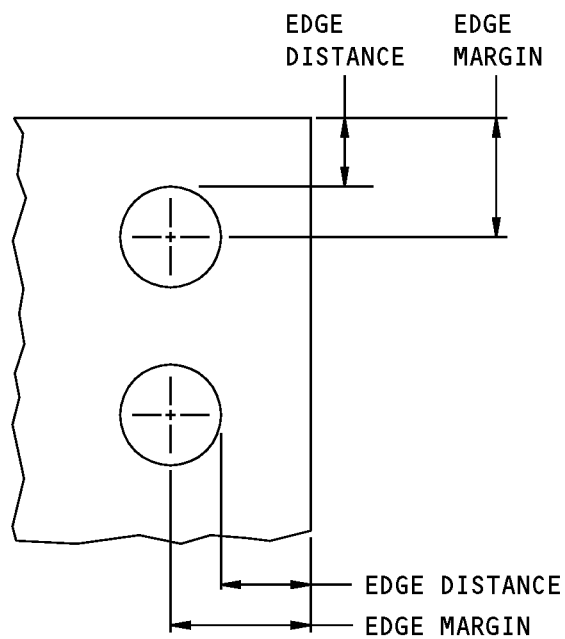
2. General

- A. Fastener edge margin as used in this manual is the distance from the center of the hole to the nearest edge of a sheet. Refer to Figure 1/GENERAL.
- B. Examples of joints in single shear and double shear are shown in Figure 2/GENERAL.
- C. Minimum fastener edge margins for metal structural applications are tabulated in Figure 3/GENERAL as follows:
 - Table I - Edge margins for aluminum alloy protruding head rivets in aluminum alloys
 - Table II - Edge margins for aluminum alloy flush head rivets in aluminum alloys.
 - Table III - Edge margins for nickel-copper alloy rivets in steel alloys
 - Table IV - Edge margins for: - Protruding head bolts and screws - Tension protruding head lockbolts and hex-drive bolts
 - Table V - Edge margins for: - 100 degree head bolts, screws, lockbolts and hex-drive bolts - Shear protruding head lockbolts and hex-drive bolts - Protruding and flush head blind fasteners.
- D. Minimum fastener edge margins for composite structural applications can be generally represented by the formula $3.0 D + 0.05$ inches where "D" is the fastener diameter.
- E. Refer to 51-40-05, GENERAL for fastener hole sizes in metal structures.
- F. Refer to 51-70-16, GENERAL for fastener hole sizes in composite structures.
- G. Edge margins for fastener diameters between those shown in the Fastener Edge Margin tables can be interpolated from the data in those tables.

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STRUCTURAL REPAIR MANUAL



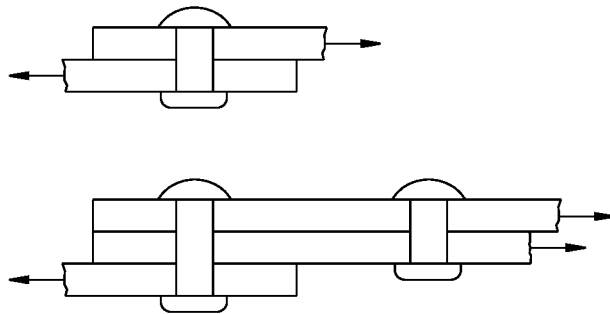
DETAIL I



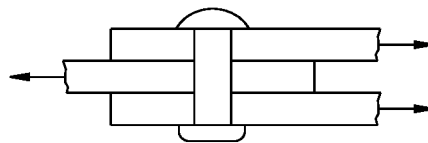
DETAIL II

Fastener Edge Margin and Edge Distance
Figure 1

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STRUCTURAL REPAIR MANUAL



SINGLE SHEAR EDGE MARGIN
DETAIL I



DOUBLE SHEAR EDGE MARGIN
DETAIL II

Joint Examples
Figure 2



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STRUCTURAL REPAIR MANUAL

HEAD STYLE		ALUMINUM ALLOY PROTRUDING HEAD RIVETS													
LOADING		SINGLE SHEAR							DOUBLE SHEAR						
RIVETED MATERIAL		RIVET DIAMETERS													
ALLOY	GAGE	3/32	1/8	5/32	3/16	1/4	5/16	3/8	3/32	1/8	5/32	3/16	1/4	5/16	3/8
ALL ALUMINUM ALLOYS EXCEPT CASTINGS		EDGE MARGIN (± 0.05)													
	0.012	0.21							0.21	0.27	0.32				
	0.016	0.21	0.27						0.21	0.27	0.32				
	0.018	0.21	0.27						0.21	0.27	0.32				
	0.020	0.21	0.27	0.32					0.21	0.27	0.32				
	0.022	0.21	0.27	0.32					0.21	0.27	0.32				
	0.025	0.21	0.27	0.32					0.21	0.27	0.32				
	0.028	0.21	0.27	0.32					0.21	0.27	0.32				
	0.032	0.20	0.27	0.32	0.37				0.21	0.27	0.32				
	0.036	0.19	0.26	0.32	0.37				0.21	0.27	0.32				
	0.040	0.18	0.26	0.32	0.37	0.48			0.21	0.27	0.32	0.37	0.48		
	0.045	0.17	0.24	0.32	0.37	0.48			0.21	0.27	0.32	0.37	0.48		
	0.050	0.17	0.23	0.32	0.37	0.48	0.58		0.21	0.27	0.32	0.37	0.48		
	0.056	0.17	0.22	0.29	0.37	0.48	0.58		0.21	0.27	0.32	0.37	0.48	0.58	
	0.063	0.17	0.21	0.28	0.36	0.48	0.58	0.69	0.20	0.27	0.32	0.37	0.48	0.58	0.69
	0.071		0.21	0.26	0.33	0.48	0.58	0.69		0.27	0.32	0.37	0.48	0.58	0.69
	0.080		0.21	0.25	0.31	0.47	0.58	0.69		0.26	0.32	0.37	0.48	0.58	0.69
	0.090		0.21	0.25	0.29	0.44	0.58	0.69		0.25	0.32	0.37	0.48	0.58	0.69
	0.100		0.21	0.25	0.29	0.41	0.58	0.69		0.23	0.31	0.37	0.48	0.58	0.69
	0.112			0.25	0.29	0.39	0.54	0.69			0.29	0.37	0.48	0.58	0.69
	0.125			0.25	0.29	0.37	0.50	0.67			0.28	0.36	0.48	0.58	0.69
	0.140			0.25	0.29	0.37	0.47	0.62			0.26	0.33	0.48	0.58	0.69
	0.160			0.25	0.29	0.37	0.46	0.57			0.24	0.31	0.47	0.58	0.69
	0.180				0.29	0.37	0.46	0.54				0.29	0.44	0.58	0.69
	0.190				0.29	0.37	0.46	0.54				0.29	0.43	0.58	0.69
	0.200				0.29	0.37	0.46	0.54				0.29	0.41	0.58	0.69
	0.224				0.29	0.37	0.46	0.54				0.29	0.39	0.54	0.68
	0.250				0.29	0.37	0.46	0.54				0.29	0.37	0.50	0.67
ADD FOR CASTINGS		0.10			0.20			0.30	0.10			0.20			0.30

TABLE I

Fastener Edge Margins
Figure 3 (Sheet 1 of 4)

51-40-06

GENERAL
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STRUCTURAL REPAIR MANUAL

HEAD STYLE		100° HEAD AND 120° MODIFIED HEAD				
LOADING		SINGLE SHEAR				
RIVETED MATERIAL		ALUMINUM RIVET DIAMETER				
ALLOY	GAGE	1/8	5/32	3/16	1/4	5/16
ALUMINUM ALLOY EXCEPT CASTINGS	ALL	EDGE MARGIN (± 0.05)				
		0.31	0.37	0.43	0.55	0.67
ADD FOR CASTINGS		0.10		0.20		

TABLE II

HEAD STYLE		PROTRUDING HEAD					100° HEAD		
LOADING		SINGLE SHEAR							
RIVETED MATERIAL		NICKEL-COPPER RIVET DIAMETERS							
ALLOY	GAGE	3/32	1/8	5/32	3/16	1/4	1/8	5/32	3/16
CORROSION RESISTANT STEEL SHEET, AISI 301 AND 302 ALSO ALLOY STEEL HT TO 100,000 PSI OR GREATER		EDGE MARGINS (± 0.05)							
	0.010	0.20	0.25	0.30	0.35	0.45			
	0.012	0.20	0.25	0.30	0.35	0.45			
	0.016	0.20	0.25	0.30	0.35	0.45			
	0.018	0.20	0.25	0.30	0.35	0.45			
	0.020	0.20	0.25	0.30	0.35	0.45	0.31		
	0.022	0.18	0.25	0.30	0.35	0.45	0.31		
	0.025	0.18	0.25	0.30	0.35	0.45	0.31	0.37	
	0.028	0.18	0.24	0.30	0.35	0.45	0.31	0.37	
	0.032	0.18	0.23	0.30	0.35	0.45	0.31	0.37	0.43
	0.036	0.18	0.23	0.29	0.35	0.45	0.31	0.37	0.43
	0.040	0.18	0.23	0.28	0.35	0.45	0.31	0.37	0.43
	0.045	0.18	0.23	0.27	0.35	0.45	0.31	0.37	0.43
	0.050	0.17	0.23	0.27	0.32	0.45	0.31	0.37	0.43
	0.056	0.17	0.22	0.27	0.32	0.41	0.31	0.37	0.43
	0.063	0.17	0.21	0.27	0.32	0.41	0.31	0.37	0.43
	0.071	0.17	0.21	0.27	0.32	0.41	0.31	0.37	0.43
	0.080	0.17	0.21	0.25	0.32	0.40	0.31	0.37	0.43
	0.090		0.21	0.25	0.29	0.40	0.31	0.37	0.43
	0.100			0.25	0.29	0.40	0.31	0.37	0.43
	0.112			0.25	0.29	0.39	0.31	0.37	0.43
	0.125				0.29	0.37	0.31	0.37	0.43

TABLE III

Fastener Edge Margins
Figure 3 (Sheet 2 of 4)



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STRUCTURAL REPAIR MANUAL

HEAD STYLE		PROTRUDING HEAD (BOLTS AND SCREWS) TENSION PROTRUDING HEAD (LOCKBOLTS AND HEX-DRIVE BOLTS)							
LOADING		SINGLE SHEAR							
BOLTED MATERIAL		BOLT DIAMETERS							
ALLOY	GAGE	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
ALUMINUM		EDGE MARGIN (± 0.05)							
	0.032	0.37	0.49						
	0.036	0.37	0.49						
	0.040	0.37	0.49						
	0.045	0.37	0.49						
	0.050	0.37	0.49	0.59					
	0.056	0.37	0.49	0.59					
	0.063	0.37	0.49	0.59	0.69				
	0.071	0.37	0.49	0.59	0.69				
	0.080	0.37	0.49	0.59	0.69	0.79			
	0.090	0.37	0.49	0.59	0.69	0.79	0.90		
	0.100	0.37	0.49	0.59	0.69	0.79	0.90	1.01	
	0.112	0.37	0.49	0.59	0.69	0.79	0.90	1.01	
	0.125	0.37	0.49	0.59	0.69	0.79	0.90	1.01	1.11
	0.140	0.37	0.49	0.59	0.69	0.79	0.90	1.01	1.11
	0.160	0.37	0.49	0.59	0.69	0.79	0.90	1.01	1.11
	0.180	0.35	0.49	0.59	0.69	0.79	0.90	1.01	1.11
	0.190	0.34	0.49	0.59	0.69	0.79	0.90	1.01	1.11
	0.200	0.33	0.49	0.59	0.69	0.79	0.90	1.01	1.11
	0.224	0.31	0.46	0.59	0.69	0.79	0.90	1.01	1.11
	0.250	0.29	0.43	0.58	0.69	0.79	0.90	1.01	1.11
	0.313	0.29	0.38	0.53	0.69	0.79	0.90	1.01	1.11
	0.375	0.29	0.37	0.48	0.63	0.79	0.90	1.01	1.11
	0.500	0.29	0.37	0.46	0.54	0.67	0.82	0.99	1.11
	0.625	0.29	0.37	0.46	0.54	0.62	0.72	0.86	1.01
	0.750	0.29	0.37	0.46	0.54	0.62	0.70	0.78	0.90

TABLE IV

Fastener Edge Margins
Figure 3 (Sheet 3 of 4)



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STRUCTURAL REPAIR MANUAL

HEAD STYLE		100 DEGREE HEAD (BOLTS, SCREWS, LOCKBOLTS AND HEX-DRIVE BOLTS) SHEAR PROTRUDING HEAD (LOCKBOLTS AND HEX-DRIVE BOLTS) PROTRUDING AND FLUSH HEAD BLIND FASTENERS									
LOADING		SINGLE SHEAR									
BOLTED MATERIAL		BOLT DIAMETERS									
ALLOY	GAGE	1/8	5/32	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
ALL ALUMINUM ALLOYS, CORROSION RESISTANT STEELS AND TITANIUM		EDGE MARGINS (± 0.05)									
	0.032	0.30	0.36								
	0.036	0.30	0.36								
	0.040	0.30	0.36								
	0.045	0.30	0.36								
	0.050	0.30	0.36	0.43	0.57						
	0.056	0.30	0.36	0.43	0.57						
	0.063	0.30	0.36	0.43	0.57	0.70	0.84	0.97	1.12		
	0.071	0.30	0.36	0.43	0.56	0.70	0.84	0.97	1.11	1.25	1.39
	0.080	0.30	0.36	0.43	0.56	0.69	0.83	0.96	1.11	1.25	1.39
	0.090	0.30	0.36	0.43	0.55	0.68	0.83	0.96	1.10	1.24	1.38
	0.100	0.30	0.36	0.43	0.55	0.68	0.82	0.95	1.09	1.24	1.38
	0.112	0.30	0.36	0.43	0.55	0.68	0.82	0.95	1.09	1.23	1.37
	0.125	0.30	0.36	0.43	0.55	0.68	0.81	0.94	1.08	1.22	1.36
	0.140	0.30	0.36	0.43	0.55	0.68	0.80	0.93	1.06	1.20	1.36
	0.160	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.06	1.20	1.35
	0.180	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.19	1.33
	0.190	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.18	1.32
	0.200	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.18	1.31
	0.224	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.17	1.30
	0.250	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.17	1.30
	0.313	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.17	1.30
	0.375	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.17	1.30
	0.500	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.17	1.30
	0.625	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.17	1.30
	0.750	0.30	0.36	0.43	0.55	0.68	0.80	0.92	1.05	1.17	1.30

TABLE V

Fastener Edge Margins
Figure 3 (Sheet 4 of 4)



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GENERAL - STRENGTH OF FASTENERS

1. References

Reference	Title
51-40-05, GENERAL	Fastener Hole Sizes
51-40-06, GENERAL	Fastener Edge Margins

2. General

- A. The fastener strength values given in this subject will not be more than the bearing strength of the material in which the fasteners are installed. Thus, if the material will fail in bearing before fastener failure, the lower value will be shown as the strength of the fasteners.
- B. The fastener strength values assume that the correct holes sizes have been used (Ref: 51-40-05, GENERAL) and that edge margin requirements have been met (Ref: 51-40-06, GENERAL).
- C. The fastener substitution factors for the MS20470D/BACR15BB()D rivets and the MS20426D/BACR15BA()D rivets are given in Figure 12/GENERAL and Figure 13/GENERAL.
- (1) The quantity of substitute rivets is calculated by multiplying the initial fastener data by the quantity factor given in the applicable fastener table.
 - (2) Make sure that you have sufficient edge margin if you use an alternative rivet that has a larger diameter than the initial rivet.
 - (3) In areas where there is minimum edge margins, then you must refer to 51-40-06.
 - (4) Use the riveted material gage that gives the highest multiplication factor when you look for fastener substitutions in Figure 12/GENERAL and Figure 13/GENERAL.

NOTE: The substitution tables given in Figure 12/GENERAL and Figure 13/GENERAL do not apply to these areas on the airplane.

- Skin, stringers and circumferential frames in the airplane fuselage
- Wing interspar skins and stiffeners, or any other areas where pressure or fuel tank sealing is specified
- Wing leading edge skins
- Vertical and horizontal stabilizer interspar skins
- Interspar skins on the trailing edge flaps
- Horizontal and vertical stabilizer leading edge skin

If they are permitted, alternative fasteners that are necessary for repairs in the above areas can be found in the applicable SRM repair.

- D. Refer to the table that follows, for fastener strength data.



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Table 1: Fastener Index

FASTENER		SHEET OR PLATE MATERIAL	LOCATION	
TYPE	PART NUMBER		FIGURE	TABLE
RIVET, UNIVERSAL HEAD, AL	*[1]	2024-T3, -T351	1	I
		2024-T4	2	I
		2024-T42	2	I
		2024-T42 TUBE	2	I
		7075-T6	3	I
		7075-T6, -T6510, -T6511 EXTRUSIONS	3	I
RIVET, FLUSH HEAD, AL	*[1]	2024-T3	4	I
		2024-T42	4	I
		7075-T6	4	I
RIVET, UNIVERSAL HEAD, MONEL	MS20615M	301-1/4 HARD CRES	5	I
RIVET, 100° FLUSH HEAD, MONEL	MS20427M	301-1/4 HARD - CRES 301-1/2 HARD - CRES 301-FULL HARD - CRES 302-ANNEALED - CRES	5	I
RIVET, BLIND, UNIVERSAL HEAD, 5056 AL SLEEVE	NAS1398B	2024-T3	6	I
RIVET, BLIND, UNIVERSAL HEAD, 2017 AL SLEEVE	NAS1398D	2024-T3	6	I
RIVET, BLIND, 100° FLUSH HEAD, 5056 AL SLEEVE	NAS1399B	2024-T3	6	I
RIVET, BLIND, 100° FLUSH HEAD, 2017 AL SLEEVE	NAS1399D	2024-T3	6	I
RIVET, BLIND, UNIVERSAL HEAD	NAS1738 B AND E BACR15FR B AND E	2024-T3 7075-T6	6	II
RIVET, BLIND, 100° FLUSH HEAD	NAS1739 B AND E BACR15FR B AND E	2024-T3 7075-T6	6	II
BOLT, BLIND, UNIVERSAL HEAD	MS90353	2024-T3	7	I
		7075-T6	7	II
BOLT, BLIND, 100° FLUSH HEAD	MS90354	2024-T3	7	I
		7075-T6	7	II
PROTRUDING HEAD BOLTS, LOCKBOLTS, HEX-DRIVE BOLTS	*[1]	2024-T3	8	I
		2024-T42 2024-T4 2024-T42 TUBE	8	II
		7075-T6 7075-T6,-T6510,-6511 EXTRUSIONS	8	III
TENSION FLUSH HEAD BOLTS, LOCKBOLTS, HEX-DRIVE BOLTS	*[1]	2024-T3	9	I
		7075-T6	9	II



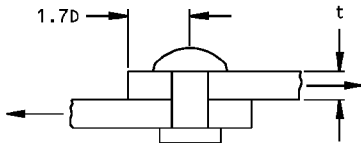
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STRUCTURAL REPAIR MANUAL

Table 1: Fastener Index (Continued)

FASTENER		SHEET OR PLATE MATERIAL	LOCATION	
SHEAR FLUSH HEAD BOLTS, SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS, AND HEX- DRIVE BOLTS	†[1]		2024-T3	10
		I&II		
7075-T6	10	III & IV		
70° HEAD RADIUS LEAD-IN BOLTS	BACB30PT	7075-T6	11	I
FASTENER SUBSTITUTION FOR MS20470D AND BACR15BB()D UNIVERSAL HEAD RIVETS			12	
FASTENER SUBSTITUTION FOR MS20426D AND BACR15BA()D RIVETS IN COUNTERSUNK HOLES			13	

*[1] Refer to the applicable Table for the part Numbers

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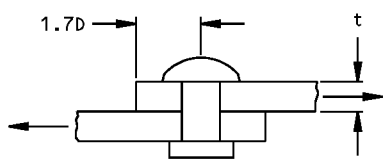
JOINT DESCRIPTION									
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS								
SHEET MATERIAL	CLAD OR BARE 2024-T3 ALUMINUM ALLOY								
									
PART NUMBERS	MS20470() AD, BACR15BB() AD, BACR15DN() AD, BACR15FT() AD								
MATERIAL	2117-T3								
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750		
SINGLE SHEAR STRENGTH - LBS	207	369	575	830	1470	2290	3300		
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS <table><tr><td>A</td><td>B</td></tr></table>							A	B
A	B								
0.018	164								
0.020	182								
0.022	196								
0.025	201							303	
0.028	204	339	485	655					
0.032	207	356							
0.036		362						545	725
0.040		367						555	790
0.045		369	565	805	1210	1990			
0.050			570	820	1360				
0.056			575	830	1410				
0.063					1440			2160	2690
0.071					1460	2210	3030		
0.080					1470	2250	3140		
0.090						2280	3210		
0.100						2290	3250		
0.112							3300		
0.125									

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD
OR BARE 2024-T3 SHEET AND -T351 PLATE

TABLE I

Strength of Solid Rivets
Figure 1 (Sheet 1 of 7)

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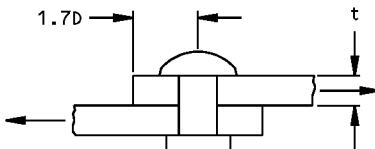
JOINT DESCRIPTION						
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS					
SHEET MATERIAL	CLAD OR BARE 2024-T3 ALUMINUM ALLOY SHEET A					
<div></div>						
PART NUMBERS	MS20470() D , BACR15BB() D , BACR15DN() D , BACR15FT() D					
MATERIAL	2017-T3					
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
SINGLE SHEAR STRENGTH - LBS	467	730	1050	1870	2910	4180
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS A B					
0.018	303					
0.020						
0.022						
0.025						
0.028	339	485				
0.032	388					
0.036	436					
0.040	465					
0.045	467	710	655			
0.050						
0.056						
0.063						
0.071		730	910	1210		
0.080						
0.090						
0.100						
0.112		1050	1020	1360	1990	2690
0.125						
		1050	820	1590	2240	3030
		1870	1020	1790	2520	3410
		1870	1050	1860	2840	3790
		2900	1870	2910	2910	4120
		2910	1870	2910	2910	4180

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD
OR BARE 2024-T3 SHEET AND -T351 PLATE

TABLE I

Strength of Solid Rivets
Figure 1 (Sheet 2 of 7)

757-200 STRUCTURAL REPAIR MANUAL

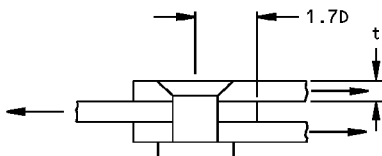
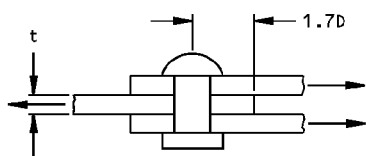
JOINT DESCRIPTION						
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS					
SHEET MATERIAL	CLAD OR BARE 2024-T3 ALUMINUM ALLOY SHEET					
<div></div>						
PART NUMBERS	MS20470() DD, BACR15BB() DD, BACR15FT() KE, BACR15FT() DD					
MATERIAL	2024-T3 AND 7050-T73					
DIAMETER	0.1562	0.1875	0.2500	0.3125	0.3750	
SINGLE SHEAR STRENGTH - LBS	785	1130	2010	3140	4530	
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B C					
0.018	485					
0.020						
0.025						
0.028						
0.032						
0.036		545	655	1210		
0.040		605	725			
0.045		680	820			
0.050		760	910			
0.056		785	1020			
0.063		1130	1590	1990		
0.071			1790	2240		2690
0.080			2000	2520		3030
0.090			2010	2840		3410
0.100				3120		3790
0.112				3140		4240
0.125						4530

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD
OR BARE 2024-T3 SHEET AND -T351 PLATE

TABLE I

Strength of Solid Rivets
Figure 1 (Sheet 3 of 7)

757-200 STRUCTURAL REPAIR MANUAL

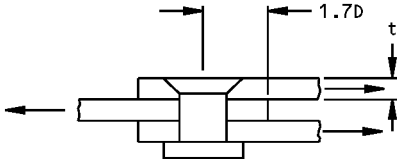
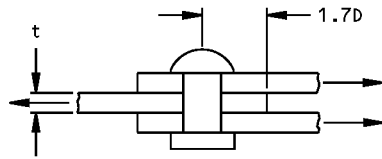
JOINT DESCRIPTION										
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVETS									
SHEET MATERIAL	CLAD OR BARE 2024-T3 SHEET AND -T351 PLATE ALUMINUM ALLOY									
<div></div>										
PART NUMBERS	MS20426() ^{AD} , MS20470() ^{AD} , BACR15BA() ^{AD} , BACR15BB() ^{AD} , BACR15BC() ^{AD} , BACR15BD() ^{AD} , BACR15CE() ^{AD} , BACR15DN() ^{AD} , BACR15DR() ^{AD} , BACR15FH() ^{AD} , BACR15FT() ^{AD}									
MATERIAL	2117-T3									
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750			
DOUBLE SHEAR STRENGTH - LBS	414	750	1150	1660	2940	4580	6600			
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS <table><tr><td>B</td><td>C</td><td>D</td></tr></table>							B	C	D
B	C	D								
0.018	164									
0.020	182									
0.025	227	303								
0.028	255	339								
0.032	291	388	485							
0.036	328	436	545	655						
0.040	364	485	605	725						
0.045	383	545	680	820						
0.050	394	605	760	910	1210					
0.056	404	670	850	1020	1360					
0.063	414	690	995	1190	1590	1990				
0.071		715	1050	1340	1790	2240	2690			
0.080		730	1080	1480	2020	2520	3030			
0.090		740	1110	1530	2270	2840	3410			
0.100			1140	1580	2520	3160	3790			
0.112			1150	1620	2660	3530	4240			
0.125				1660	2750	3950	4730			
0.160					2920	4310	5900			
0.190					2940	4490	6200			
0.250						4580	6600			
0.312										

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD
OR BARE 2024-T3 SHEET AND -T351 PLATE

TABLE I

Strength of Solid Rivets
Figure 1 (Sheet 4 of 7)

757-200 STRUCTURAL REPAIR MANUAL

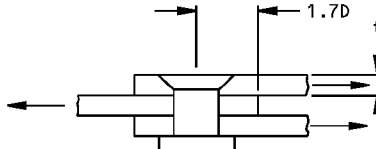
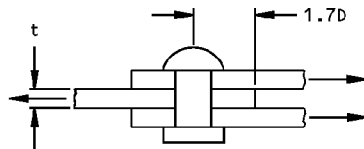
JOINT DESCRIPTION						
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVETS					
SHEET MATERIAL	CLAD OR BARE 2024-T3 SHEET AND -T351 PLATE ALUMINUM ALLOY					
<div></div>						
PART NUMBERS	MS20426() MS20470() BACR15BA() BACR15BB() BACR15CE() BACR15DN() BACR15DP() BACR15FT() BACR15GF()					
MATERIAL	2017-T3					
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
DOUBLE SHEAR STRENGTH - LBS	935	1460	2100	3740	5800	8350
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS B C D					
0.018						
0.020						
0.025	303					
0.028	339					
0.032	388	485				
0.036	436	545	655			
0.040	485	605	725			
0.045	545	680	820			
0.050	605	760	910	1210		
0.056	680	850	1020	1360		
0.063	795	995	1190	1590	1990	
0.071	895	1120	1340	1790	2240	2690
0.080	925	1260	1510	2020	2520	3030
0.090	935	1410	1700	2270	2840	3410
0.100		1450	1890	2520	3160	3790
0.112		1460	2050	2830	3530	4240
0.125			2100	3160	3950	4730
0.160				3710	5100	6100
0.190				3740	5700	7250
0.250					5800	8350
0.312						

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD
OR BARE 2024-T3 SHEET AND -T351 PLATE

TABLE I

Strength of Solid Rivets
Figure 1 (Sheet 5 of 7)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVTES										
SHEET MATERIAL	CLAD OR BARE 2024-T3 SHEET AND -T351 PLATE ALUMINUM ALLOY										
<div></div>											
PART NUMBERS	MS20426() DD , MS20470() DD , BACR15BA() DD , BACR15BB() DD , BACR15BD() DD , BACR15BD() KE , BACR15FH() DD , BACR15FH() KE , BACR15FT() DD , BACR15FT() KE , BACR15FV() KE , BACR15GG() KE , BACR15GH() KE										
MATERIAL	2024-T3 AND 7050-T73										
DIAMETER	0.1250	0.1562	0.1875	0.2188	0.2500	0.2813	0.3125	0.3750			
DOUBLE SHEAR STRENGTH - LBS	1010	1570	2260	3080	4020	5100	6300	9050			
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS <table><tr><td>B</td><td>C</td><td>D</td></tr></table>								B	C	D
B	C	D									
0.018											
0.020											
0.025	303										
0.028	339										
0.032	388	485									
0.036	436	545	665								
0.040	485	605	725	850							
0.045	545	680	820	955							
0.050	605	760	910	1060	1210						
0.056	680	850	1020	1190	1360	1530					
0.063	795	995	1190	1390	1590	1790	1990				
0.071	895	1120	1340	1570	1790	2020	2240	2690			
0.080	1000	1260	1510	1770	2020	2270	2520	3030			
0.090	1010	1420	1700	1990	2270	2560	2840	3410			
0.100		1560	1890	2210	2520	2840	3160	3790			
0.112		1570	2120	2480	2830	3180	3530	4240			
0.125			2260	2760	3160	3550	3950	4730			
0.160				3080	3990	4590	5100	6100			
0.190					4020	5100	6050	7250			
0.250							6300	8900			
0.312								9050			

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD
OR BARE 2024-T3 SHEET AND -T351 PLATE

TABLE I

Strength of Solid Rivets
Figure 1 (Sheet 6 of 7)

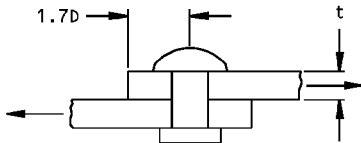
757-200
STRUCTURAL REPAIR MANUAL

NOTES

- A** BASED ON F_{bru} (at $e/D = 1.7$) OF 97 KSI FOR 0.018-0.062 GAGES, AND 101 KSI FOR 0.063-0.128 GAGES. IN DETERMINING THE ALLOWABLES, SHEAR REDUCTION FACTORS HAVE BEEN APPLIED TO RIVET SHEAR STRENGTH VALUES TO COMPENSATE FOR HIGH BEARING STRESSES ON THE RIVET AT t/D VALUES LESS THAN 0.33.
- B** VALUES BELOW THE HEAVY LINE ARE RIVET SHEAR STRENGTH CRITICAL.
- C** BASED ON F_{bru} (at $e/D = 1.7$) OF 97 KSI FOR 0.018-0.062 GAGES, AND 101 KSI FOR 0.063-0.128 GAGES, 102 KSI FOR 0.129-0.249 GAGES, AND 95 KSI FOR 0.250-0.499 GAGES. IN DETERMINING THE ALLOWABLES, SHEAR REDUCTION FACTORS HAVE BEEN APPLIED TO RIVET SHEAR STRENGTH VALUES TO COMPENSATE FOR HIGH BEARING STRESSES ON THE RIVET AT t/D VALUES LESS THAN 0.67.
- D** DESIGNER MUST NOTE THAT SOME OF THESE VALUES ARE FOR KNIFE-EDGE CONDITION, AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY. SEE THE APPLICABLE PARTS STANDARD FOR HEAD HEIGHT OF FLUSH HEAD FASTENERS. (HEAD HEIGHT $\geq t$)

Strength of Solid Rivets
Figure 1 (Sheet 7 of 7)

757-200 STRUCTURAL REPAIR MANUAL

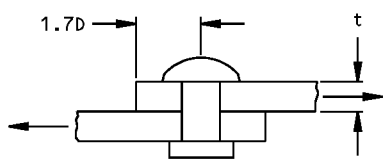
JOINT DESCRIPTION							
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS						
SHEET MATERIAL	CLAD OR BARE 2024-T42 ALUMINUM ALLOY SHEET A						
<div></div>							
PART NUMBERS	MS20470()AD, BACR15BB()AD, BACR15DN()AD, BACR15FT()AD						
MATERIAL	2117-T3						
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
SINGLE SHEAR STRENGTH - LBS	207	369	575	830	1470	2290	3300
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B C						
0.018	165*						
0.020	184*						
0.025	201	306*					
0.028	204	343*					
0.032	207	356*	490*				
0.036		362*	545*	660*			
0.040		367	555*	735*			
0.045		369	565*	790*			
0.050			570	805*	1220*		
0.056			575	820*	1370*		
0.063				830	1410*	2030*	
0.071					1440	2160*	2740*
0.080					1460	2210*	3080*
0.090					1470	2250	3140*
0.100						2280	3210
0.112						2290	3250
0.125							3300

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET,
CLAD OR BARE 2024-T42 SHEET, 2024-T42 TUBE
TABLE I

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

Strength of Solid Rivets Figure 2 (Sheet 1 of 7)

757-200 STRUCTURAL REPAIR MANUAL

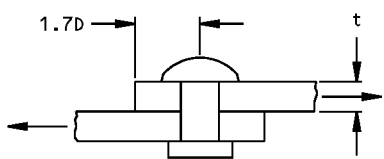
JOINT DESCRIPTION						
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS					
SHEET MATERIAL	CLAD OR BARE 2024-T42 ALUMINUM ALLOY SHEET A					
<div></div>						
PART NUMBERS	MS20470() D , BACR15BB() D , BACR15DN() D , BACR15FT() D					
MATERIAL	2017-T3					
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
SINGLE SHEAR STRENGTH - LBS	467	730	1050	1870	2910	4180
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B C					
0.018	<div>306*</div> <div>343*</div> <div>392*</div> <div>441*</div> <div>465*</div> <div>467*</div> <td rowspan="17"><div>490*</div><div>550*</div><div>610*</div><div>690*</div><div>725*</div><div>730*</div></td> <td rowspan="17"><div>660*</div><div>735*</div><div>825*</div><div>920*</div><div>1030*</div><div>1050*</div></td> <td rowspan="17"><div>1220*</div><div>1370*</div><div>1620*</div><div>1830*</div><div>1860*</div><div>1870</div></td> <td rowspan="17"><div>2030*</div><div>2290*</div><div>2570*</div><div>2850*</div><div>2900*</div><div>2910</div></td> <td rowspan="17"><div>2740*</div><div>3090*</div><div>3480*</div><div>3860*</div><div>4120*</div><div>4180*</div></td>	<div>490*</div> <div>550*</div> <div>610*</div> <div>690*</div> <div>725*</div> <div>730*</div>	<div>660*</div> <div>735*</div> <div>825*</div> <div>920*</div> <div>1030*</div> <div>1050*</div>	<div>1220*</div> <div>1370*</div> <div>1620*</div> <div>1830*</div> <div>1860*</div> <div>1870</div>	<div>2030*</div> <div>2290*</div> <div>2570*</div> <div>2850*</div> <div>2900*</div> <div>2910</div>	<div>2740*</div> <div>3090*</div> <div>3480*</div> <div>3860*</div> <div>4120*</div> <div>4180*</div>
0.020						
0.025						
0.028						
0.032						
0.036						
0.040						
0.045						
0.050						
0.056						
0.063						
0.071						
0.080						
0.090						
0.100						
0.112						
0.125						

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET,
CLAD OR BARE 2024-T42 SHEET, 2024-T42 TUBE
TABLE I (CONTINUED)

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

**Strength of Solid Rivets
Figure 2 (Sheet 2 of 7)**

757-200 STRUCTURAL REPAIR MANUAL

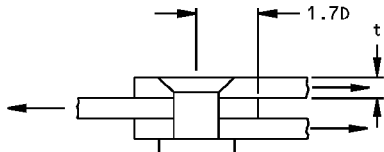
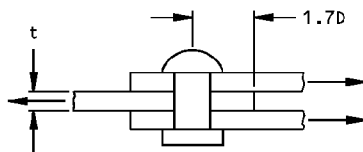
JOINT DESCRIPTION					
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS				
SHEET MATERIAL	CLAD OR BARE 2024-T42 ALUMINUM ALLOY SHEET A				
<div></div>					
PART NUMBERS	MS20470()DD, BACR15BB()DD, BACR15FT()KE, BACR15FT()DD				
MATERIAL	2024-T3 AND 7050-T73				
DIAMETER	0.1562	0.1875	0.2500	0.3125	0.3750
SINGLE SHEAR STRENGTH - LBS	785	1130	2010	3140	4530
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B C				
0.018					
0.020					
0.025					
0.028					
0.032	490*				
0.036	550*	660*			
0.040	610*	735*			
0.045	690*	825*			
0.050	765*	920*	1220*		
0.056	785	1030	1370*		
0.063		1130	1620*	2030*	
0.071			1830*	2290*	2740*
0.080			2000*	2570*	3090*
0.090			2010*	2900*	3480*
0.100				3120*	3860*
0.112				3140*	4330*
0.125					4530

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET,
CLAD OR BARE 2024-T42 SHEET, 2024-T42 TUBE
TABLE I (CONTINUED)

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

Strength of Solid Rivets Figure 2 (Sheet 3 of 7)

757-200 STRUCTURAL REPAIR MANUAL

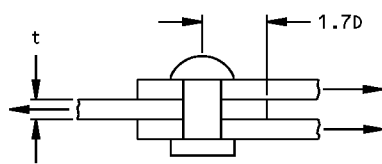
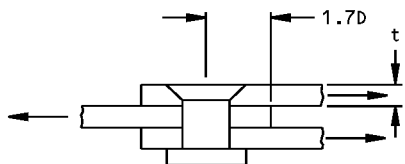
JOINT DESCRIPTION								
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVETS							
SHEET MATERIAL	CLAD OR BARE 2024-T42 ALUMINUM ALLOY SHEET A							
<div></div>								
PART NUMBERS	MS20426() AD , MS20470() AD , BACR15BA() AD , BACR15BB() AD , BACR15BC() AD , BACR15BD() AD , BACR15CE() AD , BACR15DN() AD , BACR15DP() AD , BACR15FH() AD , BACR15FT() AD							
MATERIAL	2117-T3							
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750	
DOUBLE SHEAR STRENGTH - LBS	414	740	1150	1660	2940	4580	6600	
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS C D E							
0.018	165*							
0.020	184*							
0.025	230*							
0.028	257*							
0.032	294*	306*	343*	490*				
0.036	331*	441*	550*	660*				
0.040	368*	490*	610*	735*				
0.045	383*	550*	690*	825*				
0.050	394*	610*	765*	920*	1220*			
0.056	404	670*	855*	1030*	1370*			
0.063	414	690*	1000*	1220*	1620*			2030*
0.071		715	1050*	1370*	1830*			2290*
0.080		730	1080*	1480*	2060*	2570*	3090*	
0.090		740	1110	1530*	2320*	2900*	3480*	
0.100			1140	1580*	2560*	3220*	3860*	
0.112			1150	1620	2660*	3600*	4330*	
0.125				1660	2750*	3980*	4830*	
0.160					2920	4310*	5900*	
0.190					2940	4490	6200*	
0.250						4580	6600	

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET,
CLAD OR BARE 2024-T42 SHEET, 2024-T42 TUBE
TABLE I (CONTINUED)

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

Strength of Solid Rivets
Figure 2 (Sheet 4 of 7)

757-200 STRUCTURAL REPAIR MANUAL

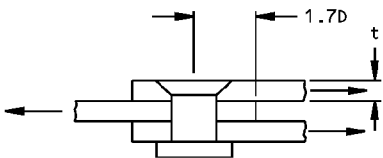
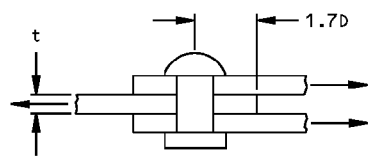
JOINT DESCRIPTION						
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVETS					
SHEET MATERIAL	CLAD OR BARE 2024-T42 ALUMINUM ALLOY SHEET A					
<div><div></div><div></div></div>						
PART NUMBERS	MS20426() D , MS20470() D , BACR15BA() D , BACR15BB() D , BACR15CE() D , BACR15DN() D , BACR15DP() D , BACR15FT() D , BACR15GF() D					
MATERIAL	2017-T3					
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
DOUBLE SHEAR STRENGTH - LBS	935	1460	2100	3740	5800	8350
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS C D E					
0.018						
0.020						
0.025	306*					
0.028	343*					
0.032	392*	490*				
0.036	441*	550*	660*			
0.040	490*	610*	735*			
0.045	550*	690*	825*			
0.050	610*	765*	920*	1220*		
0.056	685*	855*	1030*	1370*		
0.063	810*	1010*	1220*	1620*	2030*	
0.071	900*	1140*	1370*	1830*	2290*	2740*
0.080	925*	1290*	1540*	2060*	2570*	3090*
0.090	935*	1410*	1740*	2320*	2900*	3480*
0.100		1450*	1930*	2570*	3220*	3860*
0.112		1460	2050*	2880*	3600*	4330*
0.125			2100*	3220*	4020*	4830*
0.160				3710*	5150*	6200*
0.190				3740*	5700*	7350*
0.250					5800	8350*

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET,
CLAD OR BARE 2024-T42 SHEET, 2024-T42 TUBE
TABLE I (CONTINUED)

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

**Strength of Solid Rivets
Figure 2 (Sheet 5 of 7)**

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION					
FASTENER TYPE(S)	UNIVERSAL HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVETS				
SHEET MATERIAL	CLAD OR BARE 2024-T42 ALUMINUM ALLOY SHEET A				
<div></div>					
PART NUMBERS	MS20426() DD , MS20470() DD , BACR15BA() DD , BACR15BB() DD , BACR15BD() DD , BACR15FH() DD , BACR15BD() KE , BACR15FH() KE , BACR15FT() KE , BACR15FT() DD , BACR15FV() KE , BACR15CE() KE				
MATERIAL	2024-T3 AND 7050-T73				
DIAMETER	0.1562	0.1875	0.2500	0.3125	0.3750
DOUBLE SHEAR STRENGTH – LBS	1570	2260	4020	6300	9050
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH – POUNDS C D E				
0.018					
0.020					
0.025					
0.028					
0.032	490*				
0.036	550*	660*			
0.040	610*	735*			
0.045	690*	825*			
0.050	765*	920*	1220*		
0.056	855*	1030*	1370*		
0.063	1010*	1220*	1620*	2030*	
0.071	1140*	1370*	1830*	2290*	2740*
0.080	1290*	1540*	2060*	2570*	3090*
0.090	1450*	1740*	2320*	2900*	3480*
0.100	1560*	1930*	2570*	3220*	3860*
0.112	1570*	2160*	2880*	3600*	4330*
0.125		2260*	3220*	4020*	4830*
0.160			3990*	5150*	6200*
0.190			4020*	6100*	7350*
0.250				6300*	9050*

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET,
CLAD OR BARE 2024-T42 SHEET, 2024-T42 TUBE
TABLE I (CONTINUED)

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

Strength of Solid Rivets Figure 2 (Sheet 6 of 7)



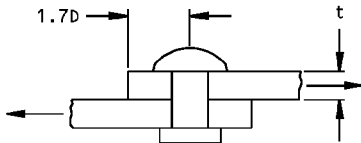
757-200
STRUCTURAL REPAIR MANUAL

NOTES

- A** THIS TABLE MAY ALSO BE USED FOR CLAD 2024-T4 COILED SHEET AND 2024-T42 TUBE.
- B** BASED ON F_{bru} (at $e/D = 1.7$) OF 98 KSI FOR 0.018-0.062 GAGES, AND 103 KSI FOR 0.063-0.128 GAGES. IN DETERMINING THE ALLOWABLES, SHEAR REDUCTION FACTORS HAVE BEEN APPLIED TO RIVET SHEAR STRENGTH VALUES TO COMPENSATE FOR HIGH BEARING STRESSES ON THE RIVET AT t/D VALUES LESS THAN 0.33.
- C** VALUES BELOW THE HEAVY LINE ARE RIVET SHEAR STRENGTH CRITICAL.
- D** BASED ON F_{bru} (at $e/D = 1.7$) OF 98 KSI FOR 0.018-0.062 GAGES, AND 103 KSI FOR 0.063-0.249 GAGES, AND 99 KSI FOR 0.250-0.312 GAGES. IN DETERMINING THE ALLOWABLES, SHEAR REDUCTION FACTORS HAVE BEEN APPLIED TO RIVET SHEAR STRENGTH VALUES TO COMPENSATE FOR HIGH BEARING STRESSES ON THE RIVET AT t/D VALUES LESS THAN 0.67.
- E** DESIGNER MUST NOTE THAT SOME OF THESE VALUES ARE FOR KNIFE-EDGE CONDITION, AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY. SEE THE APPLICABLE PARTS STANDARD FOR HEAD HEIGHT OF FLUSH HEAD FASTENERS. (HEAD HEIGHT $\geq t$)

Strength of Solid Rivets
Figure 2 (Sheet 7 of 7)

757-200 STRUCTURAL REPAIR MANUAL

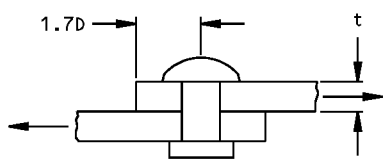
JOINT DESCRIPTION							
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS						
SHEET MATERIAL	CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET A						
<div></div>							
PART NUMBERS	MS20470() AD , BACR15BB() AD , BACR15DN() AD , BACR15FT() AD						
MATERIAL	2117-T3						
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
SINGLE SHEAR STRENGTH - LBS	207	369	575	830	1470	2290	3300
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B C						
0.018	189						
0.020	193						
0.025	201	339	505				
0.028	204	347	515				
0.032	207	356	530				
0.036		362	545	755			
0.040		367	555	775			
0.045		369	565	790			
0.050			570	805	1350		
0.056			575	820	1380		
0.063				830	1410	2110	
0.071					1440	2160	3000
0.080					1460	2210	3080
0.090					1470	2250	3140
0.100						2280	3210
0.112						2290	3250
0.125							3300

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET,
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)

TABLE I

Strength of Solid Rivets Figure 3 (Sheet 1 of 7)

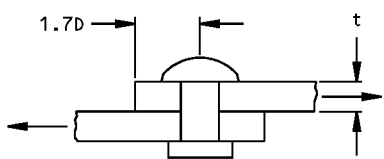
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION						
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS					
SHEET MATERIAL	CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET A					
<div></div>						
PART NUMBERS	MS20470 () D, BACR15BB () D, BACR15DN () D, BACR15FT () D					
MATERIAL	2017-T3					
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
SINGLE SHEAR STRENGTH - LBS	467	730	1050	1870	2910	4180
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B C					
0.018						
0.020						
0.025	353					
0.028	395					
0.032	450	565				
0.036	458	635	765			
0.040	465	705	800			
0.045	467	715	970			
0.050		725	1020	1440		
0.056		730	1040	1610		
0.063			1050	1800	2280	
0.071				1830	2570	3090
0.080				1860	2810	3480
0.090				1870	2850	3910
0.100					2900	4060
0.112					2910	4120
0.125						4180

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET,
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)
TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 3 (Sheet 2 of 7)

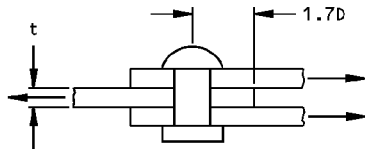
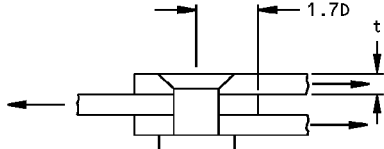
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION					
FASTENER TYPE(S)	UNIVERSAL HEAD AND MODIFIED UNIVERSAL HEAD ALUMINUM ALLOY RIVETS				
SHEET MATERIAL	CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET A				
					
PART NUMBERS	MS20470()DD, BACR15BB()DD, BACR15FT()KE, BACR15FT()DD				
MATERIAL	2024-T3 AND 7050-T73				
DIAMETER	0.1562	0.1875	0.2500	0.3125	0.3750
SINGLE SHEAR STRENGTH - LBS	785	1130	2010	3140	4530
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B C				
0.018	565	765	860	1440	1610
0.020					
0.025					
0.028					
0.032	635	770	970	1110	1830
0.036	635	765	860	1440	1610
0.040	720	860	2010	3140	4530
0.045	770	970	1440	2280	3090
0.050	780	1080	1610	2570	3480
0.056	785	1110	1830	2900	3910
0.063	785	1130	1970	3080	4350
0.071					
0.080					
0.090					
0.100	785	1130	2000	3120	4470
0.112					
0.125					
0.125			2010	3140	4530

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET,
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)
TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 3 (Sheet 3 of 7)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION							
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVETS						
SHEET MATERIAL	CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET A						
<div><div></div><div></div></div>							
PART NUMBERS	MS20426() AD , MS20470() AD , BACR15BA() AD , BACR15BB() AD , BACR15BC() AD , BACR15BD() AD , BACR15CE() AD , BACR15DN() AD , BACR15DP() AD , BACR15FH() AD , BACR15FT() AD						
MATERIAL	2117-T3						
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
DOUBLE SHEAR STRENGTH - LBS	414	740	1150	1660	2940	4580	6600
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS C D E						
0.018	191						
0.020	212						
0.025	265	353					
0.028	297	395					
0.032	337	452	565				
0.036	355	510	635	765			
0.040	369	575	720	860			
0.045	383	615	810	970			
0.050	394	640	900	1080	1440		
0.056	404	670	955	1210	1610		
0.063	414	690	1000	1340	1830	2280	
0.071		715	1050	1410	2060	2570	3090
0.080		730	1080	1480	2320	2900	3480
0.090		740	1110	1530	2450	3260	3910
0.100			1140	1580	2560	3610	4350
0.112			1150	1620	2660	3810	4870
0.125				1660	2750	3980	5300
0.160					2920	4310	5900
0.190					2940	4490	6200
0.250						4580	6600

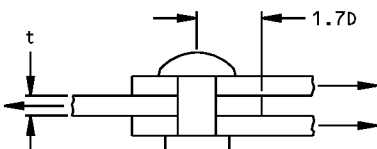
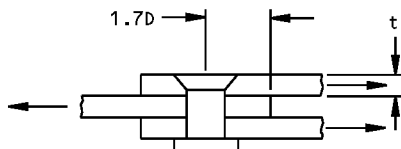
UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET,
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)

TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 3 (Sheet 4 of 7)

757-200

STRUCTURAL REPAIR MANUAL

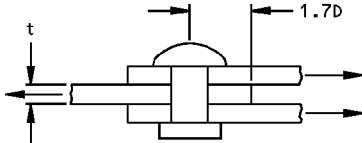
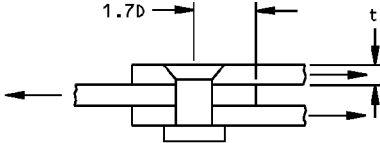
JOINT DESCRIPTION						
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVETS					
SHEET MATERIAL	CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET A					
<div><div></div><div></div></div>						
PART NUMBERS	MS20426() ^D , MS20470() ^D , BACR15BA() ^D , BACR15BB() ^D , BACR15CE() ^D , BACR15DN() ^D , BACR15DP() ^D , BACR15FT() ^D , BACR15GF() ^D					
MATERIAL	2017-T3					
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.3125	0.3750
DOUBLE SHEAR STRENGTH - LBS	935	1460	2100	3740	5800	8350
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS C D E					
0.018						
0.020						
0.025	353					
0.028	395					
0.032	452	565				
0.036	510	635	765			
0.040	575	720	860			
0.045	645	810	970			
0.050	720	900	1080	1440		
0.056	805	1010	1210	1610		
0.063	875	1140	1370	1830	2280	
0.071	900	1290	1540	2060	2570	3090
0.080	925	1370	1740	2320	2900	3480
0.090	935	1410	1940	2610	3260	3910
0.100		1450	2000	2900	3620	4350
0.112		1460	2050	3250	4060	4870
0.125			2100	3500	4530	5450
0.160				3710	5500	6950
0.190				3740	5700	7850
0.250					5800	8350

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET,
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)

TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 3 (Sheet 5 of 7)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION								
FASTENER TYPE(S)	PROTRUDING HEAD AND FLUSH HEAD ALUMINUM ALLOY RIVTES							
SHEET MATERIAL	CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET A							
<div><div></div><div></div></div>								
PART NUMBERS	MS20426() DD , MS20470() DD , BACR15BA() DD , BACR15BB() DD , BACR15BD() DD , BACR15BD() KE , BACR15FH() DD , BACR15FH() KE , BACR15FT() DD , BACR15FT() KE , BACR15FV() KE , BACR15GH() KE , BACR15GG() KE							
MATERIAL	2024-T3 AND 7050-T73							
DIAMETER	0.1250	0.1562	0.1875	0.2188	0.2500	0.2813	0.3125	0.3750
DOUBLE SHEAR STRENGTH - LBS	1010	1570	2260	3080	4020	5100	6300	9050
THICKNESS INCHES (t)	DOUBLE SHEAR ULTIMATE STRENGTH - POUNDS C D E							
0.018								
0.020								
0.025	353							
0.028	395							
0.032	452	565						
0.036	510	635	765					
0.040	575	720	860	1010				
0.045	645	810	970	1130				
0.050	720	900	1080	1260	1440			
0.056	805	1010	1210	1410	1610	1810		
0.063	915	1140	1370	1600	1830	2060	2280	
0.071	975	1290	1540	1800	2060	2320	2570	3090
0.080	1000	1450	1740	2030	2320	2610	2900	3480
0.090	1010	1520	1960	2280	2610	2940	3260	3910
0.100		1560	2150	2540	2900	3260	3620	4350
0.112		1570	2210	2840	3250	3650	4060	4870
0.125			2260	2980	3620	4080	4530	5450
0.160				3080	3990	4930	5800	6950
0.190					4020	5100	6150	8500
0.250							6300	9050

UNIVERSAL AND MODIFIED UNIVERSAL HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET,
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)
TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 3 (Sheet 6 of 7)

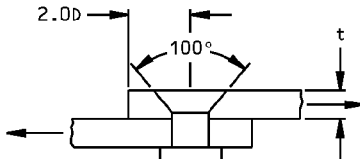
757-200
STRUCTURAL REPAIR MANUAL

NOTES

- [A] THIS TABLE MAY ALSO BE USED FOR 7075-T6, -T6510, -T6511 EXTRUSIONS LESS THAN 0.188 INCH THICK.
- [B] BASED ON F_{bru} (at $e/D = 1.7$) OF 113 KSI FOR 0.018-0.039 GAGES, 115 KSI FOR 0.040-0.062 GAGES, AND 116 KSI FOR 0.063-0.187 GAGES. IN DETERMINING THE ALLOWABLES, SHEAR REDUCTION FACTORS HAVE BEEN APPLIED TO RIVET SHEAR STRENGTH VALUES TO COMPENSATE FOR HIGH BEARING STRESSES ON THE RIVET AT t/D VALUES LESS THAN 0.33.
- [C] VALUES BELOW THE HEAVY LINE ARE RIVET SHEAR STRENGTH CRITICAL.
- [D] BASED ON F_{bru} (at $e/D = 1.7$) OF 113 KSI FOR 0.018-0.039 GAGES, 115 KSI FOR 0.040-0.062 GAGES, 116 KSI FOR 0.063-0.187 GAGES, 119 KSI FOR 0.188-0.249 GAGES, AND 113 KSI FOR 0.250-0.499 GAGES. IN DETERMINING THE ALLOWABLES, SHEAR REDUCTION FACTORS HAVE BEEN APPLIED TO RIVET SHEAR STRENGTH VALUES TO COMPENSATE FOR HIGH BEARING STRESSES ON THE RIVET AT t/D VALUES LESS THAN 0.67.
- [E] DESIGNER MUST NOTE THAT SOME OF THESE VALUES ARE FOR KNIFE-EDGE CONDITION, AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY. SEE THE APPLICABLE PARTS STANDARD FOR HEAD HEIGHT OF FLUSH HEAD FASTENERS. ($HEAD\ HEIGHT \geq t$)

Strength of Solid Rivets
Figure 3 (Sheet 7 of 7)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION										
FASTENER TYPE(S)		100° STANDARD SHEAR, FLUSH HEAD SOLID HEAD SOLID ALUMINUM ALLOY RIVETS								
SHEET MATERIAL		CLAD OR BARE 2024-T3 ALUMINUM ALLOY								
										
PART NUMBERS	MS20426() AD BACR15BA() AD				MS20426() D BACR15BA() D				MS20426() DD BACR15BA() DD	
MATERIAL	2117-T3				2017-T3				2024-T3	
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.1562	0.1875	0.2500	0.3125	0.1875	0.2500
SINGLE SHEAR STRENGTH - LBS	207	369	575	830	730	1050	1870	2910	1130	2010
THICKNESS INCHES (t)	SINGLE SHEAR JOINT ULTIMATE STRENGTH, LBS A									
0.020	132	163*								
0.025	156	221	250*							
0.028	168	248	303*							
0.032	178	272	348*						324*	
0.036	187	295	391*	474					505*	
0.040	193	309	418*	525*	476*				555*	
0.045	201	327	455*	585*	540*				680*	795*
0.050	206	340	479*	630*	580*	725*			760	975*
0.056	207	350	500	670	615*	790*			825	1150*
0.063		363	525	705	655*	860*	1200*	1630	885	1290*
0.071		369	540	740	690	915*	1340*	1760	940	1420*
0.080			560	770	720	970*	1450*	1970	990	1540*
0.090			575	795	730	1010	1550*	2040	1030	1650*
0.100				820		1050	1640*	2460	1070	1740*
0.112				830			1710	2520	1110	1820
0.125							1770	2580	1130	1880
0.140							1820	2650		1960
0.160							1870	2740		2000
0.180								2830		2010
0.190								2910		

FLUSH HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET

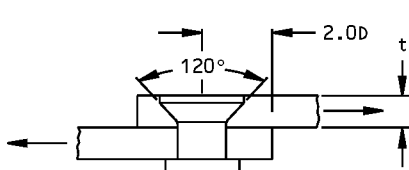
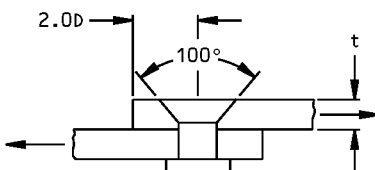
TABLE I

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

A VALUES ABOVE THE LINE ARE FOR KNIFE-EDGE CONDITION (HEAD HEIGHT $\geq t$), AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY.

Strength of Solid Rivets Figure 4 (Sheet 1 of 5)

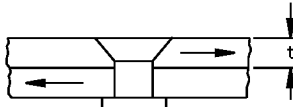
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
FASTENER TYPE(S)		100° SHEAR, AND 120° SHEAR FLUSH HEAD SOLID ALUMINUM ALLOY RIVETS									
SHEET MATERIAL		CLAD OR BARE 2024-T3 ALUMINUM ALLOY									
<div></div>											
TYPE	100° SHEAR FLUSH HEAD SOLID RIVETS				120° MODIFIED SHEAR FLUSH HEAD SOLID RIVETS						
PART NUMBERS	BACR15GF(>)D, BACR15CE(>)D				BACR15FV(>)KE						
MATERIAL	2017-T3				7050-T73						
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.1250	0.1562	0.1875	0.2188	0.2500	0.2813	0.3125
SINGLE SHEAR STRENGTH - LBS	467	730	1050	1870	505	785	1130	1540	2010	2550	3140
THICKNESS INCHES (t)	SINGLE SHEAR JOINT ULTIMATE STRENGTH, LBS A										
0.020											
0.025	195				215						
0.028	230				254						
0.032	280	315			307	346					
0.036	320	375			369	410					
0.040	360	435	485		434	478	530				
0.045	395	500	575		497	575	630	690			
0.050	430	560	665	780	505	670	730	805	860		
0.056	467	620	760	925		760	875	950	1020	1080	
0.063		675	840	1090		780	1040	1130	1200	1280	
0.071		730	925	1280		785	1110	1360	1440	1530	1630
0.080			1010	1440			1130	1540	1730	1830	1930
0.090			1050	1580					1990	2200	2320
0.100				1720					2010	2520	2720
0.112				1870						2550	3140
0.125											
0.140											
0.160											
0.180											
0.190											

FLUSH HEAD RIVETS IN CLAD OR BARE 2024-T3 SHEET
TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 4 (Sheet 2 of 5)

757-200 STRUCTURAL REPAIR MANUAL

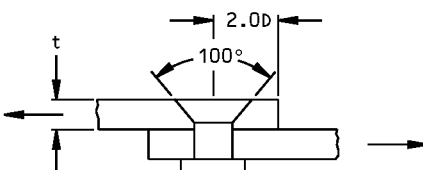
JOINT DESCRIPTION	FLUSH HEAD ALUMINUM ALLOY RIVETS IN COUNTERSINK BARE AND CLAD 2024-T42 ALUMINUM ALLOY SHEET									
<div></div>										
PART NUMBERS	MS20426() AD BACR15BA() AD				MS20426() D BACR15BA() D				MS20426() DD BACR15BA() DD	
MATERIAL	2117-T3				2017-T3				2024-T3	
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.1562	0.1875	0.2500	0.3125	0.1875	0.2500
SINGLE SHEAR STRENGTH - LBS	207	369	575	830	730	1050	1870	2910	1130	2010
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - LBS A									
0.020	132	163*								
0.025	156	221	250*							
0.028	168	248	303*							
0.032	178	272	348*						324*	
0.036	187	295	391*	474					505*	
0.040	193	309	418*	525*	476*				555*	
0.045	201	327	455*	585*	540*				680*	795*
0.050	206	340	479	630*	580*	725*			760	975*
0.056	207	350	500	670	615*	790*			825	1150*
0.063		363	525	705	655*	860*	1200*	1630	885	1290*
0.071		369	540	740	690	915*	1340*	1760	940	1420*
0.080			560	770	720	970*	1450*	1970	990	1540*
0.090			575	795	730	1010	1550*	2040	1030	1650*
0.100				820		1050	1640*	2460	1070	1740*
0.112				830			1710	2520	1110	1820
0.125							1770	2580	1130	1880
0.140							1820	2650		1960
0.160							1870	2740		2000
0.180								2830		2010
0.190								2910		

FLUSH HEAD RIVETS IN CLAD OR BARE 2024-T42 SHEET
TABLE I (CONTINUED)

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

**Strength of Solid Rivets
Figure 4 (Sheet 3 of 5)**

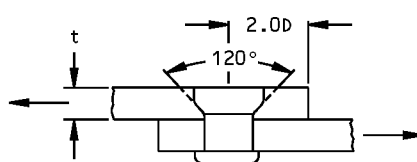
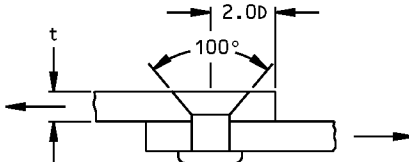
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
FASTENER TYPE(S)		100° STANDARD SHEAR FLUSH HEAD SOLID ALUMINUM ALLOY RIVETS									
SHEET MATERIAL		CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET									
<div></div>											
TYPE	100° STANDARD FLUSH HEAD SOLID RIVETS										
PART NUMBERS	MS20426() AD BACR15BA() AD				MS20426() D BACR15BA() D			MS20426() DD BACR15BA() DD			
MATERIAL	2117-T3				2017-T3				2024-T3		
DIAMETER	0.0938	0.1250	0.1562	0.1875	0.1562	0.1875	0.2500	0.3125	0.1875	0.2500	
SINGLE SHEAR STRENGTH - LBS	207	369	575	830	730	1050	1870	2910	1130	2010	
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - LBS A										
0.020	132	163*									
0.025	156	221	250*								
0.028	168	248	303*								
0.032	178	272	348*						324*		
0.036	187	295	391*	474					505*		
0.040	193	309	418*	525*	476*				555*		
0.045	201	327	455*	585*	540*				680*	795*	
0.050	206	340	479*	630*	580*	725*			760	975*	
0.056	207	350	500	670	615*	790*			825	1150*	
0.063		363	525	705	655*	860*	1200*	1630	885	1290*	
0.071		369	540	740	690	915*	1340*	1760	940	1420*	
0.080			560	770	720	970*	1450*	1970	990	1540*	
0.090			575	795	730	1010	1550*	2040	1030	1650*	
0.100				820		1050	1640*	2460	1070	1740*	
0.112				830			1710	2520	1110	1820	
0.125							1770	2580	1130	1880	
0.140							1820	2650		1960	
0.160							1870	2740		2000	
0.180								2830		2010	
0.190								2910			

FLUSH HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET
TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 4 (Sheet 4 of 5)

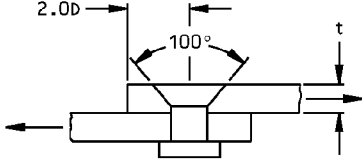
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
FASTENER TYPE(S)	100° SHEAR, AND 120° SHEAR FLUSH HEAD SOLID ALUMINUM ALLOY RIVETS										
SHEET MATERIAL	CLAD OR BARE 7075-T6 ALUMINUM ALLOY SHEET										
<div></div>											
TYPE	100° SHEAR FLUSH HEAD SOLID RIVETS				120° MODIFIED SHEAR FLUSH HEAD SOLID RIVETS						
PART NUMBERS	BACR15GF()D, BACR15CE()D				BACR15FV()KE						
MATERIAL	2017-T3				7050-T73						
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.1250	0.1562	0.1875	0.2188	0.2500	0.2813	0.3125
SINGLE SHEAR STRENGTH - LBS	467	730	1050	1870	505	785	1130	1540	2010	2550	3140
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH, LBS A										
0.020											
0.025	195				215						
0.028	230				254						
0.032	280	315			307	346					
0.036	320	375			369	410					
0.040	360	435	485		434	478	530				
0.045	395	500	575		497	575	630	690			
0.050	430	560	665	780	505	670	730	805	860		
0.056	467	620	760	925		760	875	950	1020	1080	
0.063		675	840	1090		780	1040	1130	1200	1280	
0.071		730	925	1280		785	1110	1360	1440	1530	1630
0.080			1010	1440			1130	1540	1730	1830	1930
0.090			1050	1580					1990	2200	2320
0.100				1720					2010	2520	2720
0.112				1870						2550	3140
0.125											
0.140											
0.160											
0.180											
0.190											

FLUSH HEAD RIVETS IN CLAD OR BARE 7075-T6 SHEET
TABLE I (CONTINUED)

Strength of Solid Rivets
Figure 4 (Sheet 5 of 5)

757-200 STRUCTURAL REPAIR MANUAL

SHEET MATERIAL (MACHINE COUNTERSUNK)	302 - ANNEALED CRES			301 - 1/4 HARD CRES			301 - 1/2 HARD CRES 301 - FULL HARD CRES			
<div></div>										
RIVET TYPE	100° FLUSH HEAD									
PART NUMBERS	MS20427M (F _{su} = 49 ksi)									
MATERIAL	MONEL									
NOMINAL DIAMETER	1/8 (0.1250)	5/32 (0.1562)	3/16 (0.1875)	1/8 (0.1250)	5/32 (0.1562)	3/16 (0.1875)	3/32 (0.0938)	1/8 (0.1250)	5/32 (0.1562)	3/16 (0.1875)
SINGLE SHEAR STRENGTH - LBS A	605	940	1350	605	940	1350	338	605	940	1350
ULTIMATE STRENGTH, LB B										
SHEET THICKNESS, INCHES										
0.020	259*			373*			238*	421*		
0.025	352*	402*		426*	580*		241	426	645*	
0.032	431*	562*	634*	431	653*	910*	245	431	653*	931*
0.040	439*	663*	852*	439	663	942*	251	439	663	942*
0.050	526*	673*	954*	468	673	954	322	447	673	954
0.063	605	820*	1006*	595	732	972	338	538	688	972
0.071		915*	1110*	605	830	990		605	741	984
0.080		940	1246		936	1118			850	995
0.090			1350		940	1255			940	1132
0.100						1350				1280
0.125										1350

MS20427M RIVETS IN CRES SHEET
TABLE I

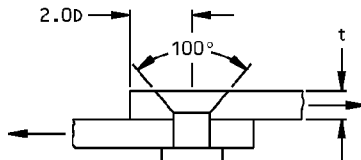
* INDICATED ULTIMATE VALUE EXCEEDS 1.5 TIMES THE YIELD VALUE.

NOTES

- A** RIVET SHEAR STRENGTH IS DOCUMENTED IN BDM-4281.
- B** VALUES ABOVE LINE ARE FOR KNIFE-EDGE CONDITION; THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES THE SPECIFIC APPROVAL OF THE PROCURING ACTIVITY.
- C** VALUES BELOW LINE ARE RIVET SHEAR STRENGTH CRITICAL.

Strength of Solid Rivets Figure 5 (Sheet 1 of 3)

757-200 STRUCTURAL REPAIR MANUAL

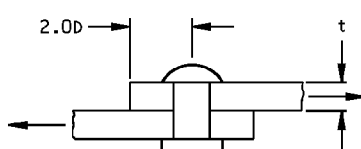
SHEET MATERIAL (MACHINE COUNTERSUNK)	302 - ANNEALED CRES			301 - 1/4 HARD CRES			301 - 1/2 HARD CRES 301 - FULL HARD CRES			
<div></div>										
RIVET TYPE	100° FLUSH HEAD									
PART NUMBERS	MS20427M (F _{su} = 49 ksi)									
MATERIAL	MONEL									
NOMINAL DIAMETER	1/8 (0.1250)	5/32 (0.1562)	3/16 (0.1875)	1/8 (0.1250)	5/32 (0.1562)	3/16 (0.1875)	3/32 (0.0938)	1/8 (0.1250)	5/32 (0.1562)	3/16 (0.1875)
SINGLE SHEAR STRENGTH - LBS A	605	940	1350	605	940	1350	338	605	940	1350
YIELD STRENGTH, LB										
SHEET THICKNESS, INCHES										
0.020	129			200			154	214		
0.025	162	197		241	309		167	264	331	
0.032	206	256	305	299	394	470	186	294	418	510
0.040	259	321	386	368	466	572	212	324	456	611
0.050	324	402	480	442	570	692	293	360	498	663
0.063	408	506	604	492	686	855	355	480	557	732
0.071		570	685	561	714	958		561	630	780
0.080		643	771		764	1012			765	848
0.090			865		893	1062			893	1000
0.100						1160				1160
0.125										1350

MS20427M RIVETS IN CRES SHEET
TABLE I (CONTINUED)

^A RIVET SHEAR STRENGTH IS DOCUMENTED IN BDM-4281.

Strength of Solid Rivets
Figure 5 (Sheet 2 of 3)

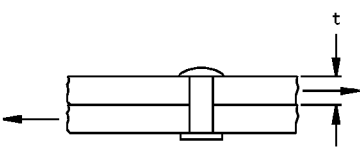
757-200 STRUCTURAL REPAIR MANUAL

SHEET MATERIAL	301 - 1/4 HARD CRES			
<div></div>				
RIVET TYPE	UNIVERSAL HEAD			
PART NUMBERS	MS20615M (F _{su} = 49 ksi)			
MATERIAL	MONEL			
NOMINAL DIAMETER, D, INCH	1/8 (0.1250)	5/32 (0.1562)	3/16 (0.1875)	1/4 (0.2500)
SINGLE SHEAR STRENGTH - LBS A	605	940	1350	2410
ULTIMATE STRENGTH, LB C				
SHEET THICKNESS, t, INCHES				
0.025	555			
0.032	585	870		
0.036	595	890	1230	
0.040	600	905	1260	
0.045	605	920	1290	
0.050		935	1310	2220
0.063		940	1350	2320
0.071				2360
0.080				2400
0.090				2410
YIELD STRENGTH, LB C				
SHEET THICKNESS, t, INCHES				
0.025	412			
0.032	530	660		
0.036	595	740	890	
0.040	600	825	990	
0.045	605	920	1110	
0.050		935	1240	1650
0.063		940	1350	2080
0.071				2340
0.080				2400
0.090				2410

MS20615M RIVETS IN CRES SHEET
TABLE I (CONTINUED)

**Strength of Solid Rivets
Figure 5 (Sheet 3 of 3)**

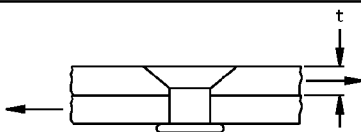
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		BLIND RIVETS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET						
								
PART NUMBERS	NAS1398B				NAS1398D			
MATERIAL	5056 ALUMINUM SLEEVE 7075 ALUMINUM STEM				2017 ALUMINUM SLEEVE 7075 ALUMINUM STEM			
DIAMETER	0.1250	0.1562	0.1875	0.2500	0.1250	0.1562	0.1875	0.2500
SINGLE SHEAR STRENGTH - LBS	388	595	860	1550	495	755	1090	1970
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS							
0.020	167	189	199		167	189	199	
0.025	228	262	290	314	228	262	290	314
0.028	254	306	342	385	261	306	342	385
0.032	289	364	412	479	304	364	412	479
0.036	313	406	483	575	329	417	483	575
0.040	337	448	555	670	355	470	555	670
0.045	362	484	605	790	386	510	625	790
0.050	388	520	660	915	418	550	695	915
0.056		555	715	1020	454	595	750	1050
0.063		595	780	1140	495	645	815	1200
0.071			855	1240		710	895	1300
0.080			860	1350		755	975	1420
0.090				1470			1070	1540
0.100				1550			1090	1670
0.112								1810
0.125								1970

NAS1398 AND NAS1399 RIVETS IN 2024-T3 BARE OR CLAD SHEET
TABLE I

Strength of Blind Rivets
Figure 6 (Sheet 1 of 6)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		FLUSH HEAD BLIND RIVETS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET				
						
PART NUMBERS	NAS1399B			NAS1399D		
MATERIAL	5056 ALUMINUM SLEEVE 7075 ALUMINUM STEM			2017 ALUMINUM SLEEVE 7075 ALUMINUM STEM		
DIAMETER	0.1250	0.1562	0.1875	0.1250	0.1562	0.1875
SINGLE SHEAR STRENGTH – LBS	388	595	860	495	755	1090
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH – POUNDS A					
0.032	119*			119*		
0.036	134*			134*		
0.040	149*	185*		149*	185*	
0.045	186*	207*		186*	207*	
0.050	223*	230*	277*	223*	230*	277*
0.056	263*	285*	313*	267*	285*	313*
0.063	310*	349*	356*	319*	349*	356*
0.071	366	415*	448*	379*	420*	448*
0.080	388	490*	545*	423	506*	545*
0.090		580	645*	459	600*	660*
0.100		595	750*	495	650	775*
0.112			800		700	865
0.125			860		755	970
0.140						1020
0.160						1090

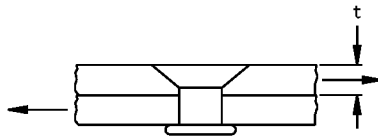
NAS1398 AND NAS1399 RIVETS IN 2024-T3 BARE OR CLAD SHEET
TABLE I (CONTINUED)

* INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

A VALUES ABOVE THE HEAVY LINE ARE FOR KNIFE-EDGE CONDITION, AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY. (HEAD HEIGHT > t)

**Strength of Blind Rivets
Figure 6 (Sheet 2 of 6)**

757-200 STRUCTURAL REPAIR MANUAL

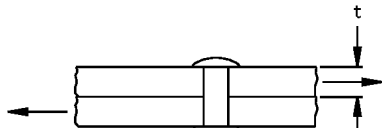
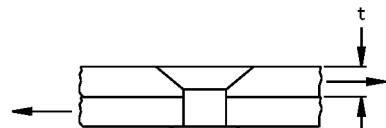
JOINT DESCRIPTION		FLUSH HEAD BLIND RIVETS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET				
<div></div>						
PART NUMBERS	NAS1399B			NAS1399D		
MATERIAL	5056 ALUMINUM SLEEVE 7075 ALUMINUM STEM			2017 ALUMINUM SLEEVE 7075 ALUMINUM STEM		
DIAMETER	0.1250	0.1562	0.1875	0.1250	0.1562	0.1875
SINGLE SHEAR STRENGTH - LBS	388	595	860	495	755	1090
THICKNESS INCHES (t)	SINGLE SHEAR YIELD STRENGTH - POUNDS C					
0.032	58	80		58	80	
0.036	65			65		
0.040	72			72		
0.045	93	96	135	93	96	135
0.050	114	113		114	113	
0.056	152	145		152	145	
0.063	197	182	170	197	182	170
0.071	247	245	220	247	245	220
0.080	304	316	304	304	316	304
0.090		396	399	367	396	399
0.100		473	493	431	473	493
0.112			605		565	605
0.125			730		670	730
0.140						870
0.160						1060

NAS1398 AND NAS1399 RIVETS IN 2024-T3 BARE OR CLAD SHEET
TABLE I (CONTINUED)

**Strength of Blind Rivets
Figure 6 (Sheet 3 of 6)**

757-200

STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		PROTRUDING AND FLUSH HEAD BLIND RIVETS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET				
						
HEAD STYLE	UNIVERSAL			100° FLUSH HEAD A		
PART NUMBERS	NAS1738 B AND E			NAS1739 B AND E		
MATERIAL	5056 ALUMINUM SLEEVE					
DIAMETER B	0.1250	0.1562	0.1875	0.1250	0.1562	0.1875
SINGLE SHEAR STRENGTH - LBS	620	935	1260	620	935	1260
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS C					
0.020	199	216	228			
0.025	267	305	330	166		
0.028	310	358	391	186		
0.032	368	428	473	212	261	
0.036	397	496	555	239	293	
0.040	427	565	635	266	326	379
0.045	453	605	725	305	368	426
0.050	480	650	815	344	410	473
0.056	510	689	860	389	468	535
0.063	545*	735	910	441	535	605
0.071	555*	785*	975	505	610	695
0.080		835*	1040*	555	695	795
0.090			1110*		785	900
0.100			1130*		835	1010
0.112						1070
0.125						1130

NAS1738 AND NAS1739 RIVETS IN 2024-T3 BARE OR CLAD SHEET
TABLE II

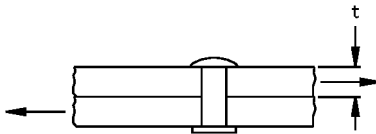
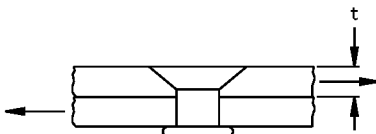
* INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES.

B ACTUAL SHANK DIAMETERS ARE LARGER THAN THE GIVEN NOMINAL DIAMETERS.

C THIS JOINT DOES NOT REACH FULL FASTENER SHEAR STRENGTH.

Strength of Blind Rivets
Figure 6 (Sheet 4 of 6)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		PROTRUDING AND FLUSH HEAD BLIND RIVETS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET				
						
HEAD STYLE	UNIVERSAL			100° FLUSH HEAD A		
PART NUMBERS	NAS1738 B AND E			NAS1739 B AND E		
MATERIAL	5056 ALUMINUM SLEEVE					
DIAMETER B	0.1250	0.1562	0.1875	0.1250	0.1562	0.1875
SINGLE SHEAR STRENGTH - LBS	620	935	1260	620	935	1260
THICKNESS INCHES (t)	SINGLE SHEAR YIELD STRENGTH - POUNDS					
0.020	185	213	228			
0.025	242	285	317	121		
0.028	266	328	367	137		
0.032	298	386	433	159	193	
0.036	309	419	500	185	220	
0.040	321	453	570	212	247	280
0.045	328	471	595	245	289	323
0.050	336	489	625	279	331	367
0.056	336	499	650	319	380	425
0.063	336	510	680	365	437	492
0.071	336	510	685	418	505	570
0.080		510	685	448	575	655
0.090			685		660	750
0.100			685		690	845
0.112						900
0.125						960

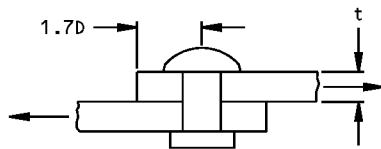
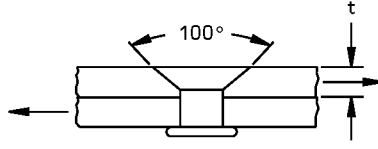
NAS1738 AND NAS1739 RIVETS IN 2024-T3 BARE OR CLAD SHEET
TABLE II (CONTINUED)

B ACTUAL SHANK DIAMETERS ARE LARGER THAN THE GIVEN NOMINAL DIAMETERS.

Strength of Blind Rivets
Figure 6 (Sheet 5 of 6)

757-200

STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		BLIND RIVETS IN BARE AND CLAD 7075-T6 ALUMINUM ALLOY SHEET				
						
HEAD STYLE	UNIVERSAL HEAD			100° FLUSH HEAD A		
PART NUMBERS	NAS1738B AND E, BACR15FR B AND E			NAS1739B AND E, BACR15FP B AND E		
MATERIAL	SLEEVE - 5056-F					
DIAMETER B	0.1250	0.1562	0.1875	0.1250	0.1562	0.1875
SINGLE SHEAR STRENGTH - LBS	620	935	1260	620	935	1260
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS					
0.020	268					
0.025	292	409				
0.032	328	454	570	201		
0.036	355	477	600	228	277	
0.040	372	500	630	256	309	352
0.045	396	535	675	286	352	410
0.050	426	565	710	324	394	454
0.056	459	615	755	360	445	510
0.063	500	665	815	407	500	575
0.071	540	710	875	449	560	660
0.080	590	770	940	497	635	740
0.090	620	840	1020	545	695	835
0.100		900	1110	600	765	915
0.112		935	1200	620	840	1000
0.125			1260		920	1090
0.140					935	1210
0.160						1260

NAS1738 AND NAS1739 RIVETS IN 7075-T6 BARE OR CLAD SHEET
TABLE II (CONTINUED)

Strength of Blind Rivets
Figure 6 (Sheet 6 of 6)



757-200
STRUCTURAL REPAIR MANUAL

FASTENER	BLIND BOLT MS90353,MS90354				
HEAD	100° FLUSH AND UNIVERSAL HEAD				
FASTENER DIAMETER	5/32	3/16	1/4	5/16	3/8
SHEAR (LBS)	2340	3450	5900	8500	12200
MATERIAL GAGE	SINGLE SHEAR ULTIMATE STRENGTH (LBS)				
0.071	1120				
0.080	1305	1480			
0.090	1510	1735			
0.100	1740	2000	2380		
0.125	2080	2670	3210	3625	
0.160	2340	3195	4440	5060	5700
0.190		3450	5090	6310	7180
0.250			5900	7860	9890
0.312				8500	11600
0.375					12200

MS90353, MS90354 BLIND BOLTS IN 2024-T3 CLAD OR BARE SHEET
TABLE I

NOTES

- YIELD STRENGTH VALUE IS LESS THAN 2/3 OF INDICATED ULTIMATE STRENGTH VALUE.
- VALUES ABOVE LINE ARE FOR KNIFE-EDGE CONDITION AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY.

Strengths of Blind Bolts
Figure 7 (Sheet 1 of 2)



757-200
STRUCTURAL REPAIR MANUAL

FASTENER	BLIND BOLT MS90353,MS90354				
HEAD	100° FLUSH AND UNIVERSAL HEAD				
FASTENER DIAMETER	5/32	3/16	1/4	5/16	3/8
SINGLE SHEAR (LB)	2340	3450	5900	8500	12200
MATERIAL GAGE	SINGLE SHEAR ULTIMATE STRENGTH (LB)				
0.071	1360				
0.080	1535	1830			
0.090	1710	2090			
0.100	1880	2330	2970		
0.125	2200	2825	3805	4490	
0.160	2340	3365	4760	5850	6960
0.190		3450	5370	6790	8310
0.250			5900	8290	10450
0.312				8500	12200
0.375					12200

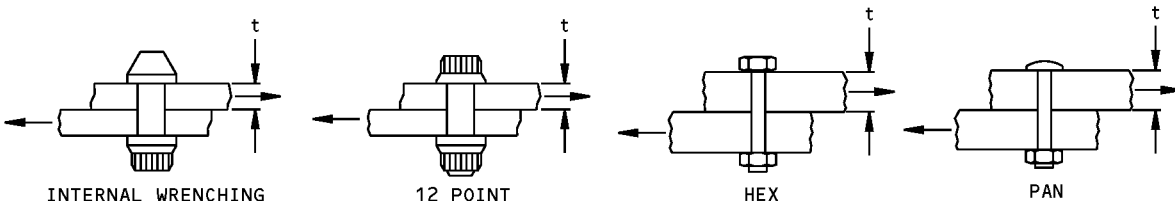
MS90353, MS90354 BLIND BOLTS IN 7075-T6 CLAD OR BARE SHEET
TABLE II

NOTES

- YIELD STRENGTH VALUE IS LESS THAN 2/3 OF INDICATED ULTIMATE STRENGTH VALUE.
- VALUES ABOVE LINE ARE FOR KNIFE-EDGE CONDITION AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY.

Strengths of Blind Bolts
Figure 7 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

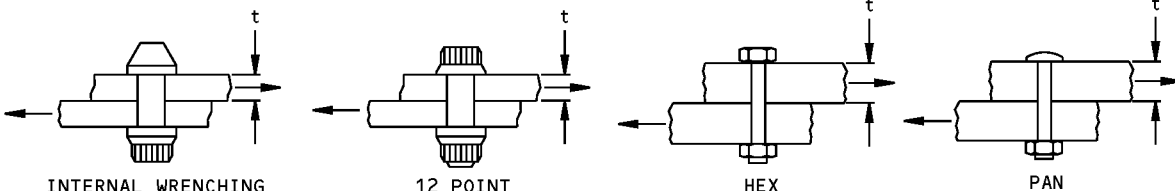
JOINT DESCRIPTION											
TENSION PROTRUDING HEAD, 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET AND -T351 PLATE											
											
PART NUMBERS	<div> <div>MS20004 THRU 20024 NAS623 NAS673 THRU 678 NAS1218 NAS1223 THRU 1235 NAS1303 THRU 1320</div> <div>NAS6603 THRU 6620 NAS6703 THRU 6720 BACB30LJ BACB30LK BACB30LM BACB30LN</div> <div>BACB30MR BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT</div> <div>BACB30PF BACB30PU BACB30PW BACB30UG</div> </div>										
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)										
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600	29100	41900	57000	74500
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH, LB A										
0.036	665										
0.040	735										
0.045	830										
0.050	920	1210									
0.056	1030	1360									
0.063	1210	1590	1990								
0.071	1360	1790	2240	2690							
0.080	1540	2020	2520	3030	3530						
0.090	1730	2270	2840	3410	3980						
0.100	1920	2520	3160	3790	4420	5050					
0.112	2150	2830	3530	4240	4950	5650	6350				
0.125	2400	3160	3950	4730	5500	6300	7100	7900			

TENSION PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
2024-T3 CLAD OR BARE, SHEET OR PLATE 95 KSI SHEAR STRENGTH
TABLE I

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 1 of 10)

757-200

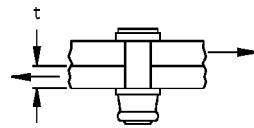
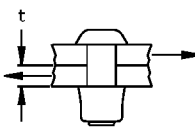
STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
TENSION PROTRUDING HEAD, 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET AND -T351 PLATE											
											
PART NUMBERS	<div>MS20004 THRU 20024</div> <div>NAS623</div> <div>NAS673 THRU 678</div> <div>NAS1218</div> <div>NAS1223 THRU 1235</div> <div>NAS1303 THRU 1320</div> <div>NAS6603 THRU 6620</div> <div>NAS6703 THRU 6720</div> <div>BACB30LJ</div> <div>BACB30LK</div> <div>BACB30LM</div> <div>BACB30LN</div> <div>BACB30MR</div> <div>BACB30NE</div> <div>BACB30NF</div> <div>BACB30NM</div> <div>BACB30NR</div> <div>BACB30NT</div> <div>BACB30PF</div> <div>BACB30PU</div> <div>BACB30PW</div> <div>BACB30UG</div>										
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)										
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600	29100	41900	57000	74500
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH, LB A										
0.140	2690	3570	4460	5350	6250	7150	8050	8900	10700		
0.160		4080	5100	6100	7150	8150	9200	10200	12200	14300	
0.180		4590	5750	6900	8050	9200	10300	11500	13800	16100	
0.200		4650	6350	7650	8900	10200	11500	12700	15300	17800	20400
0.224			7150	8550	10000	11400	12900	14300	17100	20000	22800
0.250			7300	8900	10400	11900	13400	14800	17800	20800	23700
0.312				10500	13000	14800	16700	18500	22200	25900	29600
0.375					14300	17800	20000	22300	26700	31200	35600
0.500						18600	23600	29100	34900	40700	46500
0.562									39200	45700	52500
0.625									41900	51000	58000
0.750										57000	69500
0.812											74500

TENSION PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
2024-T3 CLAD OR BARE, SHEET OR PLATE 95 KSI SHEAR STRENGTH
TABLE I (CONTINUED)

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 2 of 10)

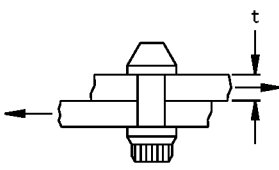
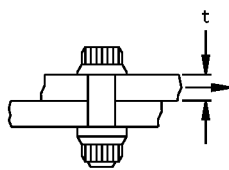
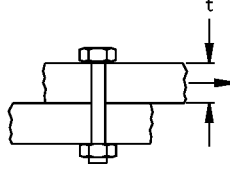
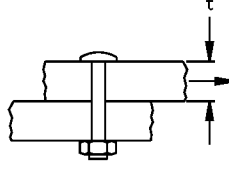
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		TENSION PROTRUDING HEAD 95 KSI SHEAR STRENGTH LOCKBOLTS AND HEX-DRIVE BOLTS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET AND -T351 PLATE						
<div></div>								
PART NUMBERS		NAS1465 THRU 1472, BACB30DX, BACB30HC, BACB30MB, BACB30NX, BACB30UB C					BACB30MB BACB30NX	
MATERIAL		ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER	0.1640	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	
SINGLE SHEAR STRENGTH - LBS	2000	2690	4650	7300	10500	14300	18600	
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B							
0.032	510							
0.036	575	665						
0.040	635	735						
0.045	715	830						
0.050	795	920	1210					
0.056	890	1030	1360					
0.063	1040	1210	1590	1990				
0.071	1180	1360	1790	2240	2690			
0.080	1330	1540	2020	2520	3030	3530		
0.090	1490	1730	2270	2840	3410	3980		
0.100	1660	1920	2520	3160	3790	4420	5050	
0.112	1860	2150	2830	3530	4240	4950	5650	
0.125	2000	2400	3160	3950	4730	5500	6300	
0.140		2690	3570	4460	5350	6250	7150	
0.160			4080	5100	6100	7150	8150	
0.180			4590	5750	6900	8050	9200	
0.200			4650	6350	7650	8900	10200	
0.224				7150	8550	10000	11400	
0.250				7300	8900	10400	11900	
0.312					10500	13000	14800	
0.375						14300	17800	
0.500							18600	

TENSION PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
2024-T3 CLAD OR BARE, SHEET OR PLATE 95 KSI SHEAR STRENGTH
TABLE I (CONTINUED)

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 3 of 10)

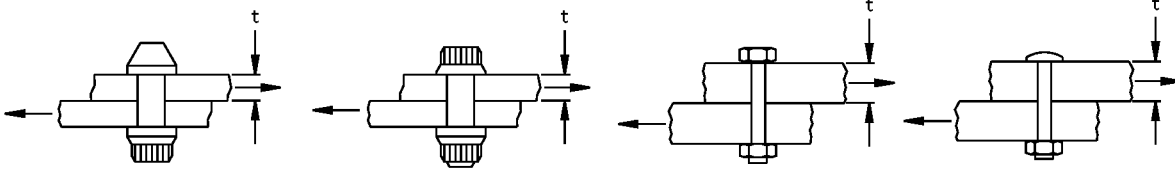
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
TENSION PROTRUDING HEAD, 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 2024-T42 ALUMINUM ALLOY SHEET AND PLATE D											
   											
<div>INTERNAL WRENCHING</div> <div>12 POINT</div> <div>HEX</div> <div>PAN</div>											
PART NUMBERS	<div>MS20004 THRU 20024</div> <div>NAS623</div> <div>NAS673 THRU 678</div> <div>NAS1218</div> <div>NAS1223 THRU 1235</div> <div>NAS1303 THRU 1320</div> <div>NAS6603 THRU 6620</div> <div>NAS6703 THRU 6720</div> <div>BACB30LJ</div> <div>BACB30LK</div> <div>BACB30LM</div> <div>BACB30LN</div> <div>BACB30MR</div> <div>BACB30NE</div> <div>BACB30NF</div> <div>BACB30NM</div> <div>BACB30NR</div> <div>BACB30NT</div> <div>BACB30PF</div> <div>BACB30PU</div> <div>BACB30PW</div> <div>BACB30UG</div>										
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)										
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600	29100	41900	57000	74500
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH, LB E										
0.036	535										
0.040	595										
0.045	665										
0.050	740	975									
0.056	830	1090									
0.063	1000	1320	1650								
0.071	1130	1490	1860	2240							
0.080	1280	1680	2100	2520							
0.090	1440	1890	2360	2830	3310	3780	4250				
0.100	1600	2100	2620	3150	3670	4200	4720				
0.112	1790	2350	2940	3530	4120	4700	5300				
0.125	1990	2620	3280	3940	4590	5250	5900	6550			

PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
2024-T42 CLAD OR BARE, SHEET OR PLATE
2024-T4 CLAD SHEET OR PLATE
2024-T42 TUBE (95 KSI SHEAR STRENGTH)
TABLE II

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 4 of 10)

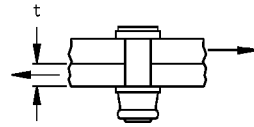
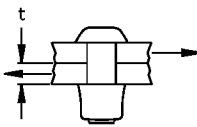
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
TENSION PROTRUDING HEAD, 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 2024-T42 ALUMINUM ALLOY SHEET AND PLATE D											
											
PART NUMBERS	<div> <div>MS20004 THRU 20024 NAS623 NAS673 THRU 678 NAS1218 NAS1223 THRU 1235 NAS1303 THRU 1320</div> <div>NAS6603 THRU 6620 NAS6703 THRU 6720 BACB30LJ BACB30LK BACB30LM BACB30LN</div> <div>BACB30MR BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT</div> <div>BACB30PF BACB30PU BACB30PW BACB30UG</div> </div>										
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)										
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600	29100	41900	57000	74500
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH, LB E										
0.140	2230	2940	3670	4410	5150	5900	6600	7350	8800		
0.160	2550	3360	4200	5050	5900	6700	7550	8400	10100	11800	
0.180	2690	3780	4720	5650	6600	7550	8500	9450	11300	13200	15100
0.200		4200	5250	6300	7350	8400	9450	10500	12600	14700	16800
0.224		4650	5900	7050	8250	9400	10600	11800	14100	16500	18800
0.250			6200	7450	8700	9950	11200	12400	14900	17400	19900
0.312			7300	9300	10900	12400	14000	15500	18600	21700	24800
0.375				10500	13000	14900	16800	18600	22400	26100	29800
0.500					14300	18600	22400	24800	29800	34800	39700
0.562							23600	27900	33500	39100	44700
0.625								29100	37300	43500	49700
0.750									41900	52000	59500
1.000										57000	74500

PROTRUDING HEAD BOLTS, LOCKBOLTS, AND HEX-DRIVE BOLTS IN:
 2024-T42 CLAD OR BARE, SHEET OR PLATE
 2024-T4 CLAD SHEET OR PLATE
 2024-T42 TUBE (95 KSI SHEAR STRENGTH)
 TABLE II (CONTINUED)

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 5 of 10)

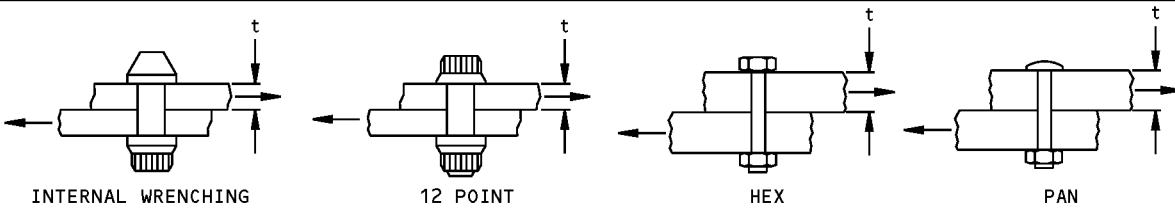
757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		TENSION PROTRUDING HEAD 95 KSI SHEAR STRENGTH LOCKBOLTS AND HEX-DRIVE BOLTS IN BARE AND CLAD 2024-T42 ALUMINUM ALLOY SHEET AND PLATE						
<div></div>								
PART NUMBERS		NAS1465 THRU 1472, BACB30DX, BACB30HC, BACB30MB, BACB30NX, BACB30UB C					BACB30MB BACB30NX	
MATERIAL		ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER		0.1640	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000
SINGLE SHEAR STRENGTH - LBS		2000	2690	4650	7300	10500	14300	18600
THICKNESS INCHES (t)		SINGLE SHEAR ULTIMATE STRENGTH - POUNDS E						
0.032		409						
0.036		460	535					
0.040		510	595					
0.045		575	665					
0.050		640	740	975				
0.056		715	830	1090				
0.063		870	1000	1320	1650			
0.071		980	1130	1490	1860	2240		
0.080		1100	1280	1680	2100	2520		
0.090		1240	1440	1890	2360	2830	3310	3780
0.100		1380	1600	2100	2620	3150	3670	4200
0.112		1540	1790	2350	2940	3530	4120	4700
0.125		1720	1990	2620	3280	3940	4590	5250
0.140		1930	2230	2940	3670	4410	5150	5900
0.160		2000	2550	3360	4200	5050	5900	6700
0.180			2690	3780	4720	5650	6600	7550
0.200				4200	5250	6300	7350	8400
0.224				4650	5900	7050	8250	9400
0.250					6200	7450	8700	9950
0.312					7300	9300	10900	12400
0.375						10500	13000	14900

TENSION PROTRUDING HEAD BOLTS, LOCKBOLTS, AND HEX-DRIVE BOLTS IN:
2024-T42 CLAD OR BARE, SHEET OR PLATE 95 KSI SHEAR STRENGTH
TABLE II (CONTINUED)

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 6 of 10)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION											
TENSION PROTRUDING HEAD, 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 7075-T6 ALUMINUM ALLOY SHEET AND -T651 PLATE F											
											
PART NUMBERS	MS20004 THRU 20024 NAS6603 THRU 6620 BACB30MR BACB30PF NAS623 NAS6703 THRU 6720 BACB30NE BACB30PU NAS673 THRU 678 BACB30LJ BACB30NF BACB30PW NAS1218 BACB30LK BACB30NM BACB30UG NAS1223 THRU 1235 BACB30LM BACB30NR NAS1303 THRU 1320 BACB30LN BACB30NT										
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)										
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600	29100	41900	57000	74500
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH, LB G										
0.036	775										
0.040	875										
0.045	985										
0.050	1090	1440									
0.056	1220	1610									
0.063	1390	1830	2280								
0.071	1560	2060	2570	3090							
0.080	1760	2320	2900	3480	4060						
0.090	1980	2610	3260	3910	4570						
0.100	2200	2900	3620	4350	5050	5800					
0.112	2470	3250	4060	4870	5700	6500					
0.125	2690	3620	4530	5450	6350	7250	8150	9050			

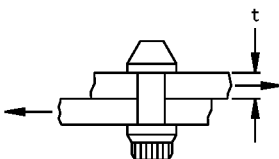
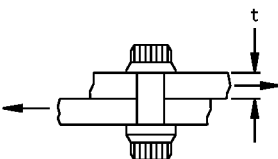
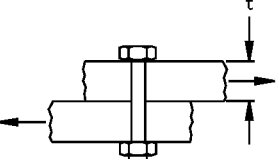
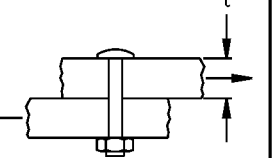
TENSION PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
 7075-T6 CLAD OR BARE, SHEET OR PLATE
 7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.185 INCH THICK)
 (95 KSI SHEAR STRENGTH)

TABLE III

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 7 of 10)

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STRUCTURAL REPAIR MANUAL

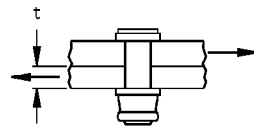
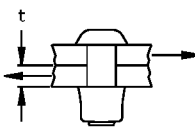
JOINT DESCRIPTION											
TENSION PROTRUDING HEAD, 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 7075-T6 ALUMINUM ALLOY SHEET AND -T651 PLATE F											
   											
PART NUMBERS	MS20004 THRU 20024 NAS623 NAS673 THRU 678 NAS1218 NAS1223 THRU 1235 NAS1303 THRU 1320										
	NAS6603 THRU 6620 NAS6703 THRU 6720 BACB30LJ BACB30LK BACB30LM BACB30LN										
	BACB30MR BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT										
	BACB30PF BACB30PU BACB30PW BACB30UG										
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)										
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600	29100	41900	57000	74500
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH, LB G										
0.140		4060	5050	6100	7100	8100	9150	10100	12200		
0.160		4640	5800	6950	8100	9300	10400	11600	13900	16200	
0.180		4650	6500	7850	9150	10400	11700	13000	15700	18300	
0.200			7300	8900	10400	11900	13400	14900	17800	20800	23800
0.224				10000	11700	13300	15000	16700	20000	23300	26700
0.250				10500	12400	14100	15900	17700	21200	24700	28200
0.312					14300	17600	19800	22000	26400	30800	35300
0.375						18600	23600	26500	31800	37100	42400
0.500								29100	41900	50300	57500
0.562										56600	64600
0.625										57000	71900
0.750											74500

TENSION PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
 7075-T6 CLAD OR BARE, SHEET OR PLATE
 7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.185 INCH THICK)
 (95 KSI SHEAR STRENGTH)

TABLE III (CONTINUED)

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
 Figure 8 (Sheet 8 of 10)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		TENSION PROTRUDING HEAD 95 KSI SHEAR STRENGTH LOCKBOLTS AND HEX-DRIVE BOLTS IN BARE AND CLAD 7075-T6 ALUMINUM ALLOY SHEET AND -T651 PLATE [F]						
<div></div>								
PART NUMBERS		NAS1465 THRU 1472, BACB30DX, BACB30MB, BACB30HC, BACB30NX, BACB30UB [C]					BACB30MB BACB30NX	
MATERIAL		ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER		0.1640	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000
SINGLE SHEAR STRENGTH - LBS		2000	2640	4650	7300	10500	14300	18600
THICKNESS INCHES (t)		SINGLE SHEAR ULTIMATE STRENGTH - POUNDS [G]						
0.032	595							
0.036	665	775						
0.040	755	875						
0.045	850	985						
0.050	945	1090	1440					
0.056	1060	1220	1610					
0.063	1200	1390	1830	2280				
0.071	1350	1560	2060	2570	3090			
0.080	1520	1760	2320	2900	3480	4060		
0.090	1710	1980	2610	3260	3910	4570		
0.100	1900	2200	2900	3620	4350	5050	5800	
0.112	2000	2470	3250	4060	4870	5700	6500	
0.125		2690	3620	4530	5450	6350	7250	
0.140			4060	5050	6100	7100	8100	
0.160			4640	5800	6950	8100	9300	
0.180			4650	6500	7850	9150	10400	
0.200				7300	8900	10400	11900	
0.224					10000	11700	13300	
0.250					10500	12400	14100	
0.312						14300	17600	
0.375							18600	

TENSION PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
7075-T6 CLAD OR BARE, SHEET OR PLATE
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.185 INCH THICK)
(95 KSI SHEAR STRENGTH)

TABLE III (CONTINUED)

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 9 of 10)



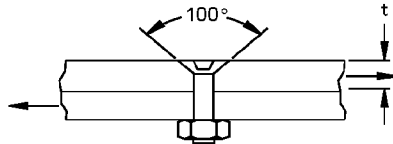
757-200 STRUCTURAL REPAIR MANUAL

NOTES

- [A] BASED ON F_{bru} (AT $e/D = 1.7$) OF 97 KSI FOR 0.036-0.062 GAGES, 101 KSI FOR 0.063-0.128 GAGES, 102 KSI FOR 0.129-0.249 GAGES, 95 KSI FOR 0.250-0.499 GAGES, AND 93 KSI FOR 0.500-1.000 GAGES.
- [B] BASED ON F_{bru} (AT $e/D = 1.7$) OF 97 KSI FOR 0.032-0.062 GAGES, 101 KSI FOR 0.063-0.128 GAGES, 102 KSI FOR 0.129-0.249 GAGES, 95 KSI FOR 0.250-0.499 GAGES.
- [C] 0.1900 THRU 0.3750 DIAMETERS ONLY FOR BACB30UB.
- [D] THIS TABLE MAY ALSO BE USED FOR CLAD 2024-T4 AND 2024-T42 TUBE.
- [E] BEARING YIELD STRENGTH OF CLAD 2024-T42 IS LESS THAN $2/3$ OF BEARING ULTIMATE STRENGTH. THUS, ALLOWABLES ARE BASED ON THE FOLLOWING F_{bry} MULTIPLIED BY 1.5:
 F_{bry} (AT $e/D = 1.7$) OF 52 KSI FOR 0.032-0.062 GAGES, 56 KSI FOR 0.063-0.249 GAGES, AND 53 KSI FOR 0.250-1.000 GAGES.
- [F] THIS TABLE MAY ALSO BE USED FOR 7075-T6, -T6510, -T6511 EXTRUSIONS LESS THAN 0.188 INCH THICK.
- [G] BASED ON F_{bru} (AT $e/D = 1.7$) OF 113 KSI FOR 0.036-0.039 GAGES, 115 KSI FOR 0.040-0.062 gages, 116 KSI FOR 0.063-0.187 GAGES, 119 KSI FOR 0.188-0.249 GAGES, 113 KSI FOR 0.250-0.499 GAGES, AND 115 KSI FOR 0.500-1.000 GAGES.

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 8 (Sheet 10 of 10)

757-200 STRUCTURAL REPAIR MANUAL

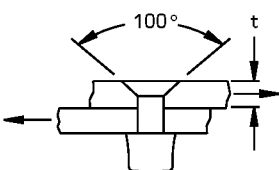
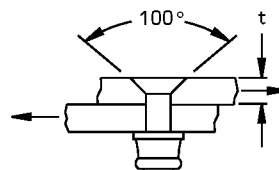
JOINT DESCRIPTION		FLUSH HEAD 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET AND -T351 PLATE					
							
PART NUMBERS	NAS333 THRU 340, NAS517, NAS 583 THRU 590, NAS 663 THRU 668, NAS 1221, BACB30AB, BACB30EM, BACB30LH, BACB30LP, BACB30LR, BACB30LU, BACB30MS, BACB30NN, BACB30PC						
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS B						
0.050	860						
0.056	965	1240					
0.063	1080	1430					
0.071	1220	1630	1920				
0.080	1380	1840	2250				
0.090	1550	2070	2580	2950			
0.100	1720	2300	2870	3350	3750		
0.112	1930	2580	3220	3860	4360	4800	
0.125	2150	2870	3590	4310	5000	5600	
0.140	2410	3220	4020	4830	5650	6450	7250
0.160	2690	3680	4600	5500	6450	7350	8250
0.180		4140	5150	6200	7250	8300	9300
0.190		4320	5400	6550	7650	8750	9800
0.200		4480	5750	6900	8050	9200	10300
0.224		4650	6450	7700	9000	10300	11600
0.250			6900	8600	10000	11500	12900
0.312			7300	10500	12500	14300	16100
0.375					14300	17100	19400
0.438						18600	22200
0.500							23600

FLUSH HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 2024-T3 SHEET OR PLATE (95 KSI SHEAR STRENGTH)
TABLE I

Strengths of Flush Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 9 (Sheet 1 of 3)

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STRUCTURAL REPAIR MANUAL

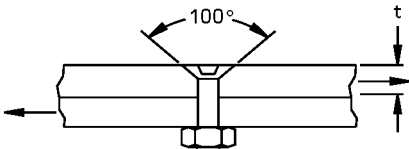
JOINT DESCRIPTION		FLUSH HEAD 95 KSI SHEAR STRENGTH LOCKBOLTS AND HEX DRIVE BOLTS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET AND -T351 PLATE			
					
PART NUMBERS	NAS 1456 THRU 1462, BACB30GX, BACB30JC, BACB30NY, BACB30UA				
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)				
DIAMETER	0.1900	0.2500	0.3125	0.3750	
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS A				
0.050	860				
0.056	965	1240			
0.063	1080	1430			
0.071	1220	1630	1920		
0.080	1380	1840	2250		
0.090	1550	2070	2580	2950	
0.100	1720	2300	2870	3350	
0.112	1930	2580	3220	3860	
0.125	2150	2870	3590	4310	
0.140	2410	3220	4020	4830	
0.160	2690	3680	4600	5500	
0.180		4140	5150	6200	
0.190		4320	5400	6550	
0.200		4480	5750	6900	
0.224		4650	6450	7700	
0.250			6900	8600	
0.312			7300	10500	

FLUSH HEAD BOLTS, LOCKBOLTS, AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 2024-T3 SHEET OR PLATE (95 KSI SHEAR STRENGTH)
TABLE I (CONTINUED)

Strengths of Flush Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 9 (Sheet 2 of 3)

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STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		FLUSH HEAD 95 KSI SHEAR STRENGTH BOLTS IN BARE AND CLAD 7075-T6 ALUMINUM ALLOY SHEET AND -T651 PLATE					
							
PART NUMBERS	BACB30AB, BACB30EM, BACB30FL, BACB30GX [A], BACB30JC [A], BACB30LH, BACB30LP, BACB30LR, BACB30LU, BACB30MS, BACB30NN, BACB30NY [A], BACB30PC, NAS333-340, NAS517, NAS583-590, NAS663-668, NAS1221, NAS1456-1462 [A], BACB30UA [A]						
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS [B]						
0.050	1010	1220					
0.056	1150	1510					
0.063	1260*	1700	1900				
0.071	1380*	1910*	2390	2570			
0.080	1520*	2150*	2700	3000			
0.090	1710*	2350*	3030*	3640	3940		
0.100	1920*	2560*	3370*	4050	4720	5000	
0.112	2190	2820	3630	4530	5260	6000	
0.125	2510*	3160*	4020*	5000*	5900*	6750	7600
0.140	2690	3590*	4450*	5450*	6600*	7550*	8500
0.160		4230*	5100*	6100*	7350*	8650*	9700*
0.180		4650	5850*	6850*	8050*	9450*	10900*
0.190			6250*	7250*	8450*	9850*	11400*
0.200			6650*	7700*	8900*	10200*	11900*
0.224			7250*	8750*	10000*	11300*	12900*
0.250			7300	10000*	10600*	12700*	14200*
0.312				10500	14300*	16500*	18100*
0.375						18600	22600*
0.500							23600*

STANDARD FLUSH HEAD BOLTS, LOCKBOLTS, AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 7075-T6 SHEET OR PLATE (95 KSI SHEAR STRENGTH)

TABLE II

NOTES

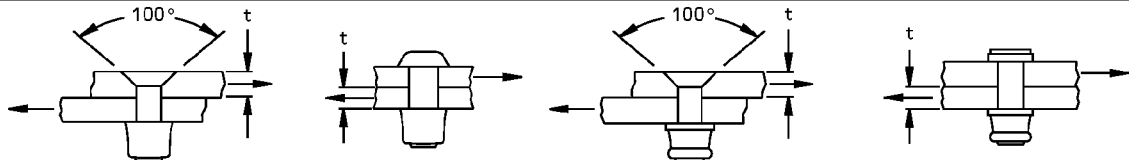
[A] DIA UP TO 0.375 INCLUSIVE

[B] VALUES ABOVE THE HEAVY LINE ARE FOR KNIFE-EDGE CONDITION, AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRCRAFT REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY. (HEAD HEIGHT $\geq t$).

Strengths of Flush Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 9 (Sheet 3 of 3)

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STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		SHEAR, FLUSH AND PROTRUDING HEAD LOCKBOLTS AND HEX DRIVE BOLTS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET AND -T351 PLATE					
							
PART NUMBERS	BACB30FM E , BACB30FN C , BACB30GW, BACB30GY E , BACB30MY B , BACB30NW B , NAS1436-1442 E , NAS1446-1452						
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS E F						
0.050	860	1150					
0.056	965	1280					
0.063	1080	1450	1810				
0.071	1220	1630	2040	2450			
0.080	1380	1840	2290	2760	3220		
0.090	1550	2070	2580	3100	3620	4140	
0.100	1720	2300	2870	3450	4030	4600	5150
0.112	1920	2570	3210	3860	4510	5150	5800
0.125	2020	2870	3590	4310	5050	5750	6450
0.140	2130	3220	4020	4830	5650	6450	7250
0.160	2170	3590	4590	5500	6450	7350	8250
0.180	2250	3670	5200	6200	7250	8300	9300
0.190	2290	3730	5450	6550	7650	8750	9800
0.200	2330	3790	5600	6900	8050	9200	10300
0.224	2430	3920	5750	7700	9000	10300	11600
0.250	2540	4050	5950	8300	10100	11500	12900
0.312	2690	4650	6350	8650	11300	14200	16200
0.375			6500	8900	11800	14900	18300
0.500					12900	16200	19000

SHEAR FLUSH HEAD BOLTS, SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS AND HEX-DRIVE BOLTS IN:

CLAD OR BARE 2024-T3 SHEET OR -T351 PLATE (95 KSI SHEAR STRENGTH)

TABLE I

NOTES

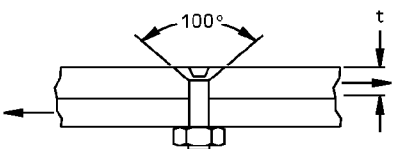
- [A] COUNTERSUNK FASTENERS ARE TO BE AVOIDED WHEN POSSIBLE
- [B] DIAMETER UP TO 0.5625 INCLUSIVE
- [C] DIAMETER UP TO 0.500 INCLUSIVE
- [D] DIAMETER UP TO 0.375 INCLUSIVE

- [E] VALUES ABOVE THE HEAVY LINE ARE FOR KNIFE-EDGE CONDITION, AND THE USE OF FASTENERS IN THIS CONDITION IS UNDESIRABLE. THE USE OF KNIFE-EDGE CONDITION IN DESIGN OF MILITARY AIRPLANE REQUIRES SPECIFIC APPROVAL OF THE PROCURING ACTIVITY (HEAD HEIGHT > t).
- [F] THIS JOINT DOES NOT REACH FULL FASTENER SHEAR STRENGTH FOR DIMENSIONS GREATER THAN 0.250 INCH.

Strengths of Shear Flush Head Bolts, Shear Flush and Protruding Head Lockbolts and Hex-Drive Bolts

Figure 10 (Sheet 1 of 4)

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		SHEAR FLUSH HEAD BOLTS IN BARE AND CLAD 2024-T3 ALUMINUM ALLOY SHEET AND -T351 PLATE								
<div></div>										
PART NUMBERS	BACB30EL, BACB30FB, BACB30LL, BACB30NU, BACB30VF, NAS 8702 THRU 8716									
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)									
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250		
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600	29100		
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS <table border="1"><tr><td>E</td><td>F</td></tr></table>								E	F
E	F									
0.050	860	1150								
0.056	965	1280								
0.063	1080	1450	1810							
0.071	1220	1630	2040	2450						
0.080	1380	1840	2290	2760	3220					
0.090	1550	2070	2580	3100	3620	4140				
0.100	1720	2300	2870	3450	4030	4600	5150			
0.112	1920	2570	3210	3860	4510	5150	5800	6450		
0.125	2020	2870	3590	4310	5050	5750	6450	7200		
0.140	2130	3220	4020	4830	5650	6450	7250	8050		
0.160	2170	3590	4590	5500	6450	7350	8250	9200		
0.180	2250	3670	5200	6200	7250	8300	9300	10300		
0.190	2290	3730	5450	6550	7650	8750	9800	10900		
0.200	2330	3790	5600	6900	8050	9200	10300	11500		
0.224	2430	3920	5750	7700	9000	10300	11600	12900		
0.250	2540	4050	5950	8300	10100	11500	12900	14400		
0.312	2690	4650	6350	8650	11300	14200	16200	18000		
0.375			6500	8900	11800	14900	18300	21500		
0.500					12900	16200	19800	23700		

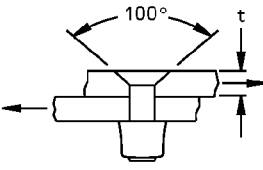
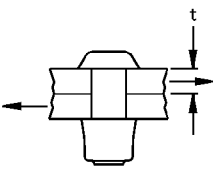
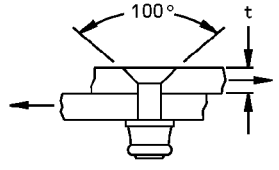
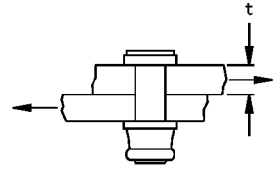
SHEAR FLUSH HEAD BOLTS, SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS
AND HEX-DRIVE BOLTS IN:

CLAD OR BARE 2024-T3 SHEET OR -T351 PLATE (95 KSI SHEAR STRENGTH)
TABLE II

**Strengths of Shear Flush Head Bolts, Shear Flush and Protruding Head Lockbolts and Hex-Drive Bolts
Figure 10 (Sheet 2 of 4)**

757-200

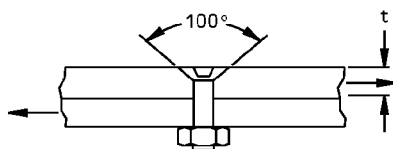
STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS AND HEX DRIVE BOLTS IN BARE AND CLAD 7075-T6 ALUMINUM ALLOY SHEET AND -T651 PLATE					
							
PART NUMBERS	NAS1436 THRU 1442 NAS1446 THRU 1452 BACB30FM BACB30FN BACB30GW	BACB30GY BACB30MY BACB30NW BACB30TY BACB30TZ	BACB30UC BACB30UD BACB30VM BACB30VN BACB30VP	BACB30VR BACB30VT BACB30VU BACB30XT BACB30YP	BACB30FM BACB30FN BACB30MY BACB30NW	BACB30FM BACB30MY BACB30NW	
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS E F						
0.050	1010	1350					
0.056	1130	1500					
0.063	1270	1700	2120				
0.071	1430	1910	2390	2870			
0.080	1620	2150	2700	3240	3780		
0.090	1820	2430	3030	3640	4250	4850	
0.100	2020	2700	3370	4050	4720	5400	6050
0.112	2270	3020	3780	4530	5300	6050	6800
0.125	2530	3370	4220	5050	5900	6750	7600
0.140	2690	3780	4720	5650	6600	7550	8500
0.160		4320	5400	6500	7550	8650	9700
0.180		4580	6050	7300	8500	9700	10900
0.190		4650	6350	7600	8900	10100	11400
0.200			6500	8100	9450	10800	12100
0.224				8900	10600	12100	13600
0.250					11800	13500	15200
0.312					12900	16400	19000
0.375							19900

SHEAR FLUSH HEAD BOLTS, SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS
AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 7075-T6 SHEET OR -T651 PLATE (95 KSI SHEAR STRENGTH)
TABLE III

**Strengths of Shear Flush Head Bolts, Shear Flush and Protruding Head Lockbolts and Hex-Drive Bolts
Figure 10 (Sheet 3 of 4)**

757-200 STRUCTURAL REPAIR MANUAL

JOINT DESCRIPTION		SHEAR FLUSH HEAD BOLTS IN BARE AND CLAD 7075-T6 ALUMINUM ALLOY SHEET AND -T651 PLATE					
<div></div>							
PART NUMBERS	NAS333 THRU 340 BACB30AB BACB30LR NAS517 BACB30EM BACB30LU NAS583 THRU 590 BACB30FL BACB30MS NAS663 THRU 668 BACB30LH BACB30NN NAS1221 BACB30LP BACB30PC						
MATERIAL	ALLOY STEEL, A286, OR 6AL-4V TITANIUM (95 KSI SHEAR STRENGTH)						
DIAMETER	0.1900	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625
SINGLE SHEAR STRENGTH - LBS	2690	4650	7300	10500	14300	18600	23600
THICKNESS INCHES (t)	SINGLE SHEAR ULTIMATE STRENGTH - POUNDS E						
0.050	1010	1220					
0.056	1150	1510					
0.063	1260*	1700	1900				
0.071	1380*	1910*	2390	2570			
0.080	1520*	2150*	2700	3000			
0.090	1710*	2350*	3030*	3640	3940		
0.100	1920*	2560*	3370*	4050	4720	5000	
0.112	2190	2820	3630	4530	5260	6000	
0.125	2510*	3160*	4020*	5000*	5900*	6750	7600
0.140	2690	3590*	4450*	5450*	6600*	7550*	8500
0.160		4230*	5100*	6100*	7350*	8650*	9700*
0.180		4650	5850*	6850*	8050*	9450*	10900*
0.190			6250*	7250*	8450*	9850*	11400*
0.200			6650*	7700*	8900*	10200*	11900*
0.224			7250	8750*	10000*	11300	12900*
0.250			7300	10000*	10600*	12700*	14200*
0.312				10500	14300	16500*	18100*
0.375						18600	22600*
0.500							23600

SHEAR FLUSH HEAD 95 KSI SHEAR STRENGTH BOLTS IN CLAD OR BARE 7075-T6 SHEET
AND -T651 PLATE
TABLE IV

*INDICATED ULTIMATE VALUES EXCEED 1.5 TIMES THE YIELD VALUES

**Strengths of Shear Flush Head Bolts, Shear Flush and Protruding Head Lockbolts and Hex-Drive Bolts
Figure 10 (Sheet 4 of 4)**



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STRUCTURAL REPAIR MANUAL

FASTENER PART NUMBERS			BACB30PT		
FASTENER DIAMETER			1/4	5/16	3/8
SINGLE SHEAR (LB)			4800	7450	10700
SINGLE SHEAR BEARING STRENGTH (LB)	MATERIAL GAGE	0.071	1970		
		0.080	2270		
		0.090	2580	3120	
		0.100	2870	3530	4100
		0.112	3190	3910	4570
		0.125	3280	4460	5250
		0.140	3530	4760	6000
		0.160	3870	5150	6650
		0.190	4360	5850	7400
		0.200	4530	6000	7600
		0.224	4800	6500	8200
		0.250		7050	8900
		0.312		7450	10400
		0.375			10700

70° HEAD RADIUS LEAD-IN BOLT IN
CLAD OR BARE 7075-T6 SHEET OR PLATE
95 KSI SHEAR STRENGTH
TABLE I

Strengths of 70 Degree Head Radius Lead-In Bolts
Figure 11

757-200 STRUCTURAL REPAIR MANUAL

SUBSTITUTE RIVET	RIVETED MATERIAL	RIVET DIAMETER		RIVETED MATERIAL GAGE															
		INITIAL MS20470D OR BACR15BB-D	SUBSTITUTE RIVET	QUANTITY FACTOR C															
				.025	.028	.032	.036	.040	.045	.050	.056	.063	.071	.080	.090	.100	.112	.125	
NAS1398D BLIND PROTRUDING HEAD RIVET A B D	CLAD OR BARE 2024-T3 2024-T4 ALUMINUM ALLOY	1/8	1/8	1.5	1.5	1.5	1.5	1.5	1.4	1.3	1.2	1.1	1.1	1.0					
		5/32	5/32	1.3	1.3	1.2	1.2	1.2	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7			
		5/32	5/32	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.4	1.3	1.2	1.2	1.1				
		3/16	3/16	1.5	1.5	1.4	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.9	0.8	0.8			
	3/16	3/16	1.8	1.8	1.6	1.6	1.5	1.5	1.5	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.1	1.0	
	1/4	1/4			1.4	1.4	1.3	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7		
	1/4	1/4			1.8	1.8	1.7	1.7	1.5	1.6	1.6	1.6	1.5	1.4	1.3	1.3	1.3	1.2	
	1/8	1/8	1.8	1.8	1.7	1.5	1.5	1.4	1.3	1.2	1.1	1.1	1.0						
	5/32	5/32	1.6	1.6	1.4	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7				
	5/32	5/32	2.0	2.0	1.8	1.8	1.7	1.5	1.5	1.4	1.3	1.2	1.2	1.1					
	3/16	3/16	1.9	1.9	1.7	1.6	1.4	1.4	1.2	1.1	1.0	1.0	0.9	0.8	0.8				
	3/16	3/16	2.2	2.2	2.0	2.0	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.1	1.0	
1/4	1/4			1.7	1.7	1.5	1.4	1.3	1.1	1.0	1.0	1.0	0.9	0.8	0.8	0.7	0.7		
BACR15BB()AD() OR MS20470AD PROTRUDING HEAD RIVETS	CLAD OR BARE 2024-T3 2024-T4 ALUMINUM ALLOY	1/4	1/4			2.2	2.2	2.0	2.0	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	
		1/8	1/8	1.0	1.0	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3					
		5/32	5/32	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9					
		5/32	5/32	1.0	1.0	1.0	1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3					
	3/16	3/16	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9					
	3/16	3/16	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.3	1.3	1.3	1.3						
	1/4	1/4							0.8	0.8	0.8	0.8	0.8						
	1/4	1/4							1.0	1.1	1.2	1.3	1.3	1.3					
	5/16	5/16																	
	1/8	1/8	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3						
	5/32	5/32	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9						
	5/32	5/32	1.0	1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3						
3/16	3/16	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9							
3/16	3/16	1.0	1.0	1.0	1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2		
1/4	1/4								0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7		
1/4	1/4								1.1	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2		
5/16	5/16																0.9		

Fastener Substitution for MS20470D and BACR15BB()D Universal Head Rivets
Figure 12 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL

SUBSTITUTE RIVET	RIVETED MATERIAL	RIVET DIAMETER		RIVETED MATERIAL GAGE															
		INITIAL MS20470D OR BACR15BB-D	SUBSTITUTE RIVET	.025	.028	.032	.036	.040	.045	.050	.056	.063	.071	.080	.090	.100	.112	.125	
				QUANTITY FACTOR C															
NAS1738E BLIND PROTRUDING HEAD RIVET A B D E	CLAD OR BARE 2024-T3 2024-T4 ALUMINUM ALLOY	1/8	1/8		1.7	1.7	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8					
		5/32	5/32		1.3	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5			
		5/32	5/32		1.7	1.7	1.7	1.7	1.5	1.4	1.2	1.1	1.0	1.1	1.0	0.9	0.9	0.8	
		3/16	3/16		1.5	1.4	1.4	1.5	1.3	1.2	1.1	1.0	1.0	0.8	0.8	0.7	0.7	0.6	
	3/16	3/16			1.7	1.7	1.7	1.7	1.7	1.7	1.5	1.3	1.2	1.1	1.0	0.9	0.9	0.9	
	CLAD OR BARE 7075-T6 ALUMINUM ALLOY	1/8	1/8		1.4	1.3	1.3	1.2	1.1	1.1	1.0	0.9	0.8	0.8					
		5/32	5/32		1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.5		
		5/32	5/32		1.2	1.3	1.4	1.4	1.3	1.2	1.1	1.1	1.0	1.1	0.9	0.9	0.8		
		3/16	3/16		1.0	1.0	1.1	1.1	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6
		3/16	3/16			1.2	1.3	1.4	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.9	0.9	0.9

NOTES

- THIS FASTENER SUBSTITUTION TABLE IS NOT APPLICABLE TO THE STRUCTURAL AREAS ON THE AIRPLANE THAT ARE SPECIFIED IN PARAGRAPH 1.C.
- REFER TO SRM 51-40-05 FOR THE CORRECT FASTENER HOLE SIZES.
- MULTIPLY THE QUANTITY FACTORS BY 1.5 FOR BLIND RIVETS THAT ARE SUBSTITUTED ON ALL FASTENED JOINTS IN PRIMARY STRUCTURE, AND FASTENED JOINTS THAT ARE SUBJECT TO ALTERNATING LOADS.
- KEEP THE QUANTITY OF BLIND RIVETS TO A MINIMUM WHEN YOU USE THEM TO REPLACE SOME OF THE SOLID RIVETS IN A GIVEN JOINT. THIS WILL MAKE SURE THAT OVER-STRESSING OF THE REMAINING SOLID RIVETS WILL NOT OCCUR.
- ONLY USE THESE QUANTITY FACTORS FOR RIVETS THAT ARE IN SINGLE SHEAR LOADING APPLICATIONS.
- YOU CAN SUBSTITUTE NAS1738E RIVETS FOR NAS1398D RIVETS, BUT ONLY IF THE SHEET THICKNESS ON THE OPPOSITE SIDE IS LESS THAN 1/4 OF THE HOLE DIAMETER. MAKE SURE THAT THE ACCESSIBILITY OF THE RIVETING TOOL IS ADEQUATE ALSO.
- INSTALL NAS1738 RIVETS IN A LARGER SIZE HOLE THAN THE INITIAL FASTENER HOLE SIZE. USE THE TABLE THAT FOLLOWS FOR THE CORRECT HOLE SIZES TO INSTALL NAS1738 RIVETS.

RIVET NOMINAL DIAMETER	MINIMUM HOLE DIAMETER	MAXIMUM HOLE DIAMETER
1/8	0.143	0.146
5/32	0.176	0.180
3/16	0.205	0.209

Fastener Substitution for MS20470D and BACR15BB(D) Universal Head Rivets
Figure 12 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

SUBSTITUTE RIVET	RIVETED MATERIAL	RIVET DIAMETER		RIVETED MATERIAL GAGE															
		INITIAL MS20426D OR BACR15BA-D	SUBSTITUTE RIVET	QUANTITY FACTOR [C]															
				.040	.045	.050	.056	.063	.071	.080	.090	.100	.112	.125	.140	.160	.180		
NAS1399D BLIND RIVET IN COUNTER- SUNK HOLES [A][B][D]	CLAD OR BARE 2024-T3 2024-T4 7075-T6 ALUMINUM ALLOY	5/32	5/32		3.5	2.8	2.6	2.4	2.0	1.6	1.4	1.2	1.0						
			3/16			2.4	2.0	1.8	1.5	1.3	1.1	0.9	0.8	0.7					
		3/16	3/16			2.9	2.5	2.2	2.0	1.8	1.6	1.3	1.1	1.0					
			1/4					2.1	1.9	1.7	1.4	1.2	1.0	0.8	0.7				
BACR15BA()AD OR MS20426AD RIVETS IN COUNTERSUNK HOLES	CLAD OR BARE 2024-T3 2024-T4 7075-T6 ALUMINUM ALLOY	1/4	1/4						2.7	2.4	2.1	1.9	1.7	1.4	1.2	1.2			
			5/32		1.1	1.1	1.2	1.3	1.3	1.3									
			3/16		1.0	0.9	0.9	0.9	1.0	1.0	0.9	0.9							
		3/16	3/16			1.1	1.1	1.2	1.3	1.3	1.3	1.3	1.3						
NAS1739E BLIND RIVETS IN COUNTER- SUNK HOLES [A][B][D][E]	CLAD OR BARE 2024-T3 2024-T4 7075-T6 ALUMINUM ALLOY	5/32	5/32	1.4	1.3	1.4	1.3	1.2	1.3	1.2	1.1	1.0	0.9	0.8	0.8				
			3/16	1.2	1.2	1.2	1.1	1.1	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.6			
		3/16	3/16			1.4	1.4	1.3	1.3	1.3	1.3	1.2	1.1	1.0	0.9	0.9			

NOTES

- [A] THIS FASTENER SUBSTITUTION TABLE IS NOT APPLICABLE TO THE STRUCTURAL AREAS ON THE AIRPLANE THAT ARE SPECIFIED IN PARAGRAPH 1.C.
- [B] REFER TO SRM 51-40-05 FOR THE CORRECT FASTENER HOLE SIZES.
- [C] MULTIPLY THE QUANTITY FACTORS BY 1.5 FOR BLIND RIVETS THAT ARE SUBSTITUTED ON ALL FASTENED JOINTS IN PRIMARY STRUCTURE, AND FASTENED JOINTS THAT ARE SUBJECT TO ALTERNATING LOADS.
- [D] YOU CAN SUBSTITUTE NAS1738E RIVETS FOR NAS1398D RIVETS, BUT ONLY IF THE SHEET THICKNESS ON THE OPPOSITE SIDE IS LESS THAN 1/4 OF THE HOLE DIAMETER. MAKE SURE THAT THE ACCESSIBILITY OF THE RIVETING TOOL IS ADEQUATE ALSO.
- [E] INSTALL NAS1738 RIVETS IN A LARGER SIZE HOLE THAN THE INITIAL FASTENER HOLE SIZE. USE THE TABLE THAT FOLLOWS FOR THE CORRECT HOLE SIZES TO INSTALL NAS1738 RIVETS.

RIVET NOMINAL DIAMETER	MINIMUM HOLE DIAMETER	MAXIMUM HOLE DIAMETER
1/8	0.143	0.146
5/32	0.176	0.180
3/16	0.205	0.209

Fastener Substitution for MS20426D and BACR15BA()D Rivets in Countersunk Holes
Figure 13



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GENERAL - COUNTERSINKING

1. Applicability

- A. The instructions given in this subject are applicable to countersink holes in metal structures.
- B. Refer to 51-70-16 to find the instructions to countersink holes in composite structures.

2. General

- A. Some of the information in this subject can be found in Boeing Process Specifications BAC5004-1, BAC5004-2, BAC5004-3, BAC5009, BAC5047, and BAC5060.
- B. Refer to the Boeing Engineer Drawings and 51-10-01, GENERAL for fastener head flushness specifications.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-40-02, GENERAL	Fastener Installation and Removal
51-40-05, GENERAL	Fastener Hole Sizes
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
53-00-01	FUSELAGE SKIN - GENERAL
AMM 20-30-92/201	Aircraft Maintenance Manual
SOPM 20-30-92	Final Cleaning Prior to General Sealing (Series 92)

4. The Use of the Countersink-Microstop Tool

- A. Use the countersink-microstop tool that is fitted with a removable cutter. Refer to Figure 1/GENERAL for use of the microstop countersink.
 - (1) The shaft of the countersink-microstop tool moves on a bearing inside an adjustable locking sleeve and foot piece assembly. The foot piece (or stop) fits on to the shaft bearing, and permits adjustments in countersink depth. You can make adjustments in increments of 0.001 inch.

CAUTION: MAKE SURE THAT THE PILOT PIN IS APPROXIMATELY 0.002 INCH LESS IN DIAMETER THAN THE FASTENER HOLE. THIS WILL PERMIT THE CUTTER TO SPIN WITHOUT BINDING INSIDE THE HOLE. IF YOU DO NOT OBEY, THE CUTTER WILL NOT OPERATE CORRECTLY AND THE RESULT CAN BE AN UNSATISFACTORY COUNTERSINK.

- (2) A pilot pin guides the spinning cutter as it cuts into the material.
- B. Countersink cutters are available with different cutting angles. The standard tool number code is stamped on each cutter as shown in Figure 1/GENERAL.

5. Instructions to use the Countersink-microstop Tool

NOTE: To cut a 120 degree countersink for a BACR15FV or MS14218 Rivet, refer to Paragraph 6./GENERAL for the procedure.

- A. To make the countersink depth adjustment on the countersink-microstop tool, do the steps that follow:
 - (1) Pull the sleeve back.
 - (2) Turn the stop to the correct countersink depth.
 - (3) Put the splines on the tool together so that the adjustment is securely locked.

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B. Before you use the countersink-microstop tool, do as follows:

- (1) Do a visual inspection of the countersink cutter. Do a check for:
 - (a) Pilot Size
 - (b) Sharpness
 - (c) Degrees to the cutting angle
 - (d) True running
- (2) Make sure that the face on the countersink-microstop tool is clean and polished so that you do not cause damage to the repair material.

C. To use the countersink-microstop tool, do as follows:

NOTE: Do the countersink on a piece of scrap material to verify the adjustment before you do it on the repair material.

- (1) Set the cutter to a safe depth, and slowly increase the depth to the correct setting.

NOTE: Make sure that you hold the countersink-microstop tool at a 90-degree angle to the material.

- (2) Make a full depth of cut each time.
- (3) Apply the pressure directly behind the countersink.
- (4) Do not permit the stop to spin on the repair material.
- (5) Install the repair fasteners as shown in 51-40-02, GENERAL.
- (6) Inspect for the correct fastener-head height as shown in 51-40-02, GENERAL.
- (7) When you can install the fasteners correctly in the piece of scrap metal, you can use the countersink-microstop tool to do the repair.

6. Instructions to use the Countersink-Microstop Tool and ST1221V Cutter to Make a Counterbore-Countersink for BACR15FV Rivets

A. To make the counterbore-countersink for the BACR15FV rivets, do the steps that follow:

- (1) Use the ST1221V counterbore-countersink cutter and the ST1221 countersink-microstop tool to make counterbore-countersink holes in a piece of scrap metal.

NOTE: Use a piece of scrap metal that is the same alloy and thickness as the initial or repair part.

CAUTION: MAKE SURE THAT THE COUNTERSINK DEPTH IS NOT GREATER THAN THE MAXIMUM DEPTH "B" AS SHOWN IN FIGURE 3/GENERAL. IF YOU DO NOT OBEY, YOU CAN CAUSE A KNIFE EDGE CONDITION IN THE SKIN.

- (2) Inspect the countersink depth as shown in Figure 3/GENERAL. If the countersink depth is incorrect, adjust the countersink-microstop tool and do steps (1) and (2) again.

CAUTION: IF YOU ENTER THE COUNTERBORE AGAIN TO ADJUST THE DEPTH, DO NOT START THE CUTTER ROTATION UNTIL THE CUTTER IS SEATED IN THE COUNTERBORE. IF YOU DO NOT OBEY, YOU CAN CAUSE AN OUT-OF-ROUND COUNTERBORE. AFTER THE CUTTER IS SEATED, START IT SLOWLY AND INCREASE THE SPEED UP TO THE RECOMMENDED MAXIMUM OF 3,000 RPM.

- (3) Inspect the countersink depth as shown in Figure 3/GENERAL again.



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- (4) If the counterbore diameter is still incorrect, install a new ST1221V cutter in the countersink-microstop tool and do steps (1) through (3) again.

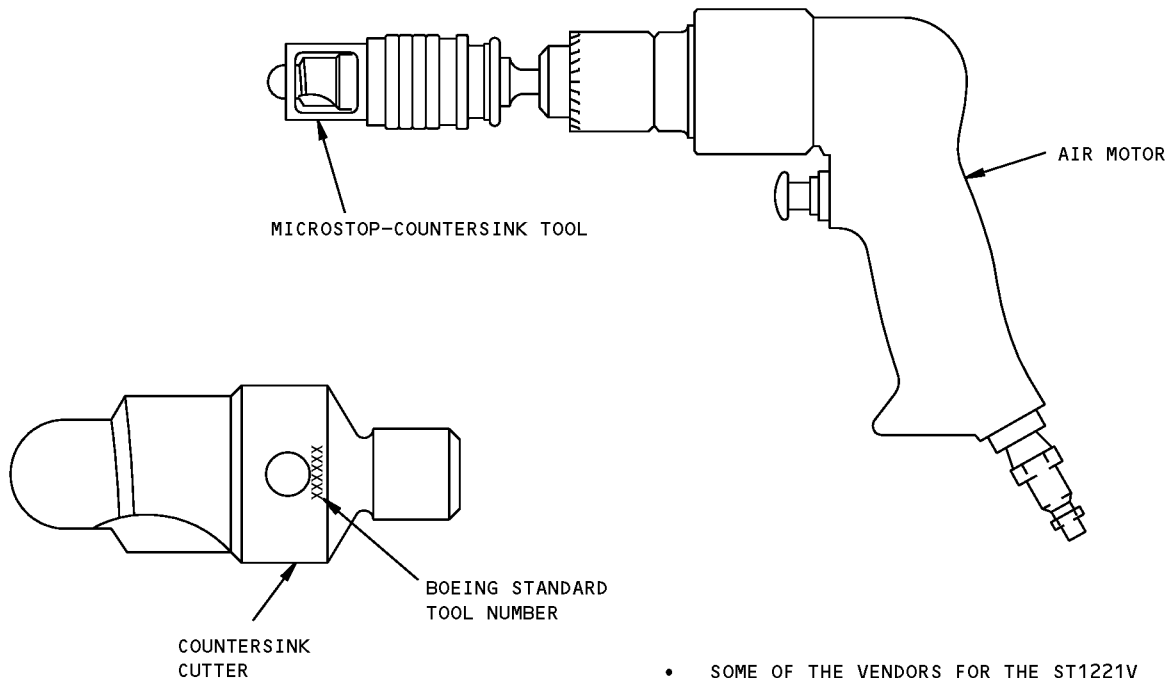
NOTE: Do not sharpen the ST1221V counterbore-countersink cutter. You must remove it from service.

- (5) Install a minimum of five BACR15FV rivets in the piece of scrap metal as shown in 51-40-02, GENERAL. Use the standard rivet gun, flush die set, and bucking bar.
- (6) Inspect the fasteners for the correct fastener head height as shown in 51-40-02, GENERAL.

NOTE: If the fastener head height is incorrect, strike the fastener head again and do step (6) again. If the head height is still incorrect, do steps (2) through (6) again.

- B. When you can install the fasteners correctly in the piece of scrap metal, you can use the countersink-microstop tool to do the repair.

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- TO FIND THE CORRECT COUNTERSINK DEPTH:

- USE THE MICROSTOP-COUNTERSINK TOOL TO MAKE 5 COUNTERSINK HOLES IN A SCRAP PIECE OF METAL. THE SCRAP PIECE OF METAL SHOULD BE MADE FROM THE SAME ALLOY AND THICKNESS AS THE PART THAT YOU COUNTERSINK
- INSTALL 5 FLUSH-HEAD REPAIR-FASTENERS IN THE SCRAP PIECE OF METAL
- INSPECT THE FASTENERS FOR CORRECT FASTENER-HEAD HEIGHT. REFER TO SRM 51-40-02
- ADJUST THE MICROSTOP-COUNTERSINK TOOL AND DO THE ABOVE STEPS AGAIN, UNTIL YOU GET THE CORRECT FASTENER-HEAD HEIGHT
- WHEN THE MICROSTOP-COUNTERSINK TOOL IS ADJUSTED FOR THE CORRECT FASTENER-HEAD HEIGHT, YOU CAN USE THE TOOL FOR THE REPAIR.

- TO SELECT THE MICROSTOP-COUNTERSINK TOOL, CUTTER, AND PILOT, SEE BOEING STANDARD TOOL DRAWINGS ST1221, ST1222 AND ST1223.
- IF COLDWORK IS NECESSARY, COLDWORK THE HOLE BEFORE YOU COUNTERSINK THE HOLE.

- SOME OF THE VENDORS FOR THE ST1221V COUNTERSINK CUTTER FOR BACR15FV AND MS14218 RIVETS ARE:

CRAIG TOOLS, INC
142 LOMITA STREET
EL SEGUNDO, CA 90245

E.F. BAILEY COMPANY
5610 - 4TH AVE. S.
SEATTLE, WA 98108

GENERAL TOOLS
5614 - 7TH AVE S.
SEATTLE, WA 98108

MAGNAVON INDUSTRIES
801 SOUTH RICHFIELD ROAD
PLACENTIA, CA 92670

PACIFIC DISTRIBUTING, INC.
7118 BEACON AVE S.
SEATTLE, WA 98108

WEST COAST INDUSTRIES
14900 WHITMAN AVE. N.
SEATTLE, WA 98133

- SOME OF THE VENDORS FOR THE ST1219, ST1221B, ST1222B AND ST1223B MICROSTOP-COUNTERSINK TOOLS ARE:

AIRTECH INTERNATIONAL INC.
2542 E. DE LAMO BLVD
CARSON, CA 90749

PACIFIC DISTRIBUTING, INC
7118 BEACON AVE. S.
SEATTLE, WA 98108

**The Microstop-Countersink Tool
Figure 1**

STRUCTURAL REPAIR MANUAL

REPAIR INSTRUCTIONS

NOTE: Use this special repair washer to plug existing countersinks for repairs where called out in this manual. A typical repair application is illustrated in Detail I.

For BACR15FV or MS14218 repair washer, any of the following may be done. Drill out rivet and plug the countersink with a standard repair washer (Ref Dwg 66-2955), machine washer from dimensions in Table I, or refer to 53-00-01 for using the rivet head as a repair washer.

1. Fabricate the countersink repair washer to match the original countersunk hole. See Tables I and II.

2. Solvent Clean:

WARNING: WHEN USING MEK (METHYL ETHYL KETONE) AVOID BREATHING OF VAPOR OR CONTACT WITH SKIN. WEAR RUBBER GLOVES. WHEN WORKING IN A CONFINED SPACE, ADEQUATE VENTILATION OR RESPIRATORY PROTECTION MUST BE PROVIDED. INJURY TO PERSONNEL MAY OCCUR.

- A. Clean countersink and the washer with MEK.
- B. Wipe off MEK before it has evaporated with a clean cloth.
- C. Repeat applications of clean solvent as necessary to remove oils.

3. Apply Sealant:

- A. Apply BMS 5-95 sealant between the mating surfaces of the countersink and the washer.
- B. Attach the surfaces with sufficient pressure to make sure the washer bonds correctly.
- C. The assembly may be moved immediately. 48 hours or more after the washer is installed, the assembly will have maximum strength.

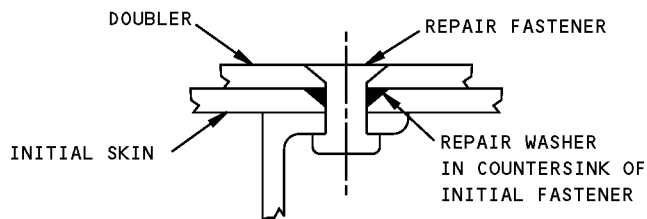
NOTES

- WHEN YOU USE THIS REPAIR REFER TO:

- SRM 51-10-00 FOR INVESTIGATION AND CLEANUP OF DAMAGE
- SRM 51-20-01 FOR PROTECTIVE TREATMENT OF METALLIC AND NONMETALLIC MATERIALS
- SRM 51-20-05 FOR REPAIR SEALING

A APPLY A CHEMICAL CONVERSION COATING AS GIVEN IN SRM 51-20-01

B OTHER SIZES CAN BE FOUND IN BOEING DRAWING 66-2955



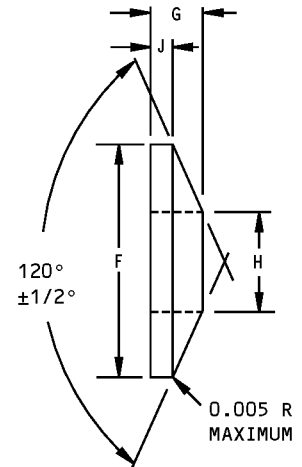
DETAIL I

Countersink Repair Washer
Figure 2 (Sheet 1 of 3)

757-200 STRUCTURAL REPAIR MANUAL

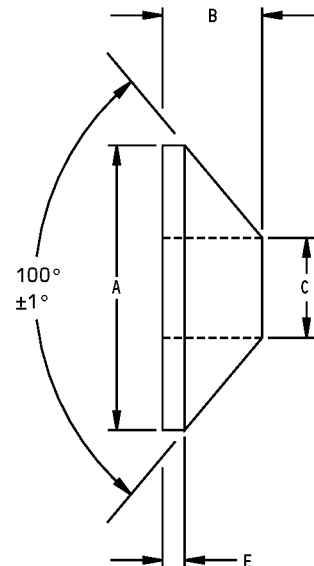
	NOM. RIVET DIA	F +0.000 -0.002	G REF	H		J MIN.	MATERIAL [A]
				MIN.	MAX.		
BACR15FV MS14218	0.125	0.162	0.027	0.128	0.135	0.014	2024-T4 BAR
	0.156	0.210	0.035	0.161	0.167	0.017	
	0.188	0.258	0.044	0.193	0.200	0.021	
	0.219	0.312	0.053	0.228	0.235	0.024	
	0.250	0.358	0.061	0.257	0.265	0.027	
	0.281	0.405	0.069	0.290	0.298	0.030	

120° HEAD COUNTERSINK REPAIR WASHERS
TABLE I



INITIAL FASTENER TYPE	DIA.	COUNTERSINK REPAIR WASHER [B]				
				DIMENSIONS		MATERIAL [A]
		A ±0.005	B (REF.)	C (DIAMETER)	E +0.005 -0.002	
BACR15CE	1/8	0.181	0.030	0.128/0.135	0.006	2024-T4 BAR OR MAKE FROM BACR15CE() RIVET
BACR15GF	5/32	0.234	0.037	0.159/0.171	0.006	
NAS1097	3/16	0.284	0.045	0.191/0.202	0.006	
	1/4	0.382	0.060	0.254/0.265	0.006	
BACR15BA BACB30ND BACB30NZ BACB30DY BACB30HD BACB30HA NAS1399	1/8	0.216	0.043	0.128/0.135	0.006	2024-T4 BAR OR MAKE FROM BACR15BA() RIVET
	5/32	0.278	0.056	0.159/0.171	0.006	
	3/16	0.344	0.070	0.191/0.202	0.006	
	7/32	0.344	0.057	0.221/0.233	0.006	
	1/4	0.439	0.093	0.254/0.265	0.015	
	9/32	0.439	0.080	0.284/0.296	0.015	
	5/16	0.527	0.105	0.312/0.316	0.015	
	11/32	0.527	0.092	0.344/0.348	0.015	
	3/8	0.657	0.133	0.375/0.379	0.015	
	13/32	0.657	0.120	0.406/0.410	0.015	
	7/16	0.747	0.152	0.437/0.422	0.022	
	15/32	0.747	0.139	0.469/0.474	0.022	
	1/2	0.860	0.173	0.500/0.505	0.022	
	17/32	0.860	0.160	0.531/0.536	0.022	

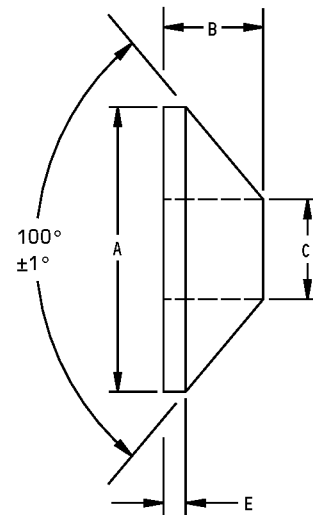
100° HEAD COUNTERSINK REPAIR WASHERS
TABLE II



Countersink Repair Washer
Figure 2 (Sheet 2 of 3)

757-200
STRUCTURAL REPAIR MANUAL

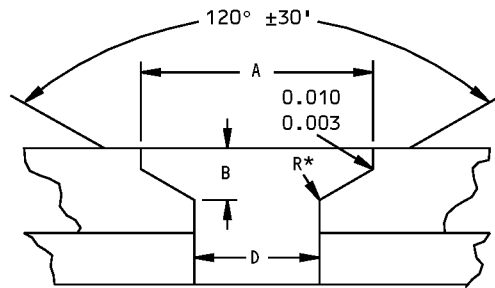
INITIAL FASTENER TYPE	DIA.	COUNTERSINK REPAIR WASHER B				MATERIAL A
		DIMENSIONS				
		A ±0.005	B (REF.)	C (DIAMETER)	E +0.005 -0.002	
BACB30FN BACB30GY BACB30EL BACB30NU	3/16	0.277	0.046	0.191/0.194	0.010	2024-T4 BAR
	7/32	0.277	0.034	0.219/0.223	0.010	
	1/4	0.358	0.060	0.250/0.254	0.015	
	9/32	0.358	0.047	0.281/0.285	0.015	
	5/16	0.438	0.068	0.312/0.328	0.015	
	11/32	0.438	0.055	0.344/0.348	0.015	
	3/8	0.525	0.078	0.375/0.379	0.015	
	13/32	0.525	0.065	0.406/0.410	0.015	
	7/16	0.617	0.097	0.437/0.442	0.022	
	15/32	0.617	0.084	0.469/0.474	0.022	
	1/2	0.704	0.108	0.500/0.505	0.022	
	17/32	0.704	0.095	0.531/0.536	0.022	
BACB30JC BACB30NY BACB30LU BACB30MS	3/16	0.344	0.079	0.191/0.194	0.015	
	7/32	0.344	0.068	0.219/0.223	0.015	
	1/4	0.469	0.106	0.250/0.254	0.015	
	9/32	0.469	0.094	0.281/0.285	0.015	
	5/16	0.595	0.133	0.312/0.328	0.015	
	11/32	0.595	0.121	0.344/0.348	0.015	
	3/8	0.722	0.160	0.375/0.379	0.015	
	13/32	0.722	0.148	0.406/0.410	0.015	
	7/16	0.835	0.189	0.437/0.442	0.022	
	15/32	0.835	0.176	0.469/0.474	0.022	
	1/2	0.961	0.217	0.500/0.505	0.022	
	17/32	0.961	0.204	0.531/0.536	0.022	



100° HEAD COUNTERSINK REPAIR WASHERS
TABLE II (CONT.)

Countersink Repair Washer
Figure 2 (Sheet 3 of 3)

757-200 STRUCTURAL REPAIR MANUAL



NOMINAL RIVET DIA	A		B MAX.	D		STD DRILL NO.	R*±0.004
	MIN.	MAX.		MIN.	MAX.		
1/8 (0.125)	0.1625	0.1655	0.028	0.128	0.135	30	0.008
5/32 (0.156)	0.2105	0.2140	0.035	0.159	0.167	21	0.009
3/16 (0.188)	0.2585	0.2625	0.044	0.190	0.200	11	0.012
7/32 (0.219)	0.3125	0.3170	0.053	0.228	0.235	1	0.015
1/4 (0.250)	0.3585	0.3640	0.061	0.255	0.261	F	0.018
9/32 (0.281)	0.4055	0.4110	0.069	0.290	0.298	L	0.020
5/16 (0.313)	0.4545	0.4600	0.078	0.316	0.327	0	0.022

COUNTERSINK FOR BACR15FV AND MS14218 RIVETS
DETAIL I

STANDARD TOOL NUMBER	FUNCTION	SUPPLIER		
ST8703XA OR ST8703XB ST8703GF	GAGE, COUNTERSINK, DEPTH GAGE, COUNTERBORE DIAMETER, GO-NO-GO	<table><tr><td>A</td></tr><tr><td>B</td></tr></table>	A	B
A				
B				

BACR15FV AND MS14218 RIVET COUNTERSINK/COUNTERBORE MEASUREMENT
TABLE I

NOTES

- THE SOURCE OF INFORMATION FOR THIS FIGURE CAN BE FOUND IN BOEING PROCESS SPECIFICATION BAC5004-1

A

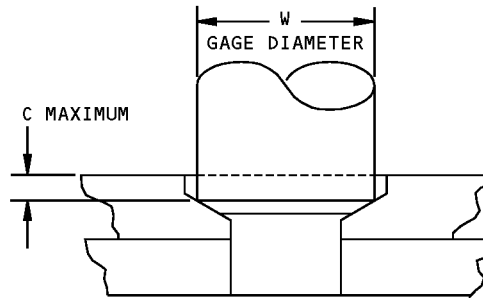
 THE BOEING COMPANY

B

 WEST COAST INDUSTRIES
14900 WHITMAN AVE N.
SEATTLE, WA 98133

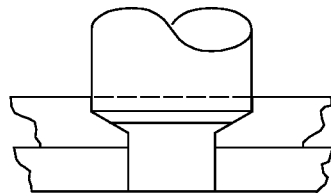
BACR15FV and MS14218 Solid Rivets
Figure 3 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL

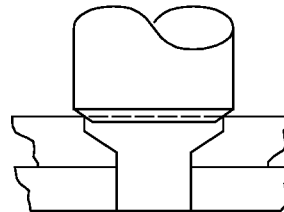


NOMINAL RIVET DIAMETER	W DIAMETER		C MAXIMUM
	MINIMUM	MAXIMUM	
1/8	0.1523	0.1525	0.0204
5/32	0.2003	0.2005	0.0229
3/16	0.2483	0.2485	0.0269
7/32	0.3023	0.3025	0.0313
1/4	0.3483	0.3485	0.0337
9/32	0.3953	0.3955	0.0382
5/16	0.4243	0.4245	0.0464

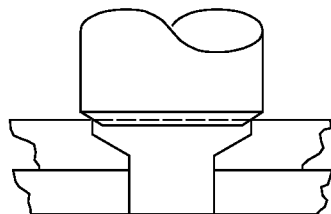
USE OF ST8703XB COUNTERSINK DEPTH GAGE FOR BACR15FV AND MS14218 RIVETS DETAIL II



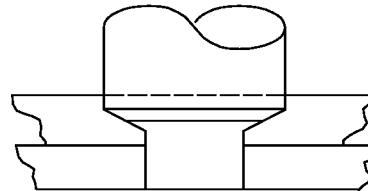
'GO' END FITS
(ACCEPTABLE CONDITION -
TRY THE 'NO-GO' END)



'GO' END DOES NOT FIT
(UNACCEPTABLE CONDITION -
COUNTERBORE IS TOO SMALL)



'NO-GO' END DOES NOT FIT
(ACCEPTABLE CONDITION)

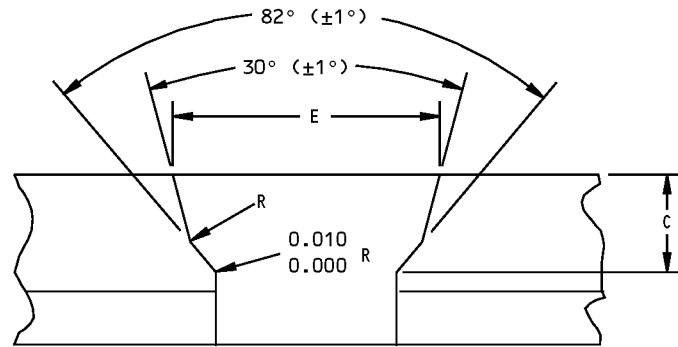


'NO-GO' END FITS
(UNACCEPTABLE CONDITION -
COUNTERBORE IS TOO LARGE)

USE OF ST8703GF COUNTERBORE DIAMETER 'GO-NO-GO' GAGE FOR BACR15FV AND MS14218 RIVETS DETAIL III

BACR15FV and MS14218 Solid Rivets Figure 3 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL



COUNTERSINK DIMENSIONS
DETAIL I

NOTES

- ALL DIMENSIONS ARE IN INCHES
- SEE TABLE I FOR BACR15FH AND BACR15GH RIVETS
- SEE TABLE II FOR BACR15FH AND BACR15GH OVERSIZE RIVETS

Dimensions of Modified 82/30 Degree Countersink
Figure 4 (Sheet 1 of 2)

757-200
STRUCTURAL REPAIR MANUAL

COUNTERSINK TYPE	RIVET DIAMETER	DIMENSION C		DIMENSION E		RADIUS R	
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
IV	1/4	0.089	0.100	0.349	0.354	0.09	0.12
	5/16	0.099	0.110	0.419	0.424	0.09	0.12
	3/8	0.105	0.120	0.479	0.484	0.09	0.12
V	5/32	0.060	0.070	0.219	0.224	0.03	0.05
	3/16	0.075	0.085	0.270	0.275	0.09	0.12
	1/4	0.102	0.112	0.355	0.360	0.09	0.12
	5/16	0.128	0.138	0.434	0.439	0.09	0.12
	3/8	0.154	0.164	0.503	0.508	0.09	0.12
	7/16	0.183	0.193	0.588	0.593	0.09	0.12

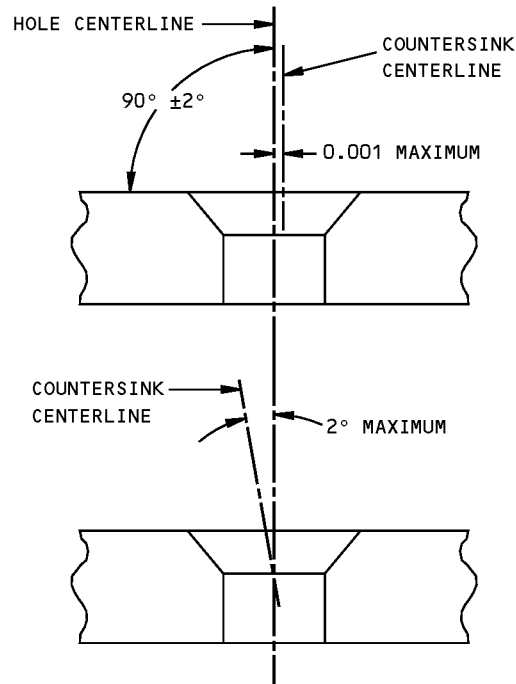
COUNTERSINK DIMENSIONS FOR BACR15FH AND BACR15GH RIVETS
TABLE I

COUNTERSINK TYPE	RIVET DIAMETER	DIMENSION C		DIMENSION E		RADIUS R	
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
IV	7/32	0.075	0.085	0.300	0.305	0.09	0.12
	9/32	0.090	0.100	0.379	0.384	0.09	0.12
	11/32	0.100	0.110	0.449	0.454	0.09	0.12
	13/32	0.107	0.117	0.509	0.514	0.09	0.12
	7/16	0.115	0.125	0.549	0.554	0.09	0.12
V	7/32	0.075	0.085	0.300	0.305	0.09	0.12
	9/32	0.102	0.112	0.385	0.390	0.09	0.12
	11/32	0.128	0.138	0.464	0.469	0.09	0.12
	13/32	0.154	0.164	0.533	0.538	0.09	0.12
	7/16	0.154	0.164	0.575	0.580	0.09	0.12
	15/32	0.183	0.193	0.620	0.625	0.09	0.12

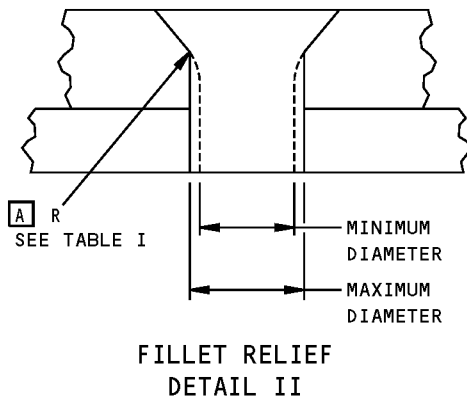
COUNTERSINK DIMENSIONS FOR OVERSIZE BACR15FH AND BACR15GH RIVETS
TABLE II

Dimensions of Modified 82/30 Degree Countersink
Figure 4 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL



PERMITTED COUNTERSINK MISALIGNMENT AND ECCENTRICITY
DETAIL I



FASTENER SIZE	RADIUS R	
	MIN	MAX
5/32 3/16 1/4	0.030	0.040
5/16 3/8	0.040	0.050
7/16 1/2 9/16 5/8 3/4 7/8 1	0.050	0.060

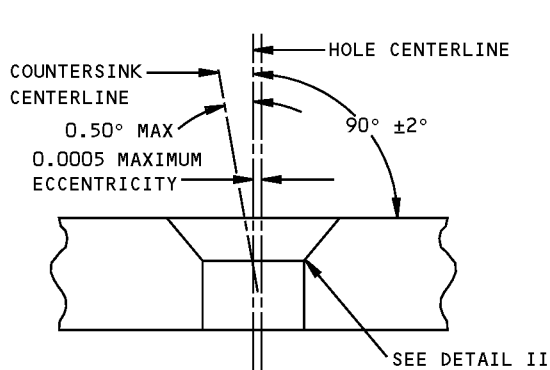
TABLE I

NOTE

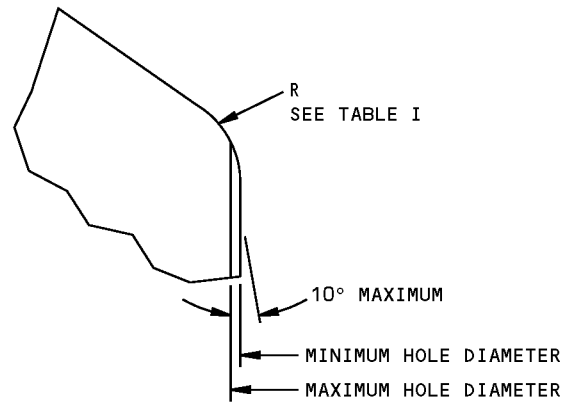
- A** MAKE THE RADIUS BLEND SMOOTHLY WITH THE SHANK DIAMETER.

Countersink Detail for Flush Head Lockbolts and Hex-Drive Bolts Figure 5

757-200 STRUCTURAL REPAIR MANUAL



PERMISSIBLE COUNTERSINK MISALIGNMENT
ECCENTRICITY AND FILLET RELIEF
DETAIL I



DETAIL II

NOMINAL THREAD SIZE	FLUSH HEAD			
	BACB30WQ "R" RADIUS		BACB30PT "R" RADIUS	
	MIN	MAX	MIN	MAX
0.1900-32	0.020	0.030	-	-
0.2500-28	0.020	0.030	0.050	0.060
0.3125-24	0.030	0.040	0.050	0.060
0.3750-24	0.030	0.040	0.050	0.060
0.4375-20	0.030	0.040	-	-

FILLET RELIEF LIMITS FOR FLUSH HEAD RADIUS LEAD-IN BOLT HOLES
TABLE I

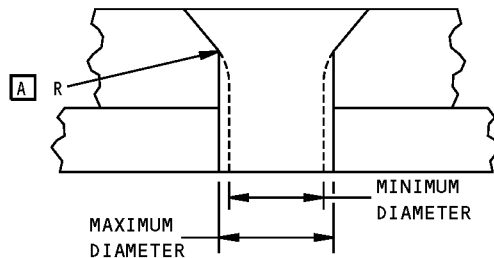
NOTES:

- THE COUNTERSINK IS CUT AT THE SAME TIME THE HOLE IS DRILLED.

Countersink Detail for Flush Head Radius Lead-In Bolts
Figure 6

757-200

STRUCTURAL REPAIR MANUAL



MAX SHANL DIA	100° FLUSH HEAD BOLT AND SCREW PART NUMBER SERIES									
	BACB30EM, BACB30FB, BACB30DL, BACB30DP, BACB30DY, BACB30FA, BACB30GD, BACB30MN, BACB30LH, BACB30LL, BACB30LP, BACB30LR, BACB30LU, BACB30NN, BACB30NU, BACB30MS, BACB30PC, BACB30RF, BACB30SW, BACB30TP, BACB30UW, BACB30VF, BACB30XK, BACB30XM, MS24693, MS27577, NAS1581, NAS1161, NAS8702		AN509, BACS12BF, BACS12BP, BACS12ER, BACS12GM, BACS12GP, BACS12GR, BACS12GX, MS24694, NAS514, NAS1219, NAS1221, NAS1299		BACB30AB, BACB30BF, BACB30WP, BACB30XD, NAS1790, NAS583 THRU 590, NAS1503, NAS1580, NAS1582, NAS1503 THRU 1510		NAS1972 THRU 1989, NAS1992 THRU 2000, NAS2803 THRU 2810, NAS333 THRU 340		NAS517, NAS1102, NAS1189, NAS1627, NAS1628	
	R FILLET RELIEF RADIUS									
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
0.1120	0.012	0.022	0.012	0.022	-- --	-- --	-- --	-- --	0.015	0.025
0.1380	0.012	0.022	0.012	0.022	-- --	-- --	-- --	-- --	0.020	0.030
0.1640	0.020	0.030	0.015	0.025	-- --	-- --	0.030	0.040	0.020	0.030
0.1900	0.020	0.030	0.015	0.025	0.035	0.045	0.030	0.040	0.020	0.030
0.2500	0.020	0.030	0.015	0.025	0.035	0.045	0.030	0.040	0.020	0.030
0.3125	0.025	0.035	0.020	0.030	0.045	0.055	0.030	0.040	0.025	0.035
0.3750	0.030	0.040	0.020	0.030	0.045	0.055	0.030	0.040	0.030	0.040
0.4375	0.030	0.040	0.020	0.030	0.055	0.065	0.030	0.040	0.035	0.045
0.5000	0.030	0.040	0.020	0.030	0.055	0.065	0.030	0.040	0.040	0.050
0.5625	0.030	0.040	0.020	0.030	0.065	0.075	0.030	0.040	-- --	-- --
0.6250	0.030	0.040	-- --	-- --	0.070	0.080	0.030	0.040	-- --	-- --
0.7500	0.030	0.040	-- --	-- --	0.080	0.090	-- --	-- --	-- --	-- --
0.8750	0.030	0.040	-- --	-- --	0.090	0.100	-- --	-- --	-- --	-- --
1.0000	0.030	0.040	-- --	-- --	0.100	0.110	-- --	-- --	-- --	-- --
1.1250	0.040	0.050	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
1.2500	0.040	0.050	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
1.3750	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
1.5000	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
1.7500	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --

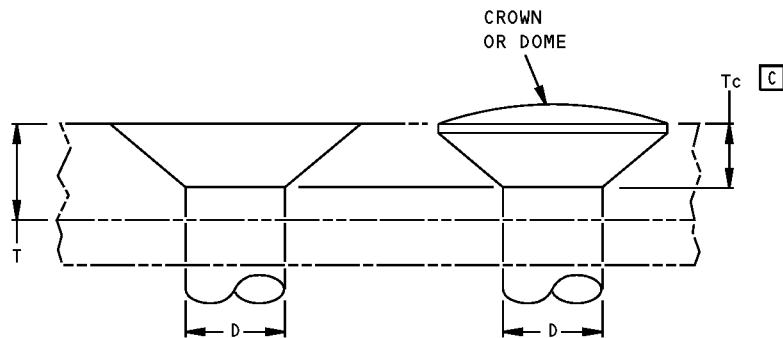
FILLET RELIEF RADIUS LIMITS FOR FLUSH HEAD BOLTS AND SCREWS

NOTES

- A** MAKE THE RADIUS BLEND SMOOTHLY WITH THE SHANK DIAMETER.

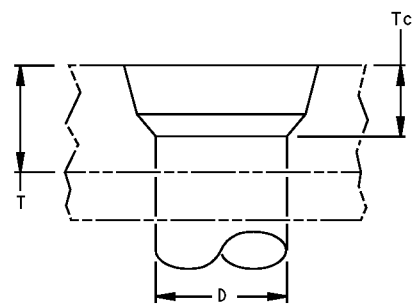
Fillet Relief for Bolts Figure 7

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T_c = COUNTERSINK HEAD DIMENSION

DETAIL I [A]



T_c = COUNTERSINK DIMENSION
(SEE FIGURE 4 FOR COUNTERSINK DATA)

DETAIL II [B]

NOTES

- T = MINIMUM SHEET THICKNESS = 1.5 X T_c
- ALL DIMENSIONS ARE GIVEN IN INCHES
- IN GENERAL, THE BOEING COMPANY RECOMMENDS THAT YOU USE THE LIMITS GIVEN IN THIS CHAPTER-SECTION-SUBJECT FOR MINIMUM SHEET THICKNESS. THE VALUES GIVEN WILL PREVENT KNIFE EDGE CONDITIONS IN COUNTERSUNK HOLES, AND WILL REDUCE POSSIBLE FATIGUE CRACKING OF THE METAL.
- IF A REPAIR IN A DIFFERENT CHAPTER-SECTION-SUBJECT GIVES LIMITS THAT ARE NOT THE SAME AS SRM 51-40-08, THEN YOU CAN USE THE DATA GIVEN IN THAT SPECIFIC REPAIR PROCEDURE.
- THE VALUES GIVEN IN THIS FIGURE APPLY TO ANY COMBINATION OF A FASTENER AND THE METAL MATERIALS THAT ARE FASTENED TOGETHER. THE MINIMUM SHEET THICKNESS VALUES ARE FOR A ZERO TOLERANCE CONDITION BETWEEN THE FASTENER HEAD AND THE METAL SURFACE.
- WHERE THE FASTENER HEAD IS PERMITTED TO BE BELOW THE FLUSH SURFACE, YOU MUST INCREASE THE VALUE OF "T_c" BY THIS AMOUNT TO CALCULATE THE MINIMUM THICKNESS "T".
- UNLESS IT IS SPECIFIED IN THE CHAPTER-SECTION-SUBJECT THAT YOU ARE PERMITTED TO SHAVE A FASTENER HEAD, IN GENERAL, THE BOEING COMPANY RECOMMENDS THAT YOU DO NOT SHAVE THE FASTENER HEAD TO MAKE IT FLUSH WITH THE SURFACE OF THE REPAIR AREA.
- FOR THE APPLICABLE DATA TO INSTALL BACR15FV RIVETS, REFER TO SRM 51-40-02.
- USE PROTRUDING HEAD FASTENERS WHEN THE THICKNESS "T" IS NOT SUFFICIENT TO CORRECTLY INSTALL A COUNTERSINK FASTENER.
- IF TWO SHEETS HAVE BEEN STRUCTURALLY BONDED TOGETHER AS GIVEN IN SRM 51-70-09, THEN THE MINIMUM SHEET THICKNESS CAN BE THE SUM OF BOTH SHEETS. (100° HEAD FASTENERS ONLY)
- DO NOT USE TABLE I AS A GUIDE FOR THE SUBSTITUTION OF LARGER DIAMETER FASTENERS IN A REPAIR AREA. USE ONLY THE OVERSIZED FASTENERS THAT ARE SPECIFIED IN THE REPAIR PROCEDURES GIVEN IN THIS STRUCTURAL REPAIR MANUAL.

- [A] TO INSTALL ALL FASTENER TYPES GIVEN IN TABLE I EXCEPT BACR15FH AND BACR15GH RIVETS
- [B] TO INSTALL BACR15FH AND BACR15GH TYPE IV AND V RIVETS.
- [C] SOME FASTENERS HAVE A "CROWN" OR "DOME". THE HEIGHT OF THE CROWN OR DOME IS NOT USED TO CALCULATE MINIMUM SHEET THICKNESS.

Minimum Sheet Thickness for Countersinking of Fasteners
Figure 8 (Sheet 1 of 4)



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EXAMPLE OF MINIMUM SHEET THICKNESS FOR COUNTERSUNK FASTENERS (T)												
FASTENER DESCRIPTION	NOMINAL FASTENER DIAMETER (D)											
	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16
BOLT — HEX DRIVE												
BACB30XR				0.069		0.090						
BACB30JC			0.110	0.125		0.168		0.209		0.251		0.293
BACB30XW			0.060	0.069		0.090		0.101		0.116		
BACB30NW			0.062	0.072		0.092		0.102		0.117		0.146
BACB30VU			0.062	0.072		0.092		0.102		0.117		
BACB30FN			0.065	0.072		0.095		0.105		0.122		0.150
BACB30XG			0.081	0.102		0.140		0.158		0.200		
BACB30ND			0.084	0.117		0.147		0.164		0.206		0.231
BACB30NZ			0.081	0.104		0.141		0.158		0.200		0.231
BACB30XF			0.105	0.122		0.162		0.203		0.243		
BACB30NY			0.105	0.122		0.162		0.203		0.243		0.285
BACB30NY (1/64 OVERSIZE)				0.112		0.159		0.200		0.242		0.284
BACB30NY (1/32 OVERSIZE)				0.105		0.149		0.189		0.231		0.273
BACB30YM				0.122		0.162		0.203		0.243		0.285
BACB30YM (1/64 OVERSIZE)				0.116		0.159		0.200		0.242		0.284
BACB30YM (1/32 OVERSIZE)				0.105		0.149		0.189		0.231		0.273
BACB30YN				0.072		0.092		0.102		0.117		0.146
BACB30YN (1/64 OVERSIZE)				0.063		0.086		0.096		0.113		0.141
BACB30YN (1/32 OVERSIZE)				0.072		0.095		0.105		0.122		0.150
BACB30YP			0.062	0.071		0.092		0.102		0.120		
LOCKBOLT												
BACB30WB			0.060	0.068		0.089		0.099		0.114		
BACB30XT				0.069		0.090		0.101		0.125		
BACB30XU				0.069		0.090		0.101		0.125		
BACB30VM			0.065	0.074		0.095		0.107		0.122		
BACB30VP			0.065	0.074		0.095		0.107		0.122		
BACB30XB			0.081	0.104		0.141		0.158		0.200		
BACB30WD			0.110	0.126		0.165		0.206		0.248		
BACB30DY			0.083	0.107		0.147		0.164		0.206		
BACB30HD				0.107		0.147		0.164		0.206		
BACB30GY				0.074		0.095		0.107		0.122		
BACB30TY				0.074		0.095		0.107		0.122		
BACB30UC				0.074		0.095		0.107		0.122		

MINIMUM SHEET THICKNESS FOR COUNTERSINKING OF 100° HEAD FASTENERS
TABLE I

Minimum Sheet Thickness for Countersinking of Fasteners
Figure 8 (Sheet 2 of 4)

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EXAMPLE OF MINIMUM SHEET THICKNESS FOR COUNTERSUNK FASTENERS (T)												
FASTENER DESCRIPTION	NOMINAL FASTENER DIAMETER (D)											
	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16
BOLT - REMOVABLE												
BACB30UW				0.072		0.095		0.105		0.122		0.150
BACB30VF				0.072		0.095		0.105		0.120		0.150
NAS87()		0.059		0.074		0.095		0.105		0.122		0.152
BACB30XD				0.104		0.141		0.158		0.200		
BACB30LH				0.125		0.168		0.209		0.251		0.293
BACB30LH (1/64 OVERSIZE)				0.116		0.159		0.200		0.242		0.284
BACB30LH (1/32 OVERSIZE)				0.105		0.149		0.189		0.231		0.273
BACB30LR				0.072		0.095		0.105		0.122		0.150
BACB30LR (1/64 OVERSIZE)				0.063		0.159		0.200		0.242		0.284
BACB30LR (1/32 OVERSIZE)				0.072		0.149		0.189		0.231		0.273
BACB30NN				0.125		0.168		0.209		0.251		0.293
BACB30PC						0.168		0.209		0.251		0.293
BACB30LU		0.092	0.108	0.125		0.168		0.209		0.251		0.293
BACB30LU (1/64 OVERSIZE)				0.116		0.159		0.200		0.242		0.284
BACB30LU (1/32 OVERSIZE)				0.105		0.149		0.189		0.231		0.273
BACB30MS				0.125		0.168		0.209		0.251		0.293
BACB30EL				0.075		0.096		0.108		0.123		0.153
BACB30NU				0.065		0.087		0.098		0.114		0.143
BACB30NU (1/64 OVERSIZE)				0.065		0.087		0.098		0.114		0.143
BACB30NU (1/32 OVERSIZE)				0.072		0.095		0.105		0.122		0.150
BACB30LL				0.072		0.095		0.105		0.122		0.150
BACB30LL (1/64 OVERSIZE)				0.063		0.086		0.096		0.113		0.141
BACB30LL (1/32 OVERSIZE)				0.072		0.095		0.105		0.122		0.150
BACB30RF				0.072		0.095		0.105		0.122		0.150
BACB30RF (1/64 OVERSIZE)				0.063		0.086		0.096		0.111		0.141
BACB30RF (1/32 OVERSIZE)				0.072		0.095		0.105		0.122		0.150
BACB30LP				0.125		0.168		0.209		0.251		0.293
BACB30LP (1/64 OVERSIZE)				0.116		0.159		0.200		0.242		0.284
BACB30LP (1/32 OVERSIZE)				0.105		0.149		0.189		0.231		0.273
BACB30TP				0.125								
BOLT - RADIUS LEAD-IN												
BACB30PT						0.105		0.120		0.135		
BACB30WQ				0.074		0.095		0.107		0.123		0.150

MINIMUM SHEET THICKNESS FOR COUNTERSINKING OF 100° HEAD FASTENERS
TABLE I (CONTINUED)

Minimum Sheet Thickness for Countersinking of Fasteners
Figure 8 (Sheet 3 of 4)

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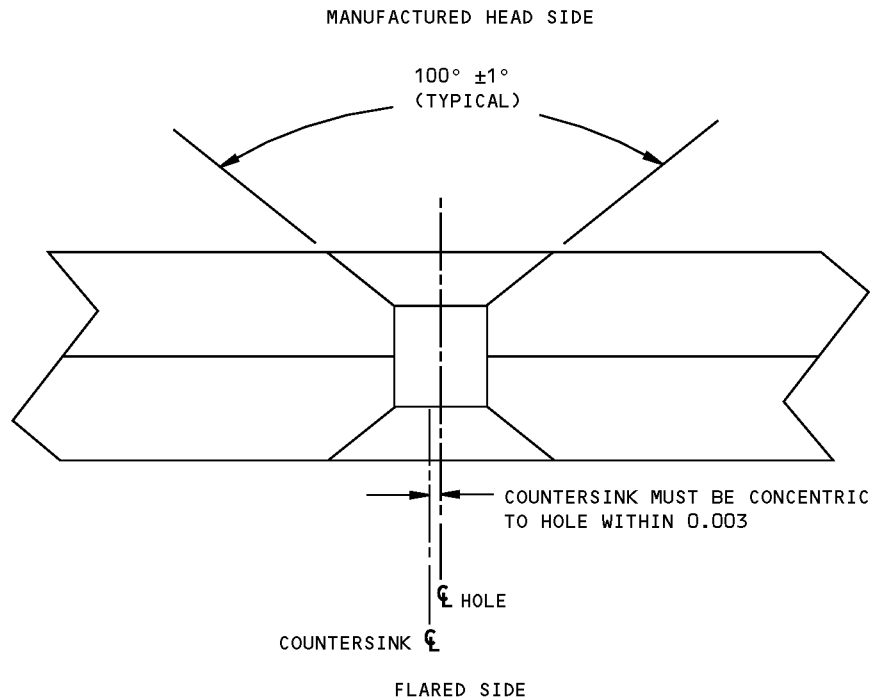
EXAMPLE OF MINIMUM SHEET THICKNESS FOR COUNTERSUNK FASTENERS (T)												
FASTENER DESCRIPTION	NOMINAL FASTENER DIAMETER (D)											
	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16
BOLT - BLIND												
BACB30VK			0.059	0.065		0.086						
MS90353			0.108	0.120		0.158		0.206		0.248		0.290
MS21140			0.111	0.123		0.162		0.210		0.252		
RIVET - BLIND												
BACR15DR AND MS20605	0.054	0.063	0.083	0.105		0.143						
NAS1739		0.053	0.071	0.095								
BACR15FP		0.053	0.071	0.095								
NAS1399		0.063	0.083	0.105		0.143						
RIVET - SOLID SHANK												
NAS1200	0.032	0.044	0.056	0.069		0.090						
BACR15CE AND NAS1097	0.036	0.045	0.059	0.072		0.093						
BACR15DS					0.069		0.092					
BACR15GF	0.032	0.042	0.056	0.068	0.068	0.090	0.090	0.110				
BACR15BA	0.057	0.068	0.087	0.110		0.149		0.165		0.209		0.242
MS20426 AND MS20427	0.063	0.072	0.092	0.115		0.155		0.172		0.215		
BACR15AD					0.219		0.281		0.344		0.406	
BACR15FH	TYPE IV TYPE V		0.105	0.128		0.150		0.165		0.180		0.195
BACR15GH			0.105	0.128		0.168		0.207		0.246		0.246
SCREW												
BACS12BP				0.120		0.159		0.200		0.239		
BACS12ER				0.120		0.159		0.200		0.239		
BACS12GP				0.120								
NAS514				0.120		0.159		0.200		0.239		
MS24693				0.125		0.165		0.207		0.248		

MINIMUM SHEET THICKNESS FOR COUNTERSINKING OF 100° HEAD FASTENERS

TABLE I (CONTINUED)

Minimum Sheet Thickness for Countersinking of Fasteners
Figure 8 (Sheet 4 of 4)

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NOMINAL RIVET DIAMETER (INCH)	COUNTERSINK DIAMETER (INCH)
(-5) 5/32	0.242 0.227
(-6) 3/16	0.297 0.282
(-7) 7/32	0.325 0.318

COUNTERSINK DIMENSION FOR FLARED SIDE OF RIVET

Countersink Dimensions for BACR15GA Rivets
Figure 9

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GENERAL - COLDWORKING OF HOLES FOR FATIGUE IMPROVEMENT

1. General

CAUTION: COLD WORKING OF PARTS MACHINED FROM 7050-T74XX AND 7050-T76XX PLATE OR FORGED BLOCKS IS PERMITTED ONLY IF THE CENTERLINE OF THE HOLES ARE ORIENTED IN THE ST (SHORT TRANSVERSE) GRAIN DIRECTION. THE GRAIN DIRECTION IN 7050-T74XX AND 7050-T76XX PARTS MUST BE DETERMINED BEFORE COLD WORKING SO THAT COLD WORKING IN THE WRONG DIRECTION IS NOT DONE. CARE MUST BE TAKEN WITH 7050-T74XX AND 7050-T76XX FINISHED MACHINE PARTS THAT HAVE SIMILAR FLANGES, SUCH AS ANGLES, TO DETERMINE THE GRAIN DIRECTION RELATIVE TO EACH FLANGE BEFORE COLD WORKING.

- A. The fatigue properties of aluminum structures can be improved by compressing the material locally around the periphery of fastener holes. This is achieved by pulling a mandrel through an undersize hole, thus enlarging the hole and compressing the metal. The cold working operation causes a radial plastic flow of metal and produces a residual compressive stress in the area surrounding the hole which, in the case of the high interference cold working process, extends approximately half the hole diameter from the edge of the hole.

NOTE: See Figure 1/GENERAL for the cold working limits in 7050-T74XX and 7050-T76XX materials.

- B. There are two types of cold working used, the high interference process and the low interference process. The low interference process compresses the metal to a lesser degree than the high interference process. For the high interference process and as an option in the low interference process a disposable steel sleeve is interposed between the mandrel and the hole. This prelubricated sleeve is not reuseable.
- C. To be effective an edge margin of twice the hole diameter is required on cold worked holes. Smaller edge margin would result in less compressive stress around the hole.
- D. Any countersinking or countersink enlargement necessary should not be carried out until the cold working process has been completed.
- E. Where broaches are used to provide close tolerance holes a suitable broach puller will be required.
- F. Each of the puller kits specified in Figure 2/GENERAL and Figure 3/GENERAL require a hydraulic power source such as 4MITBAC5973 or equivalent.
- G. For suppliers of cold working tools, see Figure 4/GENERAL.

2. High Interference Cold Working Process

- A. The sequence of operations for the high interference cold working process is as follows. A simplified pictorial sequence of operation is shown in Figure 2/GENERAL.
- (1) Ensure that the parts to be cold worked are firmly held together by clamps or fasteners. It should not be possible to insert a 0.002 inch feeler gauge between parts and contact a fastener.
 - (2) Enlarge the existing hole, or introduce a new hole as appropriate, to the required starting hole size shown in Figure 2/GENERAL, Table I for the size of fastener to be used. To achieve a hole within the tolerances given with the required surface finish of 125 microinches or better, reaming or broaching will normally be necessary. Cetyl alcohol or lauric acid may be used as a lubricant.

NOTE: Hole inspection criteria for starting holes are the same as those specified for finished holes as described in Paragraph 2.B./GENERAL

STRUCTURAL REPAIR MANUAL

- (3) Select the appropriate tools from Figure 2/GENERAL, Table II, or III or any commercially available equivalent. The length of disposable sleeve selected must be equal or greater than the thickness of material to be cold worked.
- (4) Slide the sleeve over the mandrel up to the nose piece of the puller.

CAUTION: AVOID GETTING LUBRICANT ON THE OUTSIDE OF THE SLEEVE.

- (5) Insert the mandrel and sleeve into the hole.
 - (6) Actuate the puller to pull the mandrel through the sleeve.
 - (7) Remove the sleeve from the hole and discard it.
 - (8) Broach or ream the hole to the finished hole size specified in Figure 2/GENERAL, Table I, with a surface finish of 125 microinches or better. A suitable broach puller will be required for use with a broach. Cetyl alcohol or lauric acid may be used as a lubricant.
- B. Inspect the hole to ensure that it meets the following criteria:
- (1) Holes shall be normal to the surface within 2 degrees.
 - (2) Holes shall be free from burrs at the interface.
 - (3) Holes shall be free from scratches, nicks or cuts with the exception of the following surface defects which are acceptable:
 - (a) Circumferential scratches which are a minimum of 1/16 inch or 10 percent of the part thickness from the surface of the part, whichever is smaller.
 - (b) Helical scratches which are a minimum of 1/16 inch or 25 percent of the part thickness from the surface of the part, whichever is smaller.
 - (c) Longitudinal scratches not more than 50 percent of length of hole in any one part and which neither start nor end within 1/16 inch or 25 percent of the part thickness from the surface of the part, whichever is smaller.
 - (d) Surface roughness which does not exceed 125 microinches.
 - (e) The finished hole may contain a region near the entry, exit or interface that does not totally clean up during the sizing operation. The hole will be acceptable provided the region does not extend 0.020 inch or 10 percent of the detail thickness, whichever is less.
- C. Holes failing to meet the inspection requirements may be enlarged by 1/64 inch without further cold working, using special reamers.

3. Low Interference Cold Working Process

- A. Low interference cold working may be achieved either with or without a sleeve interposed between the mandrel and the hole. The sequence of operations is as follows. A simplified pictorial sequence of operations is shown in Figure 3/GENERAL.
- (1) Ensure that the parts to be cold worked are firmly held together by clamps or fasteners. It should not be possible to insert a 0.002- inch feeler gauge between parts and contact a fastener.



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STRUCTURAL REPAIR MANUAL

- (2) Enlarge the existing hole, or introduce a new hole as appropriate, to the required starting hole size shown in Figure 3/GENERAL, Table I for the size of fastener to be used. A finish of 125 microinches is required where the sleeve process is to be used and 63 microinches for the nonsleeve process. Reaming or broaching will be required to achieve the tolerance and finish required. Cetyl alcohol or lauric acid may be used as a lubricant.

NOTE: The nonsleeve process necessitates a closer tolerance starting hole than the sleeve process. Hole inspection criteria for starting holes are the same as those specified for finished holes as described in Paragraph 3.B./GENERAL except for the finish requirement given above.

- (3) Select the appropriate tools from Figure 3/GENERAL, Table II or Table III. Where the sleeve process is chosen, the length of disposable sleeve selected must be equal to or greater than the thickness of material to be cold worked.

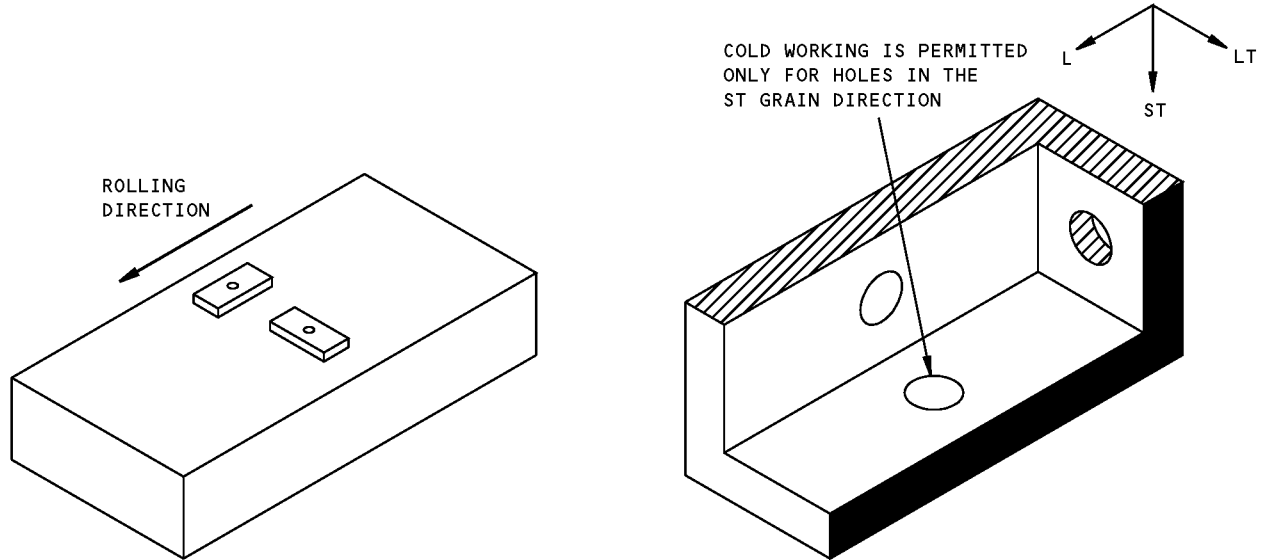
CAUTION: AVOID GETTING LUBRICANT ON THE OUTSIDE OF THE SLEEVE. DAMAGE TO EQUIPMENT MAY RESULT.

- (4) For the sleeve process only, slide the sleeve over the mandrel up to the nose piece of the puller.
- (5) Insert the mandrel or mandrel and sleeve assembly, as appropriate, into the hole.
- (6) Actuate the puller to pull the mandrel through the hole. Cetyl alcohol or lauric acid should be used as a lubricant on both mandrel and hole in the case of the nonsleeve process.
- (7) Remove the sleeve, if used, from the hole and discard it.
- (8) The hole should not require any further work unless it fails to meet the inspection requirements of Paragraph 3.B./GENERAL

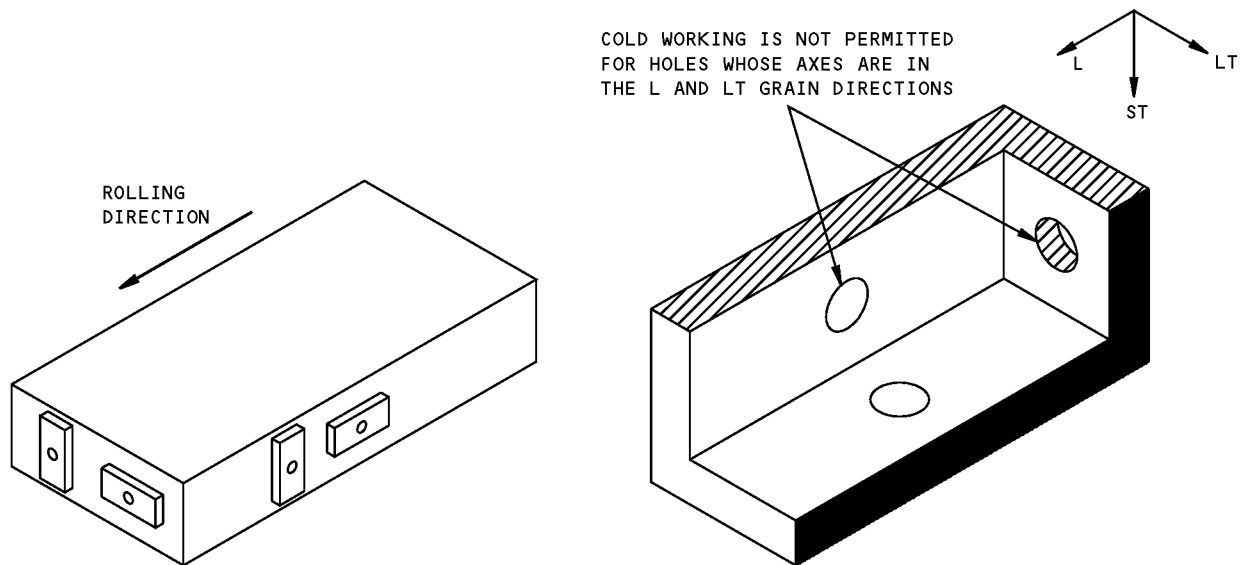
B. Inspect the hole to ensure that it meets the following criteria:

- (1) Hole shall be normal to the surface within 2 degrees unless otherwise specified.
- (2) A surface finish of 125 microinches or better is required.
- (3) Tapering of the hole when the sleeve process is used is acceptable provided that it does not exceed a maximum of 0.001 inch above the maximum diameter of the finished hole size.
- (4) Longitudinal ridges left by cold working sleeves are acceptable.
- (5) Holes shall be free from longitudinal scratches and rifling which intersect the shear plane.

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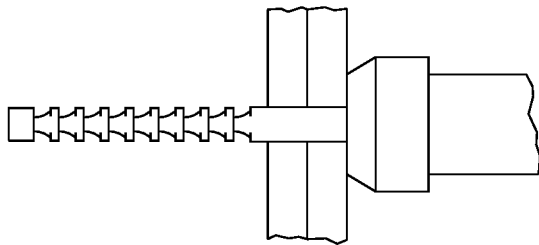


NOT APPROVED

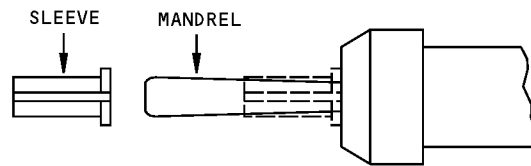
L = LONGITUDINAL GRAIN DIRECTION
LT = LONG TRANSVERSE GRAIN DIRECTION
ST = SHORT TRANSVERSE GRAIN DIRECTION

**Cold Working Limits in 7050-T74XX and 7050-T76XX Material
Figure 1**

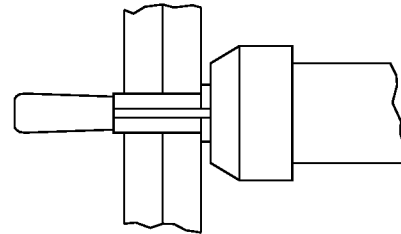
757-200 STRUCTURAL REPAIR MANUAL



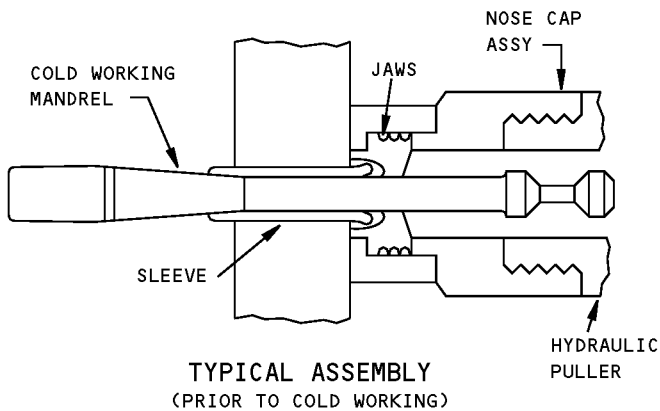
STEP 1 BROACH OR REAM HOLE
TO STARTING SIZE
SHOWN IN TABLE 1



STEP 2 SLIDE SLEEVE OVER MANDREL
UP TO NOSE PIECE OF PULLER

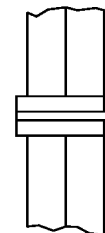


STEP 3 INSERT MANDREL AND SLEEVE
INTO HOLE

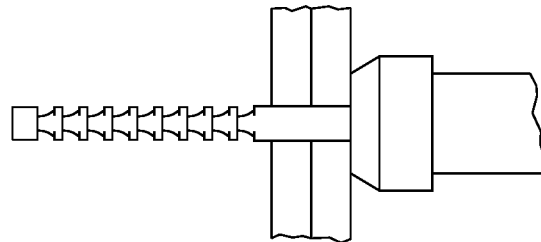


TYPICAL ASSEMBLY
(PRIOR TO COLD WORKING)

STEP 4 ACTUATE PULLER TO PULL
MANDREL THROUGH SLEEVE



STEP 5 REMOVE AND DISCARD SLEEVE





STEP 6 BROACH OR REAM HOLE TO
FINAL SIZE SHOWN IN TABLE 1

SIMPLIFIED SEQUENCE OF OPERATIONS
(REFER TO TEXT FOR COMPREHENSIVE
SEQUENCE OF OPERATIONS)

High Interference Cold Working Process
Figure 2 (Sheet 1 of 9)

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NOM FASTENER SIZE 	STARTING HOLE SIZE	FINISHED HOLE SIZE
5/32	0.146 0.143	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED. REFER TO 51-40-05 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR
11/64	0.162 0.159	
3/16	0.180 0.177	
13/64	0.196 0.193	
7/32	0.212 0.209	
15/64	0.228 0.225	
1/4	0.238 0.235	
17/64	0.254 0.251	
9/32	0.269 0.266	
19/64	0.286 0.283	
5/16	0.300 0.297	
21/64	0.316 0.313	
11/32	0.331 0.328	
23/64	0.347 0.344	
3/8	0.362 0.359	
25/64	0.378 0.375	
13/32	0.394 0.391	
27/64	0.409 0.406	
7/16	0.424 0.421	
29/64	0.440 0.437	
15/32	0.453 0.450	
31/64	0.468 0.465	

NOM FASTENER SIZE 	STARTING HOLE SIZE	FINISHED HOLE SIZE
1/2	0.477 0.474	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED. REFER TO 51-40-05 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR
33/64	0.493 0.490	
17/32	0.508 0.506	
35/64	0.524 0.521	
9/16	0.540 0.537	
37/64	0.556 0.553	
19/32	0.571 0.568	
39/64	0.586 0.583	
5/8	0.600 0.597	
41/64	0.616 0.613	
21/32	0.634 0.631	
43/64	0.649 0.646	
11/16	0.662 0.659	
45/64	0.678 0.675	
23/32	0.693 0.690	
47/64	0.709 0.706	
3/4	0.721 0.718	
49/64	0.737 0.734	
25/32	0.752 0.749	
51/64	0.768 0.765	
13/16	0.785 0.782	
53/64	0.801 0.798	

HOLE SIZES FOR HIGH INTERFERENCE COLD WORKED HOLES – TABLE I

High Interference Cold Working Process Figure 2 (Sheet 2 of 9)

757-200 STRUCTURAL REPAIR MANUAL

NOM FASTENER SIZE J	STARTING HOLE SIZE	FINISHED HOLE SIZE
27/32	0.814 0.811	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED. REFER TO 51-40-05 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR
55/64	0.829 0.826	
7/8	0.844 0.841	
57/64	0.860 0.857	
29/32	0.882 0.879	
59/64	0.897 0.894	
15/16	0.904 0.901	
61/64	0.920 0.917	
31/32	0.936 0.933	
63/64	0.952 0.949	
1	0.968 0.965	
1	0.952 G 0.949	
1-1/64	0.984 0.981	
1-1/64	0.968 G 0.965	
1-1/32	1.000 0.997	
1-3/64	1.016 1.013	
1-1/8	1.078 1.075	
1-1/8	1.062 G 1.059	
1-9/64	1.094 1.091	
1-9/64	1.078 G 1.075	
1-5/32	1.110 1.107	
1-11/64	1.126 1.123	

NOM FASTENER SIZE J	STARTING HOLE SIZE	FINISHED HOLE SIZE
1-3/16	1.140 1.136	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED. REFER TO 51-40-05 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR
1-3/16	1.124 G 1.120	
1-13/64	1.156 1.152	
1-13/64	1.139 G 1.136	
1-7/32	1.172 1.168	
1-15/64	1.188 1.184	
1-1/4	1.203 1.199	
1-1/4	1.187 G 1.183	
1-17/64	1.219 1.215	
1-17/64	1.202 G 1.199	
1-9/32	1.235 1.231	
1-19/64	1.251 1.247	
1-19/64	1.251 1.247	
1-3/8	1.320 1.316	
1-3/8	1.304 G 1.300	
1-25/64	1.340 1.336	
1-25/64	1.324 G 1.320	
1-13/32	1.356 1.352	
1-27/64	1.372 1.368	
1-1/2	1.431 1.427	
1-1/2	1.415 G 1.411	

HOLE SIZES FOR HIGH INTERFERENCE COLD WORKED HOLES - TABLE I (CONT)

High Interference Cold Working Process
Figure 2 (Sheet 3 of 9)

757-200
STRUCTURAL REPAIR MANUAL

NOM FASTENER SIZE J	STARTING HOLE SIZE	FINISHED HOLE SIZE
1-33/64	1.447 1.443	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED. REFER TO 51-40-05 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR
1-33/64	1.431 G 1.427	
1-17/32	1.463 1.459	
1-35/64	1.479 1.475	
1-5/8	1.563 1.559	
1-5/8	1.547 G 1.543	
1-41/64	1.579 1.575	
1-41/64	1.563 G 1.559	
1-21/32	1.595 1.591	
1-43/64	1.611 1.607	

HOLE SIZES FOR HIGH INTERFERENCE
COLD WORKED HOLES – TABLE I (CONT)

High Interference Cold Working Process
Figure 2 (Sheet 4 of 9)

757-200 STRUCTURAL REPAIR MANUAL

NOM FASTENER SIZE	MANDREL ST5300-CBM [F] [I]	SLEEVE ST5300-CBS [A]	UNIVERSAL KIT NO. MITBAC 5973 [D]				UNIVERSAL KIT NO. 2MITBAC 5973 [D]			
			NOSE CAP ST5300-CBC	JAW ASSY ST5300-CBC [B]	CHUCK ASSY ST1350A	NOSE CAP ST1350A-C	JAW ASSY ST5300-CBC [B]	CHUCK ASSY ST1350A	NOSE CAP ST1350A-C	CHUCK ASSY ST5300-C
5/32	-5-0-N-"E"	-5-0-N-"A"-B"	-3	-C"-23	-29	-12	-C"-23	-29	-12	-227
11/64	-5-1-N-"E"	-5-1-N-"A"-B"	-3	-C"-23	-29	-12	-C"-23	-29	-12	-227
3/16	-6-0-N-"E"	-6-0-N-"A"-B"	-3	-C"-24	-29	-12	-C"-24	-29	-12	-227
13/64	-6-1-N-"E"	-6-1-N-"A"-B"	-3	-C"-24	-29	-12	-C"-24	-29	-12	-227
7/32	-6-2-N-"E"	-6-2-N-"A"-B"	-3	-C"-24	-29	-12	-C"-24	-29	-12	-227
15/64	-6-3-N-"E"	-6-3-N-"A"-B"	-3	-C"-24	-29	-12	-C"-24	-29	-12	-227
1/4	-8-0-N-"E"	-8-0-N-"A"-B"	-3	-C"-25	-29	-12	-C"-25	-29	-12	-227
17/64	-8-1-N-"E"	-8-1-N-"A"-B"	-3	-C"-25	-29	-12	-C"-25	-29	-12	-227
9/32	-8-2-N-"E"	-8-2-N-"A"-B"	-3	-C"-25	-29	-12	-C"-25	-29	-12	-227
19/64	-8-3-N-"E"	-8-3-N-"A"-B"	-3	-C"-25	-29	-12	-C"-25	-29	-12	-227
5/16	-10-0-N-"E"	-10-0-N-"A"-B"	-3	-C"-26	-29	-12	-C"-26	-29	-12	-227
21/64	-10-1-N-"E"	-10-1-N-"A"-B"	-3	-C"-26	-29	-12	-C"-26	-29	-12	-227
11/32	-10-2-N-"E"	-10-2-N-"A"-B"	-3	-C"-26	-29	-12	-C"-26	-29	-12	-227
23/64	-10-3-N-"E"	-10-3-N-"A"-B"	-3	-C"-26	-29	-12	-C"-26	-29	-12	-227
3/8	-12-0-N-"E"	-12-0-N-"A"-B"	-3	-C"-27	-29	-12	-C"-27	-29	-12	-227
25/64	-12-1-N-"E"	-12-1-N-"A"-B"	-3	-C"-27	-29	-12	-C"-27	-29	-12	-227
13/32	-12-2-N-"E"	-12-2-N-"A"-B"	-3	-C"-27	-29	-12	-C"-27	-29	-12	-227
27/64	-12-3-N-"E"	-12-3-N-"A"-B"	-3	-C"-27	-29	-12	-C"-27	-29	-12	-227

TABLE II

High Interference Cold Working Process
Figure 2 (Sheet 5 of 9)



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STRUCTURAL REPAIR MANUAL

NOM FASTENER SIZE	MANDREL ST5300-CBM [C] [I]	SLEEVE ST5300-CBS [A]	UNIVERSAL KIT NO. 2 MITBAC 5973			
			NOSECAP ST1350A-C	JAW ASSY ST5300-CBC	CHUCK ASSY [E]	
					3-JAW ST1350A-C	THREADED ST1350A-C
7/16	-14-0-N-"D"	-14-0-N-"A"- "B"	-12	-28-S	-21	-33
29/64	-14-1-N-"D"	-14-1-N-"A"- "B"	-12	-28-S	-21	-33
15/32	-14-2-N-"D"	-14-2-N-"A"- "B"	-12	-28-S	-21	-33
31/64	-14-3-N-"D"	-14-3-N-"A"- "B"	-12	-28-S	-21	-33
1/2	-16-0-N-"D"	-16-0-N-"A"- "B"	-12	-29-S	-21	-33
33/64	-16-1-N-"D"	-16-1-N-"A"- "B"	-12	-29-S	-21	-33
17/32	-16-2-N-"D"	-16-2-N-"A"- "B"	-12	-29-S	-21	-33
35/64	-16-3-N-"D"	-16-3-N-"A"- "B"	-12	-29-S	-21	-33
9/16	-18-0-N-"D"	-18-0-N-"A"- "B"	-12	-30-S	-21	-33
37/64	-18-1-N-"D"	-18-1-N-"A"- "B"	-12	-30-S	-21	-33
19/32	-18-2-N-"D"	-18-2-N-"A"- "B"	-12	-30-S	-21	-33
39/64	-18-3-N-"D"	-18-3-N-"A"- "B"	-12	-30-S	-21	-33
5/8	-20-0-N-"D"	-20-0-N-"A"- "B"	-12	-31-S	-21	-33
41/64	-20-1-N-"D"	-20-1-N-"A"- "B"	-12	-31-S	-21	-33
21/32	-20-2-N-"D"	-20-2-N-"A"- "B"	-12	-31-S	-21	-33
43/64	-20-3-N-"D"	-20-3-N-"A"- "B"	-12	-31-S	-21	-33
11/16	-22-0-N-3	-22-0-N-"A"- "B"	-12	-32-S	-	-33
45/64	-22-1-N-3	-22-1-N-"A"- "B"	-12	-32-S	-	-33
23/32	-22-2-N-3	-22-2-N-"A"- "B"	-12	-32-S	-	-33
47/64	-22-3-N-3	-22-3-N-"A"- "B"	-12	-32-S	-	-33
3/4	-24-0-N-3	-24-0-N-"A"- "B"	-12	-33-S	-	-33
49/64	-24-1-N-3	-24-1-N-"A"- "B"	-12	-33-S	-	-33
25/32	-24-2-N-3	-24-2-N-"A"- "B"	-12	-33-S	-	-33
51/64	-24-3-N-3	-24-3-N-"A"- "B"	-12	-33-S	-	-33
13/16	-26-0-N-3	-26-0-N-"A"- "B"	-12	-34-S	-	-33
53/64	-26-1-N-3	-26-1-N-"A"- "B"	-12	-34-S	-	-33
27/32	-26-2-N-3	-26-2-N-"A"- "B"	-12	-34-S	-	-33
55/64	-26-3-N-3	-26-3-N-"A"- "B"	-12	-34-S	-	-33
7/8	-28-0-N-3	-28-0-N-"A"- "B"	-12	-35-S	-	-33
57/64	-28-1-N-3	-28-1-N-"A"- "B"	-12	-35-S	-	-33
29/32	-28-2-N-3	-28-2-N-"A"- "B"	-12	-35-S	-	-33
59/64	-28-3-N-3	-28-3-N-"A"- "B"	-12	-35-S	-	-33
15/16	-30-0-N-3	-30-0-N-"A"- "B"	-12	-36-S	-	-33
61/64	-30-1-N-3	-30-1-N-"A"- "B"	-12	-36-S	-	-33

COLD WORKING TOOLS FOR HOLES 7/16 INCH DIAMETER
AND GREATER - HIGH INTERFERENCE, SLEEVE TYPE - TABLE III

High Interference Cold Working Process
Figure 2 (Sheet 6 of 9)

757-200 STRUCTURAL REPAIR MANUAL

NOM FASTENER SIZE	MANDREL ST5300-CBM [C] [I]	SLEEVE ST5300-CBS [A]	UNIVERSAL KIT NO. 2 MITBAC 5973			
			NOSECAP ST1350A-C	JAW ASSY ST5300-CBC	CHUCK ASSY [E]	
					3-JAW ST1350A-C	THREADED ST1350A-C
31/32	-30-2-N-3	-30-2-N-"A"-B"	-12	-36-S	-	-33
63/64	-30-3-N-3	-30-3-N-"A"-B"	-12	-36-S	-	-33
1	-32-0-N-3	-32-0-N-"A"-B"	-12	-305-S	-	-33
1 [H]	-32-0-S-3	-32-0-S-"A"-B"	-12	-305-S	-	-33
1-1/64	-32-1-N-3	-32-1-N-"A"-B"	-12	-305-S	-	-33
1-1/64 [H]	-32-1-S-3	-32-1-S-"A"-B"	-12	-305-S	-	-33
1-1/32	-32-2-N-3	-32-2-N-"A"-B"	-12	-305-S	-	-33
1-3/64	-32-3-N-3	-32-3-N-"A"-B"	-12	-305-S	-	-33
1-1/8	-36-0-N-3	-36-0-N-"A"-B"	-12	-307-S	-	-33
1-1/8 [H]	-36-0-S-3	-36-0-S-"A"-B"	-12	-307-S	-	-33
1-9/64	-36-1-N-3	-36-1-N-"A"-B"	-12	-307-S	-	-33
1-9/64 [H]	-36-1-S-3	-36-1-S-"A"-B"	-12	-307-S	-	-33
1-5/32	-36-2-N-3	-36-2-N-"A"-B"	-12	-307-S	-	-33
1-11/64	-36-3-N-3	-36-3-N-"A"-B"	-12	-307-S	-	-33
1-3/16	-38-0-N-3	-38-0-N-"A"-B"	-12	-308-S	-	-33
1-3/16 [H]	-38-0-S-3	-38-0-S-"A"-B"	-12	-308-S	-	-33
1-13/64	-38-1-N-3	-38-1-N-"A"-B"	-12	-308-S	-	-33
1-13/64 [H]	-38-1-S-3	-38-1-S-"A"-B"	-12	-308-S	-	-33
1-7/32	-38-2-N-3	-38-2-N-"A"-B"	-12	-308-S	-	-33
1-15/64	-38-3-N-3	-38-3-N-"A"-B"	-12	-308-S	-	-33
1-1/4	-40-0-N-3	-40-0-N-"A"-B"	-12	-309-S	-	-33
1-1/4 [H]	-40-0-S-3	-40-0-S-"A"-B"	-12	-309-S	-	-33
1-17/64	-40-1-N-3	-40-1-N-"A"-B"	-12	-309-S	-	-33
1-17/64 [H]	-40-1-S-3	-40-1-S-"A"-B"	-12	-309-S	-	-33
1-9/32	-40-2-N-3	-40-2-N-"A"-B"	-12	-309-S	-	-33
1-19/64	-40-3-N-3	-40-3-N-"A"-B"	-12	-309-S	-	-33
1-3/8	-44-0-N-3	-44-0-N-"A"-B"	-12	-311-S	-	-33
1-3/8 [H]	-44-0-S-3	-44-0-S-"A"-B"	-12	-311-S	-	-33
1-25/64	-44-1-N-3	-44-1-N-"A"-B"	-12	-311-S	-	-33
1-25/64 [H]	-44-1-S-3	-44-1-S-"A"-B"	-12	-311-S	-	-33
1-13/32	-44-2-N-3	-44-2-N-"A"-B"	-12	-311-S	-	-33
1-27/64	-44-3-N-3	-44-3-N-"A"-B"	-12	-311-S	-	-33

COLD WORKING TOOLS FOR HOLES 7/16 INCH DIAMETER
AND GREATER - HIGH INTERFERENCE, SLEEVE TYPE
TABLE III (CONT)

High Interference Cold Working Process
Figure 2 (Sheet 7 of 9)



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STRUCTURAL REPAIR MANUAL

NOM FASTENER SIZE	MANDREL ST5300-CBM [C] [I]	SLEEVE ST5300-CBS [A]	UNIVERSAL KIT NO. 2 MITBAC 5973			
			NOSECAP ST1350A-C	JAW ASSY ST5300-CBC	CHUCK ASSY [E]	
					3-JAW ST1350A-C	THREADED ST1350A-C
1-1/2	-48-0-N-3	-48-0-N-"A"- "B"	-12	-313-S	-	-33
1-1/2 [H]	-48-0-S-3	-48-0-S-"A"- "B"	-12	-313-S	-	-33
1-33/64	-48-1-N-3	-48-1-N-"A"- "B"	-12	-313-S	-	-33
1-33/64 [H]	-48-1-S-3	-48-1-S-"A"- "B"	-12	-313-S	-	-33
1-17/32	-48-2-N-3	-48-2-N-"A"- "B"	-12	-313-S	-	-33
1-35/64	-48-3-N-3	-48-3-N-"A"- "B"	-12	-313-S	-	-33
1-5/8	-52-0-N-3	-52-0-N-"A"- "B"	-12	-315-S	-	-33
1-5/8 [H]	-52-0-S-3	-52-0-S-"A"- "B"	-12	-315-S	-	-33
1-41/64	-52-1-N-3	-52-1-N-"A"- "B"	-12	-315-S	-	-33
1-41/64 [H]	-52-1-S-3	-52-1-S-"A"- "B"	-12	-315-S	-	-33
1-21/32	-52-2-N-3	-52-2-N-"A"- "B"	-12	-315-S	-	-33
1-43/64	-52-3-N-3	-52-3-N-"A"- "B"	-12	-315-S	-	-33

COLD WORKING TOOLS FOR HOLES 7/16 INCH DIAMETER
AND GREATER - HIGH INTERFERENCE, SLEEVE TYPE
TABLE III (CONT)

High Interference Cold Working Process
Figure 2 (Sheet 8 of 9)

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STRUCTURAL REPAIR MANUAL

NOTES

A "A" IS THE LENGTH OF THE SLEEVE IN 1/16 OF AN INCH WHICH MUST EQUAL OR EXCEED THE HOLE DEPTH. SLEEVES ARE MADE IN 1/4-INCH INCREMENTS ONLY, FROM 3/4 INCH TO 1-1/2 INCHES LONG. SLEEVES MAY BE STAKED FOR DEEP HOLES.

"B" IS THE TYPE OF SLEEVE DENOTED BY THE SUFFIX F FOR FLARED TYPE OR S FOR STRAIGHT TYPE. FOR HOLES LESS THAN 7/16 DIA THE FLARED TYPE IS PREFERRED, BUT IF STACKED THE ADDITIONAL SLEEVES MUST BE OF THE STRAIGHT TYPE. FOR HOLE SIZES 7/16 DIA AND GREATER ONLY THE STRAIGHT TYPE WILL BE USED.

EXAMPLE: ST5300-CBS-10-0-N-8-F

THIS IS A FLARED SLEEVE (INDICATED BY -F) FOR A 5/16 DIA HOLE WITH A LENGTH OF 1/2 INCH (INDICATED BY -8).

B "C" IS THE TYPE OF JAW ASSY REQUIRED TO SUIT THE TYPE OF SLEEVE BEING USED. USE THE SUFFIX F FOR FLARED TYPE OR S FOR STRAIGHT TYPE.

C "D" IS THE TYPE OF MANDREL REQUIRED TO SUIT THE CHUCK. SPECIFY 2 FOR THE TYPE II MANDRELS USED WITH A 3-JAW CHUCK OR 3 FOR THE TYPE III MANDRELS USED WITH A THREADED CHUCK. TYPE III MANDRELS ARE REQUIRED FOR HOLES 11/16 DIA AND LARGER.

EXAMPLE: ST5300-CBM-18-0-N-2

THIS IS A MANDREL FOR A 9/16-INCH DIAMETER HOLE FOR USE WITH A 3-JAW CHUCK (INDICATED BY -2).

D KIT #MITBAC5973 AND KIT #2MITBAC5973 ARE ALTERNATIVES.

E 3-JAW CHUCKS OR THREADED CHUCKS ARE ALTERNATIVES FOR SIZES LESS THAN 11/16-INCH DIAMETER.

F "E" IS THE TYPE OF MANDREL REQUIRED TO SUIT THE CHUCK. SPECIFY 1 FOR THE TYPE I MANDRELS USED WITH A 3-JAW CHUCK OR 1A FOR THE TYPE 1A MANDRELS USED WITH A THREADED CHUCK.

EXAMPLE: ST5300-CBM-12-0-N-1

THIS IS A MANDREL FOR A 3/8-INCH DIAMETER HOLE FOR USE WITH A 3-JAW CHUCK (INDICATED BY -1).

G STARTING HOLE SIZE FOR SPECIAL SLEEVES

H INDICATIVE OF SPECIAL MANDRELS TO BE USED IN CONJUNCTION WITH SPECIAL SLEEVES

I MANDREL MATERIAL MUST BE SPECIFIED. SPECIFY H FOR H-11 OR H-13 TOOL STEEL OR V FOR VASCOJET TOOL STEEL. USE H-11 OR H-13 (H) TOOL STEEL FOR COLD WORKING HOLES IN ALUMINUM. USE VASCOJET (VO TOOL STEEL FOR COLD WORKING HOLES IN STEEL OR ALUMINUM

EXAMPLE: ST5300-CBM-22-0-N-3-V

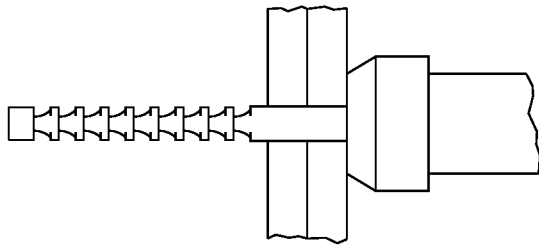
THIS IS A MANDREL MADE FROM VASCOJET TOOL STEEL

J IN SOME CONDITIONS, IT IS PERMITTED TO DO THESE STEPS:

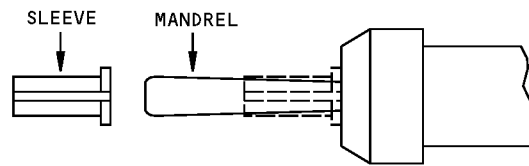
1. COLD WORK THE HOLE AS IF THE FINISHED HOLE DIAMETER WAS 1/64 SMALLER
2. REAM THE HOLE TO THE CORRECT FINISHED DIAMETER. THE FINISHED DIAMETER MUST NOT BE LARGER THAN THE MAXIMUM PERMITTED HOLE DIAMETER.

High Interference Cold Working Process
Figure 2 (Sheet 9 of 9)

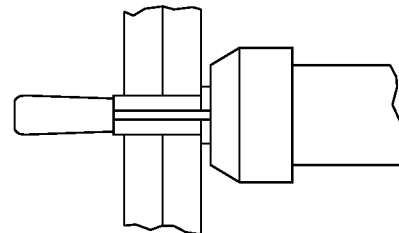
757-200 STRUCTURAL REPAIR MANUAL



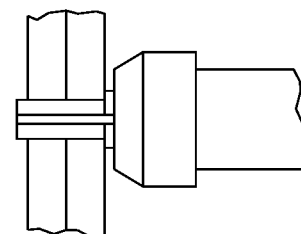
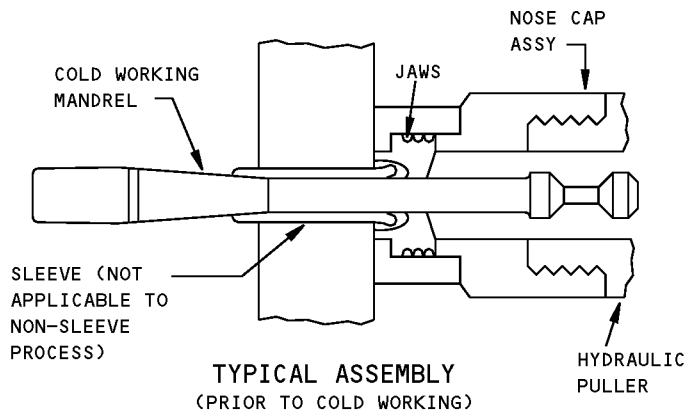
STEP 1 BROACH OR REAM HOLE
TO STARTING SIZE
SHOWN IN TABLE 1



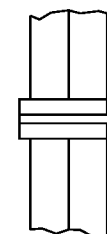
STEP 2 IF SLEEVE IS BEING USED, SLIDE
SLEEVE OVER MANDREL UP TO
NOSE PIECE OF PULLER



STEP 3 INSERT MANDREL OR MANDREL
AND SLEEVE ASSY INTO HOLE



STEP 4 ACTUATE PULLER TO PULL
MANDREL THROUGH HOLE



STEP 5 REMOVE AND DISCARD SLEEVE
IF ONE HAS BEEN USED

SIMPLIFIED SEQUENCE OF OPERATIONS (REFER TO TEXT FOR COMPREHENSIVE SEQUENCE OF OPERATIONS)

Low Interference Cold Working Process Figure 3 (Sheet 1 of 17)

757-200 STRUCTURAL REPAIR MANUAL

NOM HOLE SIZE	BOLTS AND OPEN HOLES			LOCKBOLTS AND HI-LOKS			RIVETS		
	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)
3/16	0.1922 0.1894	0.1880 0.1850	0.1880 0.1870	0.190 0.187	0.1860 0.1830	0.1860 0.1850	0.193 0.190	0.1895 0.1865	0.1895 0.1885
13/64	0.2078 0.2050	0.2036 0.2006	0.2036 0.2026	0.203 0.200	0.1990 0.1960	0.1990 0.1980			
7/32	0.2234 0.2206	0.2192 0.2162	0.2192 0.2182	0.219 0.216	0.2135 0.2105	0.2135 0.2125	0.223 0.220	0.2190 0.2160	0.2190 0.2180
15/64	0.2392 0.2364	0.2349 0.2319	0.2344 0.2339						
1/4	0.2548 0.2520	0.2505 0.2475	0.2505 0.2495	0.250 0.247	0.2460 0.2430	0.2460 0.2450	0.256 0.253	0.2525 0.2495	0.2525 0.2515
17/64	0.2704 0.2676	0.2661 0.2631	0.2661 0.2651	0.266 0.263	0.2620 0.2590	0.2620 0.2610			
9/32	0.2861 0.2833	0.2817 0.2787	0.2817 0.2807	0.281 0.278	0.2755 0.2725	0.2755 0.2745	0.286 0.283	0.2815 0.2785	0.2815 0.2805
19/64	0.3018 0.2990	0.2974 0.2944	0.2974 0.2964						
5/16	0.3175 0.3145	0.3130 0.3100	0.3130 0.3120	0.313 0.309	0.3085 0.3055	0.3085 0.3075	0.320 0.317	0.3145 0.3115	0.3145 0.3135
21/64	0.3331 0.3301	0.3286 0.3256	0.3286 0.3276	0.328 0.325	0.3235 0.3205	0.3235 0.3225			
11/32	0.3488 0.3458	0.3442 0.3412	0.3442 0.3432	0.344 0.341	0.3385 0.3355	0.3385 0.3375	0.348 0.345	0.3440 0.3410	0.3440 0.3430
23/64	0.3647 0.3615	0.3599 0.3569	0.3599 0.3589						
3/8	0.3803 0.3771	0.3755 0.3725	0.3755 0.3745	0.375 0.371	0.3700 0.3670	0.3700 0.3690	0.381 0.378	0.3755 0.3725	0.3755 0.3745
25/64	0.3960 0.3928	0.3911 0.3881	0.3911 0.3901	0.391 0.388	0.3870 0.3830	0.3870 0.3860			
13/32	0.4117 0.4083	0.4067 0.4037	0.4067 0.4057	0.406 0.403	0.4020 0.3990	0.4020 0.4010	0.411 0.408	0.4065 0.4035	0.4065 0.4055

SIZES FOR LOW INTERFERENCE COLD WORKED HOLES
TABLE I

Low Interference Cold Working Process
Figure 3 (Sheet 2 of 17)



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STRUCTURAL REPAIR MANUAL

NOM HOLE SIZE	BOLTS AND OPEN HOLES			LOCKBOLTS AND HI-LOKS			RIVETS		
	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)
27/64	0.4275 0.4241	0.4224 0.4194	0.4224 0.4214						
7/16	0.4432 0.4396	0.4380 0.4350	0.4380 0.4370	0.438 0.434	0.4315 0.4285	0.4315 0.4305	0.444 0.441	0.4370 0.4340	0.4370 0.4360
29/64	0.4589 0.4551	0.4536 0.4530	0.4536 0.4526	0.453 0.450	0.4465 0.4435	0.4465 0.4455			
15/32	0.4746 0.4708	0.4692 0.4662	0.4692 0.4682	J 0.466	0.4630 0.4600	0.4630 0.4620			
31/64	0.4905 0.4865	0.4849 0.4819	0.4849 0.4839						
1/2	0.5064 0.5020	0.5005 0.4975	0.5005 0.4995						
33/64	0.5220 0.5176	0.5161 0.5131	0.5161 0.5151						
17/32	0.5376 0.5332	0.5317 0.5287	0.5317 0.5307						
35/64	0.5533 0.5489	0.5474 0.5444	0.5474 0.5464						
9/16	0.5691 0.5647	0.5630 0.5600	0.5630 0.5620						
37/64	0.5847 0.5803	0.5786 0.5756	0.5786 0.5776						
19/32	0.6003 0.5959	0.5942 0.5912	0.5942 0.5932						
39/64	0.6160 0.6116	0.6094 0.6064	0.6094 0.6084						
5/8	0.6316 0.6272	0.6255 0.6225	0.6255 0.6245						

Low Interference Cold Working Process
Figure 3 (Sheet 3 of 17)

SIZES FOR LOW INTERFERENCE COLD WORKED HOLES
TABLE I (CONT)

757-200 STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE	MANDREL ST5300-CWM [A]	SLEEVE ST5300-CWS [B]	UNIVERSAL KIT NO. 1 MITBAC 5973				UNIVERSAL KIT NO. 2 MITBAC 5973			
			NOSE CAP ST5300 -CBC	JAW ASSY ST5300 -CBC [C]	CHUCK 3-JAW ST1350A	CHUCK ASSY THREADED ST1350A	NOSE CAP ST1350A -C	JAW ASSY ST5300 -CBC [C]	CHUCK 3-JAW ST5300-C	CHUCK ASSY THREADED ST1350A-C
1/8	0.1281	-B1267-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
9/64	0.1437	-B1423-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
5/32	0.1594	-B1580-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
11/64	0.1751	-B1737-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
3/16	0.1908	-B1894-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
13/64	0.2064	-B2050-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
7/32	0.2220	-B2206-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
15/64	0.2378	-B2364-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
1/4	0.2534	-B2520-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
17/64	0.2690	-B2676-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
9/32	0.2847	-B2833-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
19/64	0.3004	-B2990-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
5/16	0.3160	-B3145-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
21/64	0.3316	-B3301-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
11/32	0.3473	-B3458-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
23/64	0.3631	-B3615-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
3/8	0.3787	-B3771-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
25/64	0.3944	-B3928-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
13/32	0.4100	-B4083-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
27/64	0.4258	-B4241-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
7/16	0.4414	-B4396-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
29/64	0.4570	-B4551-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
15/32	0.4727	-B4708-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35

BOLTS AND OPEN HOLES - LOW INTERFERENCE SLEEVE TYPE COLD WORKING TOOLS
TABLE 11

Low Interference Cold Working Process
Figure 3 (Sheet 4 of 17)

757-200 STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE	MANDREL ST5300-CWM [A]	SLEEVE ST5300-CWS [B]	UNIVERSAL KIT NO. [D] MITBAC5973				UNIVERSAL KIT NO. 2 MITBAC 5973			
			NOSE CAP ST5300 -CBC	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY 3-JAW ST1350A	THREADED ST1350A	NOSE CAP ST1350A -C	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY 3-JAW ST5300-C	THREADED ST1350A-C
31/64	0.4885	-B4865-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
1/2	0.5042	-B5020-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
33/64	0.5198	-B5176-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
17/32	0.5354	-B5332-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
35/64	0.5511	-B5489-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
9/16	0.5669	-B5647-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
37/64	0.5825	-B5803-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
19/32	0.5981	-B5959-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
39/64	0.6138	-B6116-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
5/8	0.6294	-B6272-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
41/64	0.6451	-B6429-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
21/32	0.6607	-B6585-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
43/64	0.6764	-B6742-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
11/16	0.6921	-B6899-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
45/64	0.7077	-B7055-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
23/32	0.7234	-B7212-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
47/64	0.7391	-B7369-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
3/4	0.7548	-B7525-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
49/64	0.7704	-B7681-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
25/32	0.7860	-B7837-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
51/64	0.8018	-B7995-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
13/16	0.8174	-B8151-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35
53/64	0.8317	-B8307-"E"-F"	-3	-12	-29	-38	-12	-12	-227	-35

Low Interference Cold Working Process
Figure 3 (Sheet 5 of 17)

BOLTS AND OPEN HOLES – LOW INTERFERENCE SLEEVE TYPE COLD WORKING TOOLS
TABLE II (CONT)



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STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE		MANDREL										UNIVERSAL KIT NO. MITBAC5973		UNIVERSAL KIT NO. 2MITBAC5973		KIT NO. 3MITBAC 5973
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H][K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C	[I]			
1/8	0.1281	-1281	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-1281 -"M"	—	—	-12	-21	—	—	—				
9/64	0.1437	-1437	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-1437 -"M"	—	—	-12	-21	—	—	—				
5/32	0.1594	-1594	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-1594 -"M"	—	—	-12	-21	—	—	—				
11/64	0.1751	-1751	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-1751 -"M"	—	—	-12	-21	—	—	—				
3/16	0.1908	-1908	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-1908 -"M"	—	—	-12	-21	—	—	—				
13/64	0.2064	-2064	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-2064 -"M"	—	—	-12	-21	—	—	—				
7/32	0.2220	-2220	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-2220 -"M"	—	—	-12	-21	—	—	—				
15/64	0.2378	-2378	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-2378 -"M"	—	—	-12	-21	—	—	—				
1/4	0.2534	-2534	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	-2534	—	—	—	—	—	—	—	-4				
17/64	0.2690	-2690	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-2690 -"M"	—	—	-12	-21	—	—	—				
9/32	0.2847	-2847	—	—	—	—	—	-12	-29	-12	-227	-5				
		—	—	—	-2847 -"M"	—	—	-12	-21	—	—	—				

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III

Low Interference Cold Working Process
Figure 3 (Sheet 9 of 17)



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STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE	MANDREL								UNIVERSAL KIT NO. MITBAC5973		UNIVERSAL KIT NO. 2MITBAC5973		KIT NO. 3MITBAC 5973
	ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H][K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C			
19/64	-3004	—	—	—	—	—	-12	-29	-12	-227	[I]	CHUCK ST5300J-C	-5
	—	—	—	-3004-"M"	—	—	-12	-21	—	—	—	—	—
	-3160	—	—	-3160-"M"	—	—	-12	-29	-12	-227	—	—	-5
5/16	—	—	-3160	—	—	—	-12	—	—	—	—	—	-4
21/64	-3316	—	—	-3316	—	—	-12	-29	-12	-227	—	—	-5
11/32	-3473	—	—	-3473	—	—	-12	-29	-12	-227	—	—	-5
23/64	-3631	—	—	-3631	—	—	-12	-29	-12	-227	—	—	-5
3/8	-3787	—	—	-3787-"M"	—	—	-12	-29	-12	-227	—	—	-5
	—	—	-3787	—	—	—	—	—	—	—	—	—	-5
25/64	-3944	—	—	-3944	—	—	-12	-29	-12	-227	—	—	-5
13/32	-4100	—	—	-4100	—	—	-12	-29	-12	-227	—	—	-5
27/64	-4258	—	—	-4258	—	—	-12	-29	-12	-227	—	—	-5
7/16	-4414	—	—	-4414	—	—	-12	-29	-12	-227	—	—	-5
29/64	-4570	—	—	-4570	—	—	-12	-29	-12	-227	—	—	-5

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 3 (Sheet 10 of 17)

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STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE	MANDREL								UNIVERSAL KIT NO. MITBAC5973		UNIVERSAL KIT NO. 2MITBAC5973		KIT NO. 3MITBAC 5973
	ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H][K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C			
15/32	0.4727	-4727	—	-4727-"M"	—	—	-12	-29	-12	-227	—	—	-5
31/64	0.4885	-4885	—	-4885-"M"	—	—	-12	-29	-12	-227	—	—	-5
1/2	0.5042	-5042	—	-5042-"M"	—	—	-12	-29	-12	-227	—	—	-5
33/64	0.5198	-5198	—	—	-5198	—	-12	-29	-12	-227	—	—	-5
17/32	0.5354	-5354	—	—	-5354	—	-12	-29	-12	-227	—	—	-5
35/64	0.5511	—	—	—	-5511	—	-12	-29	-12	-227	—	—	-5
9/16	0.5669	—	—	—	-5669	—	-12	-29	-12	-227	—	—	-5
37/64	0.5825	—	—	—	-5825	—	-12	-29	-12	-227	—	—	-5
19/32	0.5981	—	—	—	-5981	—	-12	-29	-12	-227	—	—	-5
39/64	0.6138	—	—	—	-6138	—	-12	-29	-12	-227	—	—	-5
5/8	0.6294	—	—	-6294	-6294	—	-12	-29	-12	-227	—	—	-5

Low Interference Cold Working Process
Figure 3 (Sheet 11 of 17)

BOLTS AND OPEN HOLES – LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)



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STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE		MANDREL								UNIVERSAL KIT NO. MITBAC5973		UNIVERSAL KIT NO. 2MITBAC5973		KIT NO. 3MITBAC 5973
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H][K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C			
41/64	0.6451	—	-6451	—	-6451-"M"	-6451	—	-12	-29	-12	-227	CHUCK ST5300J-C		
21/32	0.6607	—	-6607	—	-6607-"M"	-6607	—	-12	-29	-12	-227	-5		
43/64	0.6764	—	-6764	—	—	-6764	—	-12	-29	-12	-227	-5		
11/16	0.6921	—	-6921	—	—	-6921	—	-12	-29	-12	-227	-5		
45/64	0.7077	—	-7077	—	—	-7077	—	-12	-29	-12	-227	-5		
23/32	0.7234	—	-7234	—	—	-7234	—	-12	-29	-12	-227	-5		
47/64	0.7391	—	-7391	—	—	-7391	—	-12	-29	-12	-227	-5		
3/4	0.7548	—	-7548	—	—	-7548	-7548	-12	-29	-12	-227	-5		
49/64	0.7704	—	-7704	—	—	-7704	-7704	-12	-29	-12	-227	-5		
25/32	0.7860	—	-7860	—	—	-7860	-7860	-12	-29	-12	-227	-5		
51/64	0.8018	—	-8018	—	—	-8018	-8018	-12	-29	-12	-227	-5		

BOLTS AND OPEN HOLES – LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 3 (Sheet 12 of 17)



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STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE	MANDREL								UNIVERSAL KIT NO. MITBAC5973		UNIVERSAL KIT NO. 2MITBAC5973		KIT NO. 3MITBAC 5973
	ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H][K]	ST5300-A [K]	ST5300-AB	UNIVERSAL KIT NO. MITBAC5973		NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	KIT NO. 3MITBAC 5973
13/16	—	-8174	—	—	-8174	-8174	[I]		-12	-29	-12	-227	[I]
53/64	—	-8330	—	—	-8330	—	[I]		-12	-29	-12	-227	—
27/32	—	-8487	—	—	-8487	—			-12	-29	-12	-227	-5
55/64	—	-8644	—	—	-8644	—			-12	-29	-12	-227	-5
7/8	—	-8801	—	—	-8801	—			-12	-29	-12	-227	-5
57/64	—	-8957	—	—	-8957	—			-12	-29	-12	-227	-5
29/32	—	-9114	—	—	-9114	—			-12	-29	-12	-227	-5
59/64	—	-9271	—	—	-9271	—			-12	-29	-12	-227	-5
15/16	—	-9428	—	—	-9428	—			-12	-29	-12	-227	-5
61/64	—	-9584	—	—	-9584	—			-12	-29	-12	-227	-5
31/32	—	-9740	—	—	-9740	—			-12	-29	-12	-227	-5

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 3 (Sheet 13 of 17)



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STRUCTURAL REPAIR MANUAL**

NOMINAL HOLE SIZE	MANDREL							UNIVERSAL KIT NO. MITBAC5973		UNIVERSAL KIT NO. 2MITBAC5973		KIT NO. 3MITBAC 5973
	ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H]	ST5300-A [K]	ST5300-AB		NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	
63/64	—	-9898	—	—	-9898	—		-12	-29	-12	-227	-5
1	—	-10054	—	—	-10054	—		-12	-29	-12	-227	-5
1-1/64	—	-10211	—	—	-10211	—		-12	-29	-12	-227	-5
1-1/32	—	-10367	—	—	-10367	—		-12	-29	-12	-227	-5
1-7/32	—	-12229	—	—	-12229	-12229		-12	-29	-12	-227	-5

BOLTS AND OPEN HOLES – LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

**Low Interference Cold Working Process
Figure 3 (Sheet 14 of 17)**



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STRUCTURAL REPAIR MANUAL

NOMINAL HOLE SIZE	MANDREL			UNIVERSAL KIT NO. MITBAC5973		UNIVERSAL KIT NO. 2MITBAC5973		KIT NO. 3MITBAC 5973
	ST5300A [E]	ST5300A-A [F]	ST5300K [H][K]	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	
3/16	—	—1885 -"L"-X"	—	-12	-29	-12	-227	-5
13/64	—	—	-1885 -"M"	-12	-21	—	—	—
7/32	-2015	-2015 -"L"-X"	—	-12	-29	-12	-227	-5
1/4	—	—	-2015 -"M"	-12	-21	—	—	—
17/64	—	-2175 -"L"-X"	—	-12	-29	-12	-227	-5
9/32	—	—	-2175 -"M"	-12	-21	—	—	—
5/16	-2485	-2485 -"L"-X"	—	-12	-29	-12	-227	-5
21/64	—	—	-2485 -"M"	-12	-21	—	—	—
11/32	-2645	-2645 -"L"-X"	—	-12	-29	-12	-227	-5
3/8	—	—	-2645 -"M"	-12	-21	—	—	—
25/64	—	-2795 -"L"-X"	-2645 -"M"	-12	-29	-12	-227	-5
	—	—	-2795 -"M"	-12	-21	—	—	—
	-3110	-3110 -"L"-X"	—	-12	-29	-12	-227	-5
	—	—	-3110 -"M"	-12	-21	—	—	—
	-3265	-3265 -"L"-X"	-3265 -"M"	-12	-29	-12	-227	-5
	—	—	-3265 -"M"	-12	-29	—	—	—
	-3730	-3730 -"L"-X"	-3730 -"M"	-12	-29	-12	-227	-5
	—	—	-3730 -"M"	-12	-29	—	—	—
	-3895	-3895 -"L"-X"	-3895 -"M"	-12	-29	-12	-227	-5
	—	—	-3895 -"M"	-12	-29	—	—	—

HEX-DRIVE BOLTS AND LOCKBOLTS - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 3 (Sheet 15 of 17)

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STRUCTURAL REPAIR MANUAL

NOTES

A "E" IS MATERIAL STACKUP IN 1/16 OF AN INCH. -24 FOR STACKUP OF 1-1/2 INCHES TO BE USED WITH -1 OR -1A MANDREL AND -48 FOR STACKUP OF 3 INCHES TO BE USED WITH -2 OR -3 MANDREL

"F" IS THE TYPE OF MANDREL REQUIRED. -1 OR -1A MANDREL IS REQUIRED TO SUIT A SMALL 3 JAW OR THREADED (1/2 - 20) CHUCK, RESPECTIVELY AND -2 OR -3 MANDREL IS REQUIRED TO SUIT A LARGE 3 JAW OR THREADED (7/8 - 14) CHUCK, RESPECTIVELY. A THREADED CHUCK IS PREFERRED FOR SIZES OVER 0.4045 DIA

EXAMPLE: ST5300-CWM-R1280-24-1A

THIS IS A MANDREL FOR STACKUPS LESS THAN 1-1/2 INCHES (INDICATED BY -24) FOR USE WITH A THREADED CHUCK (INDICATED BY -1A) FOR COLD WORKING A RIVET HOLE WITH A NOMINAL SIZE OF 0.1280 DIA

B "G" IS THE LENGTH OF THE SLEEVE IN 1/16 OF AN INCH WHICH MUST EQUAL OR EXCEED THE HOLE DEPTH. SLEEVES ARE MADE IN 1/4-INCH INCREMENTS ONLY, FROM 3/4 INCH TO 1-1/2 INCHES LONG. SLEEVES MAY BE STACKED FOR DEEP HOLES

"H" IS THE TYPE OF SLEEVE DENOTED BY THE SUFFIX F FOR FLARED TYPE OR S FOR STRAIGHT TYPE. FLARED SLEEVES ARE PREFERRED FOR HOLES UP TO 0.3447 DIA, BUT IF STACKED, THE ADDITIONAL SLEEVES MUST BE THE STRAIGHT TYPE

EXAMPLE: ST5300-CWS-R1280-8-F

THIS IS A FLARED SLEEVE (INDICATED BY -F) FOR A 0.1280 DIA RIVET HOLE WITH A LENGTH OF 1/2 INCH (INDICATED BY -8)

C "C" IS THE TYPE OF JAW ASSY REQUIRED TO SUIT THE TYPE OF SLEEVE BEING USED. USE THE SUFFIX F FOR FLARED TYPE OR S FOR STRAIGHT TYPE

D KIT MITBAC5973 AND KIT 2MITBAC5973 ARE ALTERNATIVES

E THIS MANDREL FOR USE IN EXTREMELY LIMITED ACCESS AREAS ONLY WHERE MATERIAL STACKUP DOES NOT EXCEED 5/8 INCH

F "L" IS THE THICKNESS OF MATERIAL STACKUP IN 1/8 OF AN INCH INCREMENTS

"X" IS TYPE-1 FOR NORMAL USE OR TYPE-2 IF REQUIRED FOR USE WITH THE OFFSET PULLER INCLUDED WITH KIT MITBAC5973

BOTH TYPE-1 AND TYPE-2 MANDRELS ARE FOR USE IN LIMITED ACCESS AREAS ONLY

G THIS MANDREL FOR USE WHERE MATERIAL STACKUP DOES NOT EXCEED 3/8 INCH

H "M" IS THE PILOT LENGTH IN 1/4-INCH INCREMENTS. THE PILOT LENGTH IS NOT CRITICAL FOR THE PROCESS DESCRIBED IN THIS SUBJECT

I KITS ARE ALTERNATIVES PROVIDED THAT THE CORRECT CORRESPONDING MANDREL IS USED

J FOR HI-LOKS ONLY

K SUITABLE FOR GENERAL USE WHERE ACCESS IS AVAILABLE

Low Interference Cold Working Process
Figure 3 (Sheet 17 of 17)

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STRUCTURAL REPAIR MANUAL

TOOL NOMENCLATURE AND NUMBER	SOURCE
SLEEVE ST5300-CBS ST5300-CWS ALL DASH NUMBERS	FATIGUE TECHNOLOGY 150 ANDOVER PARK WEST P.O. BOX C-88388 TUKWILA, WA 98188 WEST COAST INDUSTRIES 14900 WHITMAN AVENUE NORTH SEATTLE, WA 98133
MANDREL ST5300-CBM ST5300-CWM MANDREL PULLER KIT A MITBAC5973 2MITBAC5973 3MITBAC5973	WEST COAST INDUSTRIES 14900 WHITMAN AVENUE NORTH SEATTLE, WA 98133 PACIFIC TOOL INCORPORATED 15235 NORTHEAST 92ND STREET REDMOND, WA 98052-3518 FATIGUE TECHNOLOGY 150 ANDOVER PARK WEST P.O. BOX C-88388 TUKWILA, WA 98188
POWER SOURCE (4MITBAC5973) POWER UNIT MODEL NO. H&A MODIFIED PA130	HYDRAULIC AND AIR EQUIPMENT CO. 4401 AIRPORT WAY SOUTH SEATTLE, WA 98108 WEST COAST INDUSTRIES 14900 WHITMAN AVENUE NORTH SEATTLE, WA 98133

NOTES

- A KIT INCLUDES HYDRAULIC PULLER COMPLETE WITH
 THREADED NOSE CAP ASSEMBLIES, CHUCKS AND
 THREADED ADAPTER, OFFSET ADAPTER, QUICK-
 DISCONNECT FITTINGS, SET OF JAW ASSEMBLIES,
 AND SET OF DRAWINGS OF TOOL DETAILS

Tools for Cold Working of Holes
Figure 4

STRUCTURAL REPAIR MANUAL

GENERAL - FASTENER TYPES - RB211-535 ENGINES**1. General**

- A. Three basic types of fasteners are used in the construction of the RB211-535C7 and E4 engine nacelle hinged cowls, translating cowls and thrust reverser C-ducts. The fastener types are rivets, fastener pins and collars, and threaded fastener pins and nuts.

2. References

Reference	Title
51-40-01, GENERAL	Fasteners
51-40-02, GENERAL	Fastener Installation and Removal
51-41-02, GENERAL	Fastener Installation and Removal - RB211-535 Engines

3. Rivets

- A. Solid rivets made from aluminum alloy are used to fasten together structural parts of the nacelle where structural loads, temperature ranges, and galvanic corrosion conditions permit. Solid rivets of titanium are used in titanium structures, 2219 aluminum alloy structures, graphite composite structures, stainless steel, Monel and Inconel parts. Solid rivets of bi-metal construction with a hard titanium alloy body and a ductile titanium alloy tail reduce the pressures required for installation. Solid rivets of Monel are used in steels, stainless steels, titanium, graphite epoxy composite structures and Inconel parts where temperature and stress ranges are high. The installation and removal of solid rivets are described in 51-40-02, GENERAL except for titanium alloy Cherry-Buck and E-Z Buck rivets which are described in 51-41-02, GENERAL.
- B. Blind rivets are used where access is not available to form the driven head of a solid rivet. Blind rivets are of two-piece construction, with a hollow sleeve and a solid spindle (with an interference fit) which is pulled into the sleeve until rivet and spindle are locked in place. The sleeves and spindles of blind rivets are of various materials and their selection depends on the heat range, strength requirements and dissimilar metal characteristics of the material in which they are used. Blind rivets must not be used in areas subject to vibration, or in fluid-tight joints. Installation and removal instructions for blind rivets which are used in the Boeig 757 airplane and the RB211-535C37 and E4 nacelle are described in 51-40-02, GENERAL. Installation and removal instructions for blind rivets used only in the RB211-535C37 and E4 nacelle area described in 51-41-02, GENERAL.

NOTE: Blind rivets used in repair are time limited and must be checked at frequent intervals for looseness.

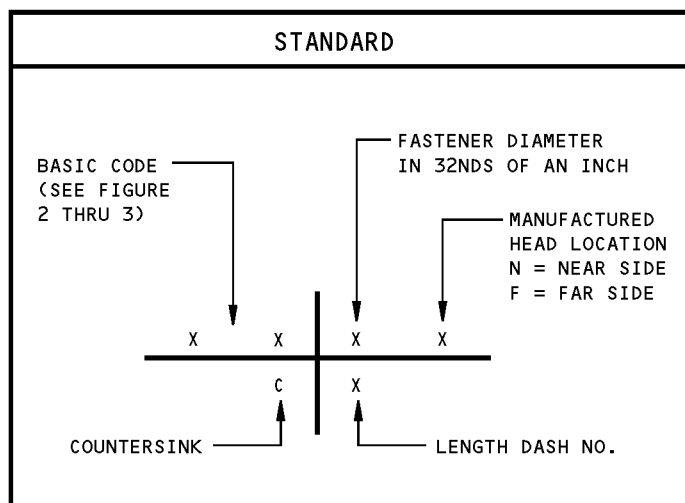
4. Fastener Pins

- A. Lockbolt fastener pins are installed by swaging a collar on to the serrated end of the pin. The installation is usually an interference fit operation with the fastener hole being slightly smaller in diameter than the fastener pin. A tool pulls the pin into the fastener hole until the fastener head seats, the collar is swaged on to the serrated end of the pin and the pin-tail breaks off at the proper tension load. The pin size and fastener hole size must be carefully controlled to assure proper installation. Installation and removal instructions for lockbolts are described in 51-40-02, GENERAL.

STRUCTURAL REPAIR MANUAL**5. Threaded Fasteners**

- A. Bolts and screws are the standard threaded fasteners used in the RB211-535C37 and E4 nacelle structure. They are used in combination with threaded nuts or directly installed into helical threads tapped into a structure member or part. There are several different combinations of bolts, screws, and nuts; most of which contain a locking device to prevent relative movement of the bolt and nut once it has been installed and torqued to the proper tension. Unlike rivets which are used almost exclusively in shear application, bolts are used also in tension to hold structural members clamped together. Hexagonal (Hex-Drive) bolt heads and nuts are used to rotate the fastener combination and apply the torque required to properly install the threaded fastener. Standard and oversize Hex-Drive bolts used on the Boeing 757 airplane are described in 51-40-01, GENERAL, and their installation and removal described in 51-40-02, GENERAL. The installation and removal of threaded fasteners which are used only in the RB211-535C37 and E4 engine nacelle are described in 51-41-02, GENERAL.
- B. Blind bolts and blind nuts using protruding or flush head core bolts are used where access is limited to one side of the work. The fastener hole is reamed to accept a sleeve with a countersunk head. An expander threaded on to a core bolt precedes the sleeve through the fastener hole which has been countersunk to accept the sleeve countersunk head. Rotation of the core bolt pulls the serrated expander up into the sleeve causing it to expand against the underside of the part in which the sleeve is installed. The bottom of the sleeve closes around the serrated expander which serves as a nut, permitting the core bolt to be removed while the sleeve and nut remain locked in place. The core bolt is installed through the material or part to be attached, threaded back through the blind nut, and torqued to installation tension requirements. By use of a longer sleeve two pieces of material can be held together by the blind nut even when the core bolt is removed. Installation and removal instructions are provided in 51-40-02, GENERAL.
- C. A fastener system supplied by Huck Manufacturing Company called ASP fasteners provides a means of fastening metal surfaces to soft-core material in the RB211-535C37 and E4 nacelle without crushing the sandwich honeycomb core, and without the need for potting, bushing, inserts or step hole preparation. The fasteners are available as either protruding head fastener and sleeve, flush fastener and sleeve or a combination of protruding and flush component. A shouldered pintailed threaded fastener is installed in one side of a fastener hole in a honeycomb sandwich panel, and a threaded sleeve installed over the pintail from the other side of the panel and tightened until the heads on both fastener and sleeve are properly seated. A locking collar is placed over the pintail and swaged into place between the pintail and the sleeve head. The collar swages into longitudinal grooves in the fastener threads and prevents the sleeve from loosening due to rotation on the pin threads. The pintail breaks off when the locking collar is properly swaged into place. Installation and removal instructions are provided in 51-41-02, GENERAL.
- D. A fastener system supplied by Huck Manufacturing Company provides a wide flush shear head sleeve of AISI4027 or AISI4037 alloy steel with a shouldered pin of AISI8740 alloy. The sleeve and pin are cadmium plated. A locking collar can be obtained in carbon steel, alloy steel, or A286 CRES steel. The fastener is installed as a blind bolt fastener into a 100° countersink recess in the top surface of the part sandwich. The fastener is tool installed and the locking collar swaged into place as the pintail breaks off. The sleeve expands against the undersurface of the part sandwich to lock the fastener into place.

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<div style="display: inline-block; text-align: center;"> <div style="border-bottom: 1px solid black; width: 20px; margin: 0 auto;">APR</div> <div style="border-left: 1px solid black; border-right: 1px solid black; width: 10px; height: 10px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">6N</div> </div>	NAS1200M RIVET 100° SHEAR HEAD 3/16 DIAMETER MONEL COUNTERSINK, NEAR SIDE
--	---

<div style="display: inline-block; text-align: center;"> <div style="border-bottom: 1px solid black; width: 20px; margin: 0 auto;">XW</div> <div style="border-left: 1px solid black; border-right: 1px solid black; width: 10px; height: 10px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">8FN</div> </div>	ASP FASTENER PIN FLUSH HEAD 1/4 DIAMETER STEEL ASP SLEEVE - STEEL FLUSH COLLAR - 2219 ALUM.
--	--

<div style="display: inline-block; text-align: center;"> <div style="border-bottom: 1px solid black; width: 20px; margin: 0 auto;">RN</div> <div style="border-left: 1px solid black; border-right: 1px solid black; width: 10px; height: 10px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">5</div> </div>	NAS1398C BLIND RIVET 5/32 DIAMETER 2117-T4
--	--

<div style="display: inline-block; text-align: center;"> <div style="border-bottom: 1px solid black; width: 20px; margin: 0 auto;">AMP</div> <div style="border-left: 1px solid black; border-right: 1px solid black; width: 10px; height: 10px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">5N 4</div> </div>	CHERRY BUCK RIVET UNIVERSAL HEAD, 5/32 DIAMETER, 0.187 LENGTH, 6AL-4V TITANIUM, BODY TI/CO TAIL
--	--

<div style="display: inline-block; text-align: center;"> <div style="border-bottom: 1px solid black; width: 20px; margin: 0 auto;">ARV</div> <div style="border-left: 1px solid black; border-right: 1px solid black; width: 10px; height: 10px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">8</div> </div>	HL40 HI-LOK PROTRUDING HEAD 1/4 DIAMETER CRES, WITH HL70 COLLAR
---	---

EXAMPLES

Fastener Symbols - All RB211-535 Engines
Figure 1

757-200

STRUCTURAL REPAIR MANUAL

TYPE	CODE	PART NUMBER		MATERIAL ALLOY AND TEMPER	DESCRIPTION
		STANDARD	VENDOR		
SOLID SHANK PROTRUDING HEAD	LN	MS20515M		MONEL 2024-T31 TI/COLUMBIUM 6AL-4V TI BODY A286 CRES	UNIVERSAL HEAD UNIVERSAL HEAD UNIVERSAL HEAD FLAT HEAD UNIVERSAL HEAD
	CX <input type="checkbox"/> D AMY AMP MM <input type="checkbox"/> E	MS20470DD NAS1198	CSR903B <input type="checkbox"/> A CSR925 <input type="checkbox"/> A		
SOLID SHANK FLUSH HEAD	AMO	NAS1097	CSR924 <input type="checkbox"/> A	6AL-4V TI BODY 2117-T3 5056-H32 A286 CRES A286 CRES MONEL CRES MONEL STEEL ALLOY STEEL ALLOY TI/COLUMBIUM 6AL-4V TI BODY	100° SHEAR HEAD 100° SHEAR HEAD 100° SHEAR HEAD 100° HEAD 100° SHEAR HEAD 100° SHEAR HEAD 100° HEAD 100° HEAD 100° SHEAR HEAD 100° SHEAR HEAD 100° HEAD 100° HEAD
	LZ <input type="checkbox"/> D MA <input type="checkbox"/> D MN MO APR DH <input type="checkbox"/> D BF --- --- ANE AMN	NAS1097AD NAS1097B NAS1199 NAS1200 NAS1200M MS20427F MS20427M MS20426 MS20426	4B100T <input type="checkbox"/> C S7B100T <input type="checkbox"/> B CSR902B <input type="checkbox"/> A CSR922 <input type="checkbox"/> A		
BLIND PROTRUDING HEAD	AMS		CCR274CS <input type="checkbox"/> A CR3523 <input type="checkbox"/> A	A286 CRES MONEL A286 CRES MONEL INCONEL	UNIVERSAL HEAD UNIVERSAL HEAD BULBED CHERRY MAX, LOCKED SPINDLE LOCK SPINDLE BULBED RIVET LOCKED SPINDLE LOCKED SPINDLE
	XK RN AAR ---	NAS1398C NAS1738M NAS1738C	CR2663 <input type="checkbox"/> A CR2539 <input type="checkbox"/> A CR2839 <input type="checkbox"/> A		
BLIND UNISINK	--- <input type="checkbox"/> E		CR2554 <input type="checkbox"/> A	MONEL	100° HEAD PROTRUDING

STANDARD RIVETS

TABLE I

NOTES

- THE CODE USED IN THE FASTENER TABLES IN 51-41-01 TO IDENTIFY THE FASTENER VENDORS IS THE SAME AS THAT USED IN 51-40-01

☐ A TOWNSEND COMPANY
CHERRY RIVET DIVISION
1224 EAST WARNER AVE.
SANTA ANA, CALIFORNIA 92707

☐ B HUCK MANUFACTURING CO.
2650 BELLVUE AVE.
DETROIT, MICHIGAN 48207

☐ C HIGH SHEAR CORPORATION
2600 SKYPARK DRIVE
TORRANCE, CALIFORNIA 90509

☐ D USED ON RB211-535C37 ONLY

☐ E USED ON RB211-535E4 ONLY

Fastener Codes - Rivets - All RB211-535 Engines
Figure 2 (Sheet 1 of 3)

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STRUCTURAL REPAIR MANUAL

TYPE	CODE	PART NUMBER		MATERIAL ALLOY AND TEMPER	DESCRIPTION
		STANDARD	VENDOR		
BLIND FLUSH HEAD	AMC		CCR264SS3 <input type="checkbox"/> A	STEEL	100° HEAD, NON- STRUCTURE
	ADD		CR2164 <input type="checkbox"/> A	2017 ALUM	2017-T4, LOCKED SPINDLE, NAS1097 HEAD STYLE
	ADE		CR2564 <input type="checkbox"/> A	MONEL	CAD PLATE, LOCKED SPINDLE, NAS1097 HEAD STYLE
	ADF		CR2664 <input type="checkbox"/> A	A286 CRES	NAS1097 HEAD STYLE
	XJ		CR3522 <input type="checkbox"/> A	MONEL	100° HEAD, LOCKED SPINDLE
	XR		CR2564M <input type="checkbox"/> A	MONEL	100° SHEAR HEAD, NAS1097 HEAD STYLE
	RS	NAS1399C	CR2662 <input type="checkbox"/> A	A286 CRES	100° HEAD, LOCKED SPINDLE
	AAX <input type="checkbox"/> D	NAS1739MW	CR2538P <input type="checkbox"/> A	MONEL	100° HEAD, CAD PLATED, LOCKED SPINDLE
	AAW	NAS1739M	CR2538 <input type="checkbox"/> A	MONEL	100° HEAD, LOCKED SPINDLE
	AJN <input type="checkbox"/> D	NAS1739A	CR2838 <input type="checkbox"/> A	2219-T62	100° HEAD, LOCKED SPINDLE
	ATT <input type="checkbox"/> D	NAS1739B	CR2248 <input type="checkbox"/> A	5056F	100° HEAD, LOCKED SPINDLE
	AAV	NAS1739E	CR2238	5056F	100° HEAD, LOCKED SPINDLE

STANDARD RIVETS
TABLE I (CONT)

Fastener Codes - Rivets - All RB211-535 Engines
Figure 2 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL

TYPE	ORIGINAL FASTENER		OVERSIZE FASTENER		
	CODE	PART NO.	CODE	PART NO.	NOMINAL OVERSIZE
BLIND PROTRUDING HEAD	XK	CR3523		CR3553	1/64 IN.
BLIND FLUSH HEAD	XJ	CR3522		CR3552	1/64 IN.

NOTES

- CHERRY BUCK CSR922, CSR924 OR CSR925 RIVETS OF THE SAME DASH NUMBER CAN BE USED AS OVERSIZE FOR E-Z BUCK CSR902B, CSR903B OR CSR904B RIVETS. i.e.,

E-Z BUCK

-5 ACTUAL DIA. 0.1560

-6 ACTUAL DIA. 0.1870

CHERRY BUCK

-5 ACTUAL DIA. 0.1640

-6 ACTUAL DIA. 0.1895

- CHERRYLOCK RIVETS (NAS1398 AND NAS1399) ARE SMALLER IN ACTUAL DIAMETER THAN BULBED CHERRYLOCK RIVETS (NAS1738 AND NAS1739) OF CORRESPONDING DASH NUMBERS WITH EXCEPTION OF NAS1097 RIVET HEAD CONFIGURATIONS.
- FOR OVERSIZE APPLICATION A CHERRYLOCK RIVET (NAS1398 OR NAS1399) CAN BE REPLACED BY A BULBED CHERRYLOCK (NAS1738 OR NAS1739) OF THE SAME DASH NUMBER AND A BULBED CHERRYLOCK CAN BE REPLACED BY THE NEXT HIGHER DASH NUMBER CHERRYLOCK RIVET.

OVERSIZE RIVETS TABLE II

**Fastener Codes - Rivets - All RB211-535 Engines
Figure 2 (Sheet 3 of 3)**

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STRUCTURAL REPAIR MANUAL

CODE	PART NUMBER	VENDOR	MATERIAL	DESCRIPTION
--	LGPL9SC-V	A	TITANIUM	130° FLUSH HEAD
--	LGPL9SP-V	A	TITANIUM	PROTRUDING HEAD
--	LGPL2SC-V	A	TITANIUM	100° FLUSH SHEAR HEAD
--	LGPL2SP-V	A	TITANIUM	PROTRUDING SHEAR HEAD

LIGHTWEIGHT GP PINS
TABLE I**NOTES**

A HUCK MANUFACTURING CO.
900 WATSON CENTER RD.
CARSON, CA 90745

Fastener Codes - Pins - RB211-535E4 Engines
Figure 3

757-200
STRUCTURAL REPAIR MANUAL

100° FLUSH HEAD							
CODE	PART NUMBER	VENDOR	MATERIAL	DESCRIPTION	COLLAR	1/64 IN. OVERSIZE PART NUMBER	1/32 IN. OVERSIZE PART NUMBER
AOW D	HL13	A	TITANIUM, 160 KSI	TENSION HEAD, HEX-DRIVE	HL75 HL86 HL198 HL280	HL113	NONE LISTED
	HL15	A	STEEL, 156 KSI	SHEAR HEAD, HEX-DRIVE	HL288 HL574	HL215	HL715
ARR	HL41	A	CRES, 95 KSI	SHEAR HEAD, HEX-DRIVE	HL70 HL79 HL82 HL94 HL97 HL297	HL141	HL241
ALH ALS	HL641 C	A	CRES, 95 KSI	SHEAR HEAD, HEX-DRIVE 3/32 GRIP VARIATION	HL579 HL694	HL643	NONE LISTED
	HL49 C	A	CRES, 160 KSI	TENSION HEAD	HL75 HL78 HL86	HL249	NONE LISTED
	HL31 D	A	CRES, 125 KSI	SHEAR HEAD	HL70 HL79 HL82 HL94 HL97 HL297	HL67	NONE LISTED
	HL34 D	A	CRES, 125 KSI	SHEAR HEAD			

STANDARD AND OVERSIZE HI-LOK FASTENERS
TABLE I

Fastener Code - Threaded Fasteners - All RB211-535 Engines
Figure 4 (Sheet 1 of 5)

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STRUCTURAL REPAIR MANUAL

PROTRUDING HEAD							
CODE	PART NUMBER	VENDOR	MATERIAL	DESCRIPTION	COLLAR	1/65 IN. OVERSIZE PART NUMBER	1/32 IN. OVERSIZE PART NUMBER
NO VF ABE AAB	HL10	<input type="checkbox"/> A	TITANIUM, 95 KSI	SHEAR HEAD, HEX-DRIVE	HL70 HL79 HL82 HL94 HL97 HL379	HL110	HL410
A0Y	HL12	<input type="checkbox"/> A	TITANIUM, 160 KSI	TENSION HEAD, HEX-DRIVE	HL75 HL86 HL198 HL280	HL112	NONE LISTED
SL	HL30	<input type="checkbox"/> A	CRES, 125 KSI	SHEAR HEAD, HEX-DRIVE	HL70 HL79 HL82 HL94 HL97 HL175	HL66	HL58
ARV ALF ALR	HL40	<input type="checkbox"/> A	CRES, 95 KSI	SHEAR HEAD, HEX-DRIVE	HL70 HL79 HL82 HL94 HL97 HL297	HL140	HL240
AKK	HL644 <input type="checkbox"/> C	<input type="checkbox"/> A	CRES, 125 KSI	TENSION HEAD, HEX-DRIVE	HL70 HL79 HL82 HL94 HL97 HL175	HL744	NONE LISTED
	HL48 <input type="checkbox"/> C	<input type="checkbox"/> A	CRES, 160 KSI	TENSION HEAD, HEX-DRIVE	HL75 HL78 HL86	HL248	NONE LISTED
	HL32 <input type="checkbox"/> C	<input type="checkbox"/> A	CRES, 125 KSI	TENSION HEAD, HEX-DRIVE	HL73 HL75 HL86 HL89 HL273	HL36	NONE LISTED

STANDARD AND OVERSIZE HI-LOK FASTENERS
TABLE I (CONT)

Fastener Code - Threaded Fasteners - All RB211-535 Engines
Figure 4 (Sheet 2 of 5)

757-200 STRUCTURAL REPAIR MANUAL

CODE	PART NUMBER	VENDOR	MATERIAL	DESCRIPTION	SLEEVE	COLLAR	1/65 IN. OVERSIZE PART NO.	1/32 IN. OVERSIZE PART NO.
AAA XW	100° FLUSH HEAD PIN							
	ASP-FF-DT	B	STEEL, 108 KSI	SHEAR HEAD PIN AND SLEEVE, CAD. PLATE	ASPF-S-DT	ASP-LC-2AC	OASPPF-DT	
	ASPF-DT	B	STEEL, 108 KSI	SHEAR HEAD PIN, PROTRUDING SLEEVE, CAD. PLATE	2ASP-S-DT	ASP-LC-2AC	OASPPF-DT	
	ASP100P-DT	B	STEEL, 108 KSI	SHEAR HEAD PIN, PROTRUDING SLEEVE, CAD. PLATE	2ASP-S-DT	ASP-LC-2AC	OASP100-DT	
	2ASPPF-DT	B	STEEL, 108 KSI	SHEAR HEAD PIN AND SLEEVE, CAD. PLATE	2ASPF-S-DT	ASP-LC-2AC	O2ASPPF-DT	
	2ASP509F-DT	B	STEEL, 108 KSI	TENSION HEAD PIN AND SLEEVE, CAD. PLATE	2ASPF-S-DT	ASP-LC-2AC	O2ASP509F-DT	
	2ASP509P-DT	B	STEEL, 108 KSI	TENSION HEAD, PROTRUDING SLEEVE, CAD. PLATE	2ASPP-S-DT	ASP-LC-2AC	O2ASP509P-DT	
	PROTRUDING HEAD PIN							
	2ASPPF-DT	B	STEEL, 108 KSI	FLAT HEAD PIN, FLUSH SLEEVE, CAD. PLATE	2ASPP-S-DT	ASP-LC-2AC	O2ASPPF-DT	

STANDARD AND OVERSIZE ASP FASTENERS
TABLE II

Fastener Code - Threaded Fasteners - All RB211-535 Engines
Figure 4 (Sheet 3 of 5)

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STRUCTURAL REPAIR MANUAL

CODE	PART NUMBER	VENDOR	MATERIAL	DESCRIPTION	SLEEVE	COLLAR	1/65 IN. OVERSIZE PART NO.	1/32 IN. OVERSIZE PART NO.
HE	100° FLUSH HEAD CORE BOLT AND SLEEVE							
	BB301	A	CRES, 125 KSI	CORE BOLT				
	BB309	A	CRES, 95 KSI	CORE BOLT				
	BB351-8	A	CRES BOLT AND SLEEVE, 125 KSI	BLIND BOLT ASSEMBLY	BB321 BB321PB	BB341 BB341G BB341PB	BB321.64	BB321.32
	BB351-10	A	CRES BOLT AND SLEEVE, 125 KSI	BLIND BOLT ASSEMBLY	BB321 BB321PB	BB341 BB341G BB341PB	BB321.64	BB321.32
	NB1101	A	STEEL, 160 KSI, CAD. PLATE	CORE BOLT				
	NB1114	A	CRES, 160-180 KSI	CORE BOLT				
	PROTRUDING HEAD CORE BOLT AND SLEEVE							
	BB302	A	CRES, 125 KSI	CORE BOLT				
	BB352	A	CRES BOLT AND SLEEVE, 125 KSI	BLIND BOLT ASSEMBLY	BB322 BB322PB	BB341 BB341G BB341PB	BB322.64	BB322.32
	NB1102	A	STEEL, 160 KSI CAD. PLATE	CORE BOLT				

STANDARD AND OVERSIZE BLIND BOLTS
TABLE III

Fastener Code - Threaded Fasteners - All RB211-535 Engines
Figure 4 (Sheet 4 of 5)

757-200
STRUCTURAL REPAIR MANUAL

CODE	PART NUMBER	VENDOR	MATERIAL	DESCRIPTION	TENSILE STRENGTH	SHEAR STRENGTH
	NAS1581A		ALLOY STEEL	100° FLUSH SHEAR-HEAD BOLT	160-180 KSI	95-108 KSI
	NAS1581E		A286 CRES	100° FLUSH SHEAR-HEAD BOLT	160-180 KSI	95-108 KSI
	NAS1581V		6AL-4V TITANIUM	100° FLUSH SHEAR-HEAD BOLT	160-180 KSI	95-108 KSI

100° FLUSH REDUCED HEAD BOLT
TABLE IV

NOTES

- THE CODE USED IN THE FASTENER TABLES IN 51-41-01 TO IDENTIFY THE FASTENER VENDORS IS THE SAME AS THAT USED IN 51-40-01.

A HI-SHEAR CORPORATION
2600 SKYPARK DRIVE
TORRANCE, CALIFORNIA 90509

B HUCK MANUFACTURING CO.
900 WATSON CENTER RD
CARSON, CA 90745

C USED ON RB211-535C37 ONLY

D USED ON RB211-535E4 ONLY

Fastener Code - Threaded Fasteners - All RB211-535 Engines
Figure 4 (Sheet 5 of 5)

757-200 STRUCTURAL REPAIR MANUAL

GENERAL - FASTENER INSTALLATION AND REMOVAL - RB211-535 ENGINES

1. References

Reference	Title
51-31-03, GENERAL	Nonmetallic Materials - RB211-535 Engine Nacelle
51-40-02, GENERAL	Fastener Installation and Removal
51-40-04, GENERAL	Torque Values
51-41-01, GENERAL	Fastener Types - RB211-535 Engines
51-41-05, GENERAL	Fastener Hole Sizes - RB211-535 Engines
51-41-08, GENERAL	Countersinking - RB211-535 Engines

2. Solid Shank Rivets

A. General

- (1) The solid shank rivets that are used in RB211-535C37 and E4 engine nacelle hinged cowl, translating cowl and thrust reverser C-ducts are made of titanium bi-metallic construction, Monel, steels and aluminum alloys. Rivet part numbers have a suffix denoting the material, while the rivet head has identification marks. These materials are found in Table 1/GENERAL.

Table 1: Rivet Markings

Material	Suffix	Head Marking
2024	DD	Two raised dashes
2117	AD	Dimple
5056	B	Raised cross
A286CRES	None	One raised dot
Ti/Co	B	Dimple and depressed dot
6AL-4VTi	None	Double dimple

- (2) Rivets made from 2017, 2117 and 5056 aluminum alloy can be stored and used at room temperature.
- (3) Rivets made from 2024 aluminum alloy must be heat-treated and then stored at a temperature of -10°F or lower. After removal from cold storage, the rivets must be completely driven within 15 minutes. These rivets must not be returned to cold storage once they have been removed.
- (4) Refer to 51-41-05, GENERAL for hole sizes.
- (5) Refer to 51-41-08, GENERAL for details of countersinking.

B. Installation of Solid Rivets

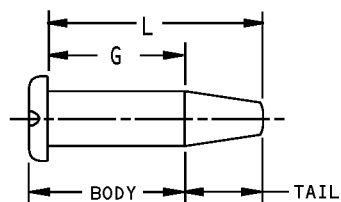
- (1) Solid rivets can be installed by the use of a rivet gun and bucking bar or a suitable squeeze riveting tool. Rivet guns and bucking bars must be large enough to drive the rivets quickly. Three or four seconds driving duration is the optimum, while 7 seconds must be the maximum. Avoid overdriving rivets as this can cause diagonal cracks. Bucking bars must have very smooth driving faces, especially when driving the harder 2017 aluminum alloy rivets.
- (2) Refer to Figure 3/51-40-02, GENERAL, Tables I and II for grip length ranges and driven head sizes for solid MS20615, MS20470, CSR902B, CSR903B, NAS1097, NAS1199 and NAS1200 rivets.

757-200**STRUCTURAL REPAIR MANUAL**

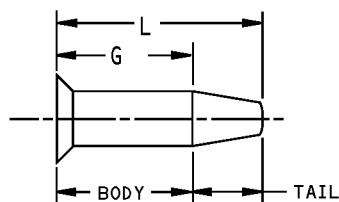
- (3) Refer to Figure 1/GENERAL, Table I for grip length ranges for CSR922, CSR924 and CSR925 rivets.
- (4) Refer to Figure 1/GENERAL, Table II for CSR902B, CSR903B, CSR922, CSR924 and CSR925 rivet installation, equipment and pressures.
- C. Fastener Corrosion Protection
 - (1) Application:
 - (a) Install fasteners with PR1431G (Refer to 51-31-03, GENERAL, Figure 1) sealant, a two-part polysulfide compound soluble chromates.
 - (2) Curing:
 - (a) The compound will cure at room temperature.
- D. Refer to 51-40-02, GENERAL for cracks in driven heads.
- E. Refer to 51-40-02, GENERAL, Figure 5 for solid shank rivet removal.

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STRUCTURAL REPAIR MANUAL



CSR925
PROTRUDING HEAD RIVET



CSR922 AND CSR924
FLUSH HEAD RIVET

PART NUMBER
EXAMPLE:

CSR922 -6 -4 R
 HALF SIZE
 GRIP DASH NUMBER
 DIAMETER DASH NUMBER
 MS20426 FLUSH HEAD, 6AL-4V TI BODY WITH TI/CB TAIL

CSR924 -6 -4 R
 HALF SIZE
 GRIP DASH NUMBER
 DIAMETER DASH NUMBER
 NAS1097 FLUSH HEAD, 6AL-4V TI BODY WITH TI/CB TAIL

GRIP RANGE		G + .015 - .000	-5 (5/32)		-6 (3/16)		-8 (1/4)	
MIN.	MAX.		DASH NO.	L ±.010	DASH NO.	L ±.010	DASH NO.	L ±.010
0.094	0.125	0.093	5-2R	0.298				
0.126	0.156	0.125	5-3	0.330	6-3	0.347		
0.157	0.187	0.156	5-3R	0.361	6-3R	0.378	8-3R	0.423
0.188	0.218	0.187	5-4	0.392	6-4	0.410	8-4	0.455
0.219	0.250	0.218	5-4R	0.423	6-4R	0.441	8-4R	0.486
0.251	0.281	0.250	5-5	0.455	6-5	0.472	8-5	0.517
0.282	0.312	0.281	5-5R	0.486	6-5R	0.503	8-5R	0.548
0.313	0.343	0.312	5-6	0.517	6-6	0.535	8-6	0.580
0.344	0.375	0.343	5-6R	0.548	6-6R	0.566	8-6R	0.611
0.376	0.406	0.375	5-7	0.580	6-7	0.597	8-7	0.642
0.407	0.437	0.406	5-7R	0.611	6-7R	0.628	8-7R	0.673
0.438	0.468	0.437	5-8	0.642	6-8	0.660	8-8	0.705
0.469	0.500	0.468	5-8R	0.673	6-8R	0.691	8-8R	0.736
0.501	0.531	0.500	5-9	0.705	6-9	0.722	8-9	0.767
0.532	0.562	0.531	5-9R	0.736	6-9R	0.753	8-9R	0.798
0.563	0.593	0.562	5-10	0.767	6-10	0.785	8-10	0.830
0.594	0.625	0.593	5-10R	0.798	6-10R	0.816	8-10R	0.861
0.626	0.656	0.625	5-11	0.830	6-11	0.847	8-11	0.892
0.657	0.687	0.656	5-11R	0.861	6-11R	0.878	8-11R	0.923
0.688	0.718	0.687	5-12	0.892	6-12	0.910	8-12	0.955
0.719	0.750	0.718	5-12R	0.923	6-12R	0.941	8-12R	0.986
0.751	0.781	0.750	5-13	0.955	6-13	0.972	8-13	1.017
0.782	0.812	0.781	5-13R	0.986	6-13R	1.003	8-13R	1.048
0.813	0.843	0.812	5-14	1.017	6-14	1.035	8-14	1.080
0.844	0.875	0.843	5-14R	1.048	6-14R	1.066	8-14R	1.111
0.876	0.906	0.875	5-15	1.080	6-15	1.097	8-15	1.142
0.907	0.937	0.906	5-15R	1.111	6-15R	1.128	8-15R	1.173
0.938	0.968	0.937	5-16	1.142	6-16	1.160	8-16	1.205
0.969	1.000	0.968	5-16R	1.173	6-16R	1.191	8-16R	1.236

UNDRIVEN LENGTH AND GRIP RANGES FOR CSR922, CSR924 AND CSR925 RIVETS
TABLE I

Installation of Cherrybuck Rivets - All RB211-535 Engines
Figure 1 (Sheet 1 of 3)

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STRUCTURAL REPAIR MANUAL

NOMINAL FASTENER DIAMETER	TYPICAL SQUEEZE LOAD (LBS.) [C]	RECOMMENDED RIVET HAMMERS [A]				BUCKING BAR WEIGHTS (LBS.)
		JIFFY	INGERSOLL RAND	CHICAGO PNEUMATIC	CLEVELAND PNEUMATIC	
3/32	1200	100	AVC10	Q-Y	E2	1-2
1/8	2150	200	AVC11	2X	E2	2-3
5/32	3700	300	AVC12	4XB	E4	3-5
3/16	5000	400	AVC13	5XB	E5	5-8
1/4	8600	400	AVC24	9XB	G5	8-12
5/16	15200	[B]	[B]	[B]	[B]	[B]
3/8	22000	[B]	[B]	[B]	[B]	[B]

RIVET INSTALLATION EQUIPMENT AND PRESSURES FOR CSR902B, CSR903B,
CSR922, CSR924 AND CSR925 RIVETS

TABLE II

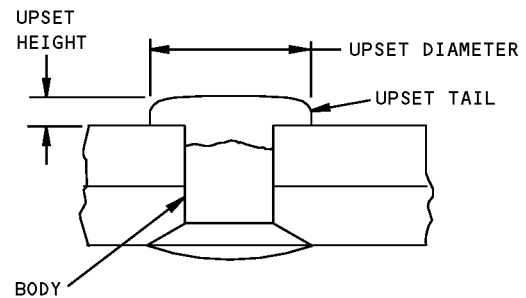
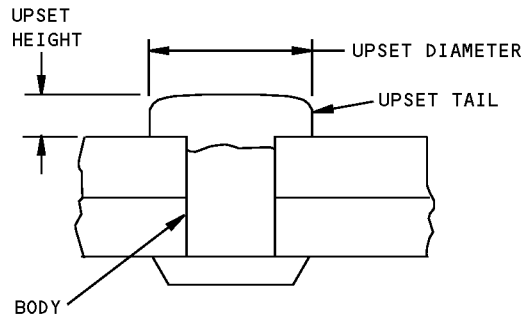
NOMINAL DIAMETER	MIN. UPSET DIAMETER 1.3D	MIN. UPSET HEIGHT	
		CHERRY BUCK [D]	E-Z BUCK [E]
3/32	0.122	—	0.028
1/8	0.163	—	0.038
5/32	0.213	0.056	0.049
3/16	0.246	0.065	0.057
1/4	0.325	0.085	—
5/16	0.408	0.106	—
3/8	0.488	0.128	—

MINIMUM UPSET HEIGHT FOR CHERRY BUCK AND E-Z BUCK RIVETS

TABLE III

Installation of Cherrybuck Rivets - All RB211-535 Engines
Figure 1 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- | | |
|--|---|
| <p>A HAMMER SELECTION IS BASED ON 70-90 PSI AIR LINE PRESSURE</p> <p>B SQUEEZE ONLY</p> <p>C VALUES INDICATE TYPICAL LOADS REQUIRED TO ACHIEVE 1.3D UPSET DIAMETER AND APPLY TO CHERRY BUCK IN MAXIMUM GRIP AND E-Z BUCK WITH 1.0D INITIAL PROTRUSION. SQUEEZE LOADS ARE GUIDELINES AND MAY BE VARIED AS REQUIRED</p> | <p>D CHERRY BUCK MIN. UPSET HEIGHT = 0.34D</p> <p>E E-Z BUCK MIN. UPSET HEIGHT = 0.3D</p> |
|--|---|

Installation of Cherrybuck Rivets - All RB211-535 Engines
Figure 1 (Sheet 3 of 3)

757-200 STRUCTURAL REPAIR MANUAL

3. Blind Rivets

A. General

- (1) The blind rivets that are used in the RB211-535C37 and E4 engine nacelle hinged cowl, translating cowl and thrust reverser C-ducts are made of aluminum alloy, Monel, A286CRS and steel.
- (2) Refer to 51-41-01, GENERAL for limitations on the use of blind rivets.
- (3) Refer to 51-41-05, GENERAL for hole sizes.
- (4) Refer to 51-41-08, GENERAL for details of countersinking.
- (5) Refer to Figure 2/GENERAL, Table I for grip length ranges for blind rivets.

B. Installation

- (1) Blind rivets are installed with special tools usually supplied by the fastener manufacturer listed in 51-41-06.

NOTE: Blind rivets are supplied with different spindle configurations, full and partial serrations. Rivets having different spindle configurations cannot be installed with the same pulling head.

- (2) Refer to Figure 2/GENERAL, Table II for installation of Cherrymax CR3522, CR3523, CR3552 and CR3553 rivets.
- (3) Check that rivet stem and collar protrusions are within limits shown in Figure 2/GENERAL, Table III and IV.

STRUCTURAL REPAIR MANUAL

S7B100T RIVET		
GRIP DASH NO.	GRIP RANGE	
	MIN.	MAX.
04	0.219	0.282
06	0.334	0.407
08	0.469	0.532
09	0.531	0.595
14	0.844	0.907
15	0.906	0.970
16	0.969	1.032
17	1.031	1.095
18	1.066	1.157
24	1.469	1.532

CCR264,CCR274,CR2164,CR2564,CR2664 NAS1738,NAS1739,NAS1398 AND NAS1399 RIVETS		
GRIP RANGE		GRIP DASH NO.
MIN.	MAX.	
0.126	0.187	-3
0.188	0.250	-4
0.251	0.312	-5
0.313	0.375	-6
0.376	0.437	-7
0.438	0.500	-8
0.501	0.562	-9
0.563	0.625	-10
0.626	0.687	-11

S4B100T RIVET		
GRIP DASH NO.	GRIP RANGE	
	MIN.	MAX.
03	0.125	0.188
04	0.187	0.251
05	0.250	0.313
06	0.312	0.376
07	0.375	0.438
08	0.437	0.501
09	0.500	0.563
10	0.562	0.626
11	0.625	0.688
12	0.687	0.751

CR3522 RIVET	
FLUSH HEAD	
DASH NO.	MIN. GRIP
-4	0.063
-5	0.065
-6	0.080

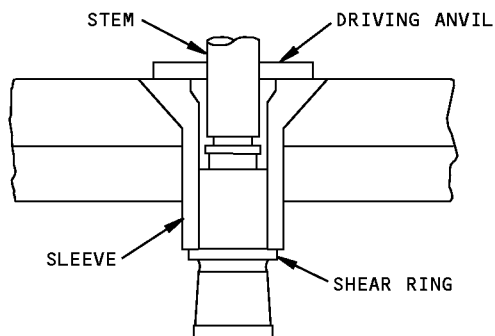
CR3552 RIVET	
FLUSH HEAD	
DASH NO.	MIN. GRIP
-4	0.045
-5	0.063
-6	0.073

CR3523 AND CR3553 RIVETS	
FLUSH HEAD	
DASH NO.	MIN. GRIP
-4	0.025
-5	0.031
-6	0.037

GRIP LENGTH RANGES - BLIND RIVETS
TABLE I

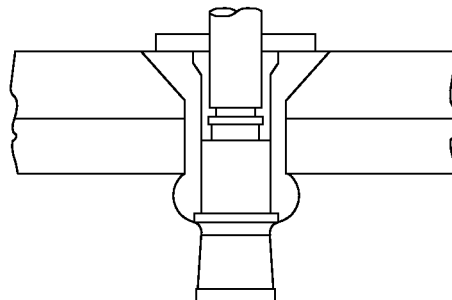
Installation of Blind Rivets - All RB211-535 Engines
Figure 2 (Sheet 1 of 4)

757-200 STRUCTURAL REPAIR MANUAL



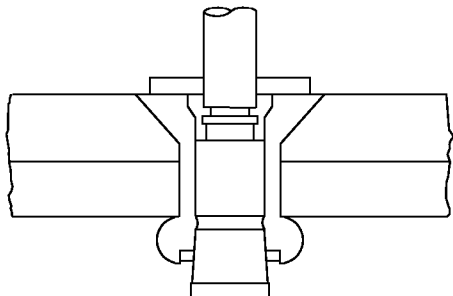
RIVET INSERTED INTO PREPARED ATTACH HOLE.
PULLING SERRATIONS OF STEM ENGAGED IN
JAWS OF PULLING HEAD.

STEP A



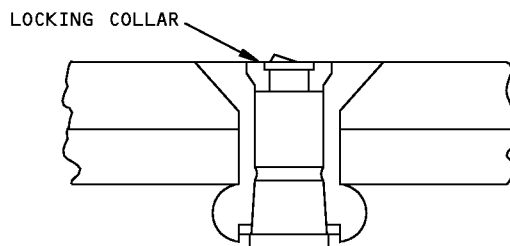
STEM IS PULLED INTO RIVET SLEEVE AND
STARTS TO FORM A LARGE BULBED BLIND HEAD.

STEP B



SHEAR RING SHEARS FROM CONE TO ALLOW
STEM TO PULL FURTHER INTO RIVET SLEEVE.

STEP C



UPSET COMPLETED WITH FRACTURE OF STEM.
LOCKING COLLAR IS IN COLLAR RECESS
LOCKING STEM AND SLEEVE TOGETHER.

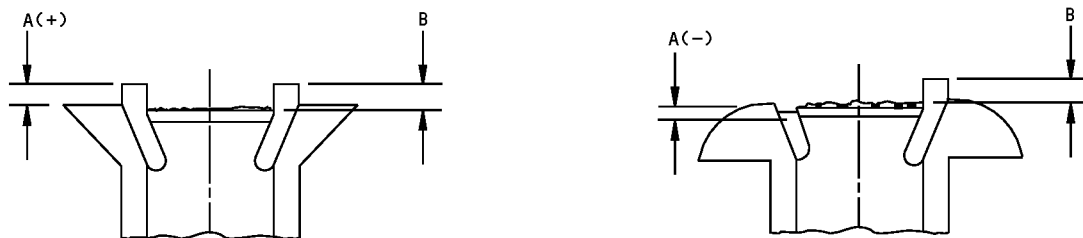
STEP D

CHERRYMAX RIVET UPSET SEQUENCE

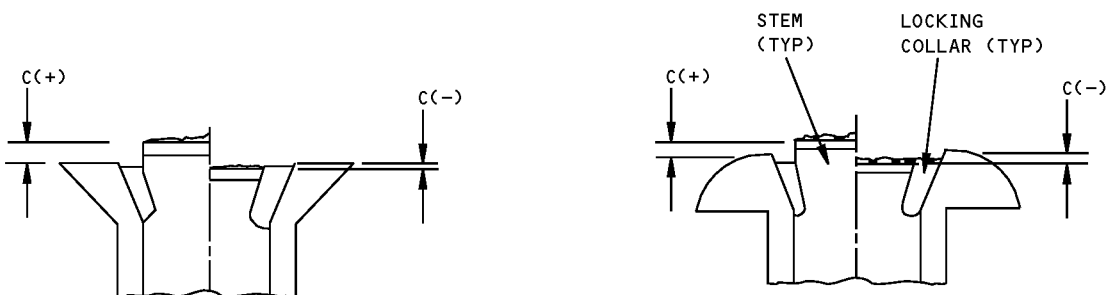
INSTALLATION OF CR3522, CR3523, CR3552, AND CR3553 RIVETS
TABLE II

Installation of Blind Rivets - All RB211-535 Engines
Figure 2 (Sheet 2 of 4)

757-200 STRUCTURAL REPAIR MANUAL



LOCKING COLLAR PROTRUSION LIMITS



STEM PROTRUSION LIMITS

A = MAXIMUM ALLOWABLE DISTANCE OF LOCKING COLLAR
ABOVE (+) OR BELOW (-) FASTENER HEAD

B = MAXIMUM ALLOWABLE DISTANCE OF LOCKING COLLAR
ABOVE TOP LAND ON STEM

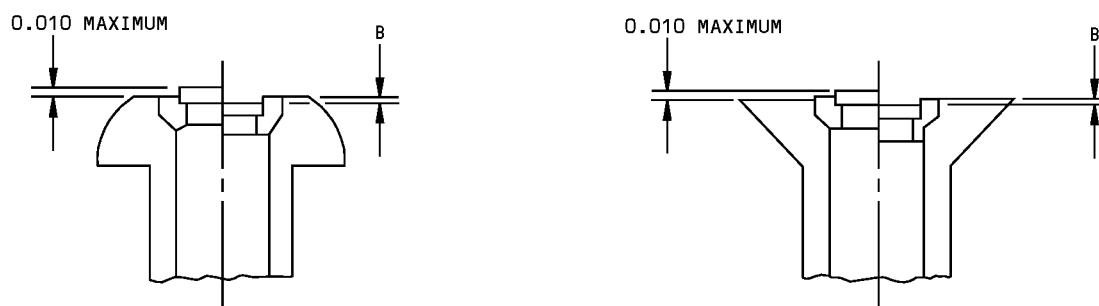
C = MAXIMUM ALLOWABLE DISTANCE OF TOP OF LAND ON
STEM ABOVE (+) OR BELOW (-) FASTENER HEAD

STEM AND COLLAR PROTRUSION LIMITS FOR NAS1398, NAS1399, NAS1738, NAS1739, CR2164, CR2564, CR2664 RIVETS				
NOMINAL RIVET DIA.	A	B	C	
1/8	+0.020	+0.015	+0.020	-0.010
5/32	+0.020	+0.020	+0.020	-0.010
3/16	+0.020	+0.025	+0.020	-0.010
1/4	+0.020	+0.030	+0.020	-0.010

CHERRYLOCK RIVET STEM AND COLLAR FLUSHNESS LIMITS
TABLE III

Installation of Blind Rivets - All RB211-535 Engines
Figure 2 (Sheet 3 of 4)

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STRUCTURAL REPAIR MANUAL



RIVET DIA.	-4	-5	-6
B MAX.	0.015	0.020	0.020

RIVET STEM AND COLLAR FLUSHNESS LIMITS FOR CHERRYMAX RIVETS
CR3522, CR3523, CR3552 AND CR3553

TABLE IV

Installation of Blind Rivets - All RB211-535 Engines
Figure 2 (Sheet 4 of 4)

STRUCTURAL REPAIR MANUAL**4. Blind Bolts**

CAUTION: BLIND BOLTS ARE NOT TO BE USED WHERE THEY COULD ENTER AN ENGINE AIR INTAKE IF THEY BECOME LOOSE.

A. General

- (1) BB301, BB302, BB309, BB351, NB1101, NB1114 flush head and NB1102 protruding head blind bolts are approved for use in the RB211-535C37 and E4 engine nacelle.
- (2) For temperature consideration, stainless steel blind bolts (e.g., BB351 or BB352) serve for general purpose use to 450°F (232°C).
- (3) Refer to 51-41-05, GENERAL for hole sizes.
- (4) Refer to 51-41-08, GENERAL for details of countersinking.

B. Installation

- (1) Install blind bolts with special tools, usually supplied by the fastener manufacturer listed in 51-41-01, GENERAL.
- (2) Install the bolt sleeve and expander on the gun mandrel and insert into hole. Push gun control button to pull the expander into the sleeve, wedging the sleeve into the hole.

C. Removal

- (1) Drill the sleeve to a depth slightly beyond the head diameter using a drill diameter slightly smaller than that of the sleeve. Use moderate pressure when drilling to prevent turning of the sleeve.

5. Hex-drive bolts**A. General**

- (1) A hex-drive bolt is a threaded fastener usually installed with a special nut consisting of a one-piece collar and hexagonal torquing device. The hexagonal torquing device breaks off at a predetermined load, thus eliminating the need for torque loading. Bolts and collars are factory lubricated and must not be degreased.
- (2) Refer to 51-41-05, GENERAL for hole sizes.
- (3) Refer to 51-41-08, GENERAL for details of countersinking.

B. Installation

- (1) The bolts can be installed with power or hand tools. For repair purposes hand tools will normally be used as follows:
 - (a) Insert the pin into the hole until the head is seated.
 - (b) Screw collar on finger tight.
 - (c) Prevent pin from turning with a hexagonal key in the recess provided and tighten the collar with a modified ratchet and socket or a box wrench until the wrenching device is torqued off. Refer to Figure 10/51-40-02, GENERAL for installation.
- (2) Where access is not available for the installation of the special nut, it is permissible to use BACN10JC for locknuts for shear head Hi-Lok bolts or BACN10GW for tension head Hi-Lok bolts assembled with a 0.062 in. thick standard washer. Refer to Figure 8/51-40-02, GENERAL for criteria to be used in selection of washer material. Refer to 51-40-04, GENERAL for torque values.
- (3) After the collar is installed check for the following:
 - (a) Pin protrusion limits as given in Figure 10/51-40-02, GENERAL.

757-200 STRUCTURAL REPAIR MANUAL

C. Removal

- (1) Hex-drive bolts are removed by inserting a hexagonal key in the pin and gripping and turning the collar with locking pliers.

6. ASP Threaded Fasteners

A. General

- (1) Threaded fasteners used in RB211-535E4 engine nacelle are ASPFF, 2ASPFF, ASPFP, 2ASPFP, ASP100P, 2ASP509F, 2ASPFP509P. The pins and sleeves are made of steel with cadmium plate.
- (2) Refer to 51-41-05, GENERAL for hole sizes.
- (3) Refer to 51-41-08, GENERAL for details of countersinking.
- (4) Refer to Figure 3/GENERAL, Table I for grip length ranges.

B. Installation

- (1) Threaded fasteners are installed with special tools usually supplied by the fastener manufacturer listed in 51-41-01, GENERAL.
 - (a) Insert pin from one side of work.
 - (b) Place sleeve over pintail and torque into position against work.
 - (c) Place lock collar over pintail.
 - (d) Place installation tool on pintail and form collar into recess to lock sleeve on pin.
- (2) Check that pin protrusion and collar height are within limits shown in Figure 4/GENERAL, Tables I and II.

C. Removal

- (1) Refer to Figure 5/GENERAL, Table I for threaded fastener lock removal.

757-200 STRUCTURAL REPAIR MANUAL

GRIP NUMBER	GRIP RANGE		GRIP NUMBER	GRIP RANGE	
	MIN.	MAX.		MIN.	MAX.
05	0.251	0.312	19	1.126	1.188
06	0.313	0.375	20	1.189	1.250
07	0.376	0.438	21	1.251	1.312
08	0.439	0.500	22	1.313	1.375
09	0.501	0.562	23	1.376	1.438
10	0.563	0.625	24	1.439	1.500
11	0.626	0.688	25	1.501	1.562
12	0.689	0.750	26	1.563	1.625
13	0.751	0.812	27	1.626	1.688
14	0.813	0.875	28	1.689	1.750
15	0.876	0.938	29	1.751	1.812
16	0.939	1.000	30	1.813	1.875
17	1.001	1.062	31	1.876	1.938
18	1.063	1.125	32	1.939	2.000

GRIP LENGTH FOR ASP THREADED FASTENERS
 ASPFF, 2ASPFF, ASPFP, 2ASPFP, ASP100P, 2ASP509F, 2ASPFP509P
 TABLE I

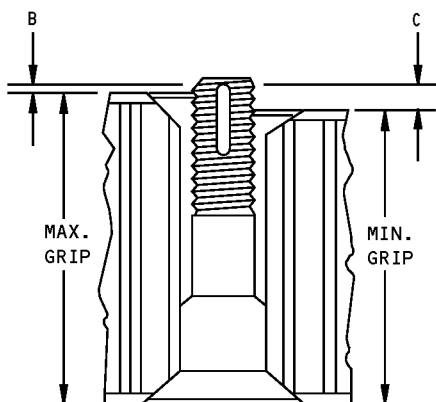
NOTE

ASP FASTENERS = ADJUSTABLE CLAMPING FORCE
 POSITIVE LOCK FASTENERS USED PRIMARILY IN HONEYCOMB SANDWICH CONSTRUCTION

ASP Fastener Grip Range - All RB211-535 Engines
Figure 3

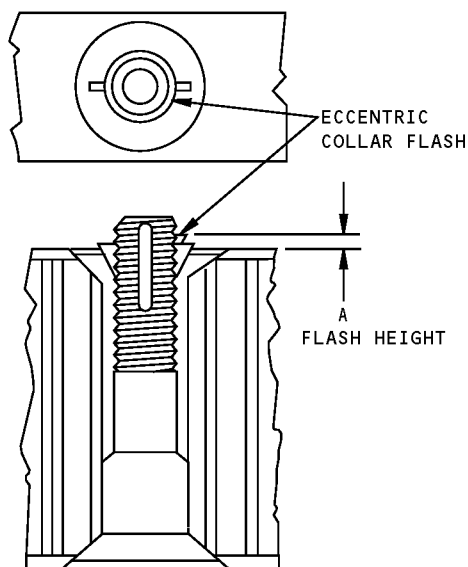
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STRUCTURAL REPAIR MANUAL

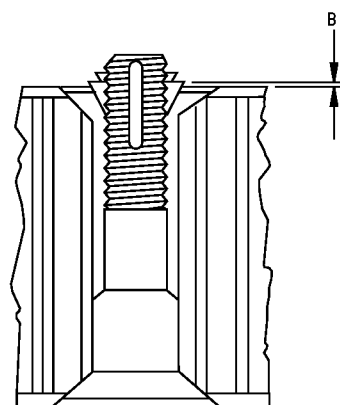


PIN PROTRUSION

FASTENER DIAMETER	B MIN. PIN PROTRUSION ABOVE SLEEVE	C MAX. PIN PROTRUSION ABOVE SLEEVE
13/64 (6)	0.020"	0.107"
17/64 (8)	0.030"	0.119"
21/64 (10)	0.035"	0.129"

ASP PIN PROTRUSION
TABLE I

COLLAR/FLASH HEIGHT



COLLAR HEIGHT

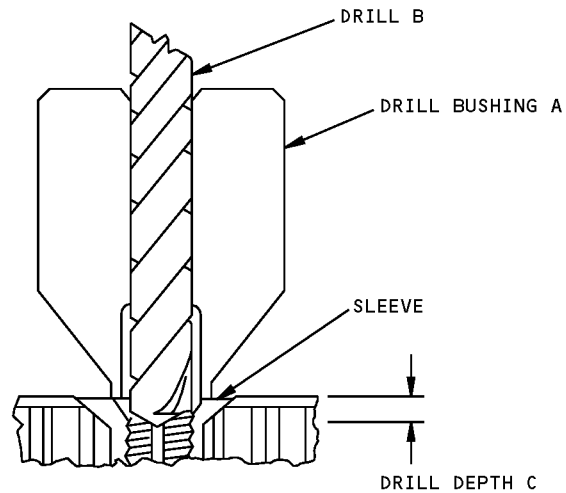
FASTENER DIAMETER	A MAX. FLASH HEIGHT (Widest Point)	B MAX. COLLAR HEIGHT (Not Including Flash)
13/64 (6)	0.020	0.010
17/64 (8)	0.030	0.013
21/64 (10)	0.040	0.016

ASP COLLAR HEIGHT
TABLE II

Pin Protrusion and Collar Height Limits for ASP Threaded Fasteners - All RB211-535 Engines
Figure 4

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STRUCTURAL REPAIR MANUAL



FASTENER DIAMETER	A DRILL BUSHING HUCK P/N	B DRILL DIAMETER	C DRILL DEPTH
13/64 (6)	103617	0.1562	3/64"
17/64 (8)	103618	0.1875	1/16"
21/64 (10)	103619	0.2280	5/64"

ASP FASTENER LOCK REMOVAL
TABLE I

ASP Threaded Fastener Lock Removal - All RB211-535 Engines
Figure 5

STRUCTURAL REPAIR MANUAL**GENERAL - FASTENER SUBSTITUTION - RB211-535 ENGINES****1. General**

- A. The edge distance and spacing for the substitute fastener must be the same as the original attachment.
- B. Substitutions must be made on a basis of the same size and grip length.
- C. When pull-type lockbolts cannot be installed due to tool clearance, a short pintail lockbolt is the preferred substitution. If the short pintail lockbolt cannot be installed, a Hi-Lok can be substituted if an interference-fit hole is required; a bolt must be substituted if a clearance-fit hole is required. When bolts or Hi-Loks are used on a substitution basis, they must be used with self-aligning nuts.
- D. Refer to Figure 1 (Sheet 1), Table 1, for substitution for Hi-Lok fasteners which are used only on RB211-535C37 and E4 engine nacelle. When the required grip length for a Hi-Lok is not obtainable, the next grip length can be used and a spacer/washer must be used under the collar or nut.
- E. Substitute steel fasteners can be used for steel or titanium bolts specified in the applicable figure, provided they are of equivalent or greater strength. Tension type fasteners are designed for use in tension and shear applications, but it is not acceptable to use shear fasteners in tension.
- F. Substitution of rivets can be made provided proper consideration is given to the type, size, head style (flush or non-flush), features (standard or minimum pin clearance) and material.

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FASTENER	EQUIVALENT
HL10	HL40
HL12	HL48
HL13	HL49
HL15	NOT AVAILABLE
HL30	HL644
HL40	HL10
HL41	HL641

HI-LOK FASTENERS SUBSTITUTION
TABLE I

Equivalent Fastener Substitution Data All RB211-535 Engines
Figure 1

STRUCTURAL REPAIR MANUAL**GENERAL - TORQUE VALUES - RB211-535 ENGINES****1. General**

- A. Torque values for nut tightening and bolt tightening are the same for RB211-535C37 and E4 engine nacelle hinged cowls, translating cowls, and thrust reverser C-ducts as those given in 51-40-04, GENERAL for standard hexagonal and 12-point-head bolts and nuts.
- B. Hi-Lok pins (bolts) are threaded fasteners which use a threaded drive collar with a hexagonal drive section which shears or breaks off when the proper wrenching torque is applied. Where access is not available for installation of a hex-drive collar, standard locknuts can be used and torqued to the values shown in Figure 1/GENERAL, Table IV, for hex-drive bolts used in both the RB211-535C37 and E4 engine nacelle and the Boeing 757 airplane. For H-Lok bolts, used only in the RB211-535C engine nacelle Refer to Figure 1/GENERAL, Table I.
- C. Torque values for the installation of ASP fastener pins and sleeves are given in Figure 1/GENERAL, Table II.
- D. Refer to Figure 1/GENERAL, Table III, for core bolt torque values for blind bolts used in the RB211-535C engine nacelle.

2. References

Reference	Title
51-40-04, GENERAL	Torque Values

3. Torque Wrench Adapters and Extensions

- A. The use of torque wrench adapters and/or extensions is limited to those applications where the torque wrench cannot be applied directly.
- B. When an adapter or extension is used with a torque wrench, a correction must be made to the torque reading obtained. If the centerline of the adapter or extension aligns with the centerline of the torque wrench (in a straight line), the correction to the torque wrench reading can be made as shown in 51-40-04, Figure 2/GENERAL. If the adapter or extension centerline must misalign with the centerline of the torque wrench in order to obtain the rotation required, the correction to the reading must be made as shown in Figure 2/GENERAL.

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FASTENER DIAMETER AND THREAD SIZE		TORQUE (POUND-INCH)					
		LOCKNUT	LOCKNUT	LOCKNUT	LOCKNUT	LOCKNUT	LOCKNUT
		BACN10JC BACN10GW	BACN10GW	BACN10GW	BACN10JC BACN10GW	BACN10GW	BACN10GW
DIA. (IN.)	THD. PER INCH	100° COUNTERSUNK HEAD			PROTRUDING HEAD		
		SHEAR TYPE HI-LOK BOLTS		TENSION TYPE HI-LOK BOLTS	SHEAR TYPE HI-LOK BOLTS		TENSION TYPE HI-LOK BOLTS
		HL-41 HL-641	HL-15	HL-13 HL-49	HL-10 HL-40	HL-30	HL-12 HL-48 HL-644
5/32	32	7	10	10	7	10	10
3/16	32	12	16	16	12	16	16
1/4	28	26	26	26	26	26	26
5/16	24	40	40	40	40	40	40
3/8	24	50	50	50	50	50	50
7/16	20	70	70	70	70	70	70
1/2	20	100	100	100	100	100	100

TORQUE VALUES FOR LOCKNUTS ON HI-LOK BOLTS
TABLE I

Torque Values - All RB211-535 Engines
Figure 1 (Sheet 1 of 3)

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STRUCTURAL REPAIR MANUAL

FASTENER DIAMETER		TORQUE RANGE (POUND-INCH)	
NOMINAL (IN.)	DASH NO.	MINIMUM	MAXIMUM
13/64	-6	10	20
17/64	-8	20	30
21/64	-10	30	40

TORQUE VALUES FOR ASP FASTENERS
TABLE IITorque Values - All RB211-535 Engines
Figure 1 (Sheet 2 of 3)

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STRUCTURAL REPAIR MANUAL

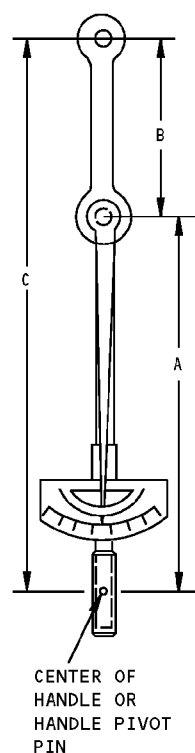
CORE BOLT SHANK DIAMETER AND THREAD SIZE				TORQUE RANGE (POUND-INCH)		
				COUNTERSUNK HEAD FASTENER CORE BOLT	PROTRUDING HEAD FASTENER CORE BOLT	
DASH NO.	NOM. DIA. (IN.)	SHANK DIA. (IN.)	THD PER INCH	BB309 (95 KSI)	BB301 (125 KSI)	BB302 (125 KSI)
-5	5/32	0.1120	40	4-5	7-9	7-9
-6	3/16	0.1240	40	5-7	9-11	9-11
-8	1/4	0.1650	32	9-12	15-19	15-19
-10	5/16	0.2180	28	16-20	27-34	27-34
-12	3/8	0.2490	28	21-26	35-44	35-44
-14	7/16	0.3110	24	33-41	55-69	55-69
-16	1/2	0.3740	24	48-60	80-99	80-99
-5 -6 -8 -1032 -12 -14 -16 -720 -820		0.1120	40		NB1101 (160 KSI)	NB1102 (160 KSI)
		0.1375	32		16-17	—
		0.1635	32		24-26	24-26
		0.1895	32		33-37	33-37
		0.2495	28		45-50	45-50
		0.3120	24		80-100	80-100
		0.3745	24		145-200	145-200
		0.4370	20		240-280	240-280
		0.4995	20		650-720	—
					700-1000	—
-5		0.1993	32		NB1114 (160-180 KSI)	
					45-50	

TORQUE VALUES FOR BLIND BOLT FASTENER CORE BOLTS
TABLE III

Torque Values - All RB211-535 Engines
Figure 1 (Sheet 3 of 3)

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STRUCTURAL REPAIR MANUAL



FORMULA:

$$TI = \frac{TA \times A}{A + (K \times B)}$$

EXAMPLE:

$$TI = \frac{160 \times 12}{12 + 1.0 \times 6} = \frac{1920}{18}$$

$$TI = 106.7 \text{ IN. LB}$$

$$A = 12$$

$$B = 6$$

$$TA = 160 \text{ IN. LB}$$

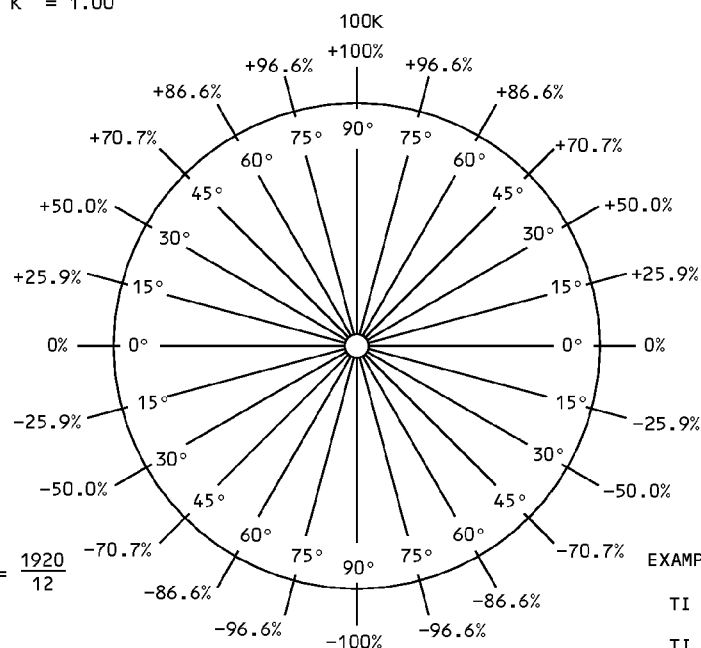
$$TI = 106.7 \text{ IN. LB}$$

$$K = 1.00$$

EXAMPLE:

$$TI = \frac{160 \times 12}{12 + 0.707 \times 6} = \frac{1920}{16.242}$$

$$TI = 118.2 \text{ IN. LB}$$



EFFECTIVE % OF B

EXAMPLE:

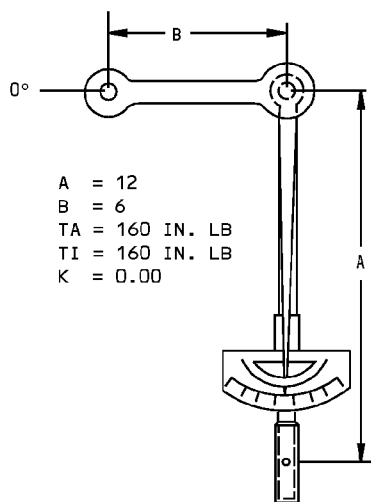
$$TI = \frac{160 \times 12}{12 + 0 \times 6} = \frac{1920}{12}$$

$$TI = 160 \text{ IN. LB}$$

EXAMPLE:

$$TI = \frac{160 \times 12}{12 - (0.707 \times 6)} = \frac{1920}{7.758}$$

$$TI = 247.5 \text{ IN. LB}$$



$$A = 12$$

$$B = 6$$

$$TA = 160 \text{ IN. LB}$$

$$TI = 160 \text{ IN. LB}$$

$$K = 0.00$$

$$A = 12$$

$$B = 6$$

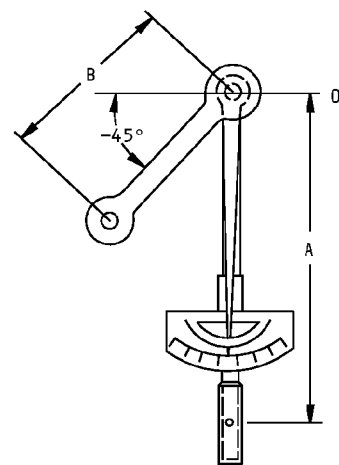
$$TA = 160 \text{ IN. LB}$$

$$TI = 247.5 \text{ IN. LB}$$

$$K = -0.707$$

NOTE:

TA = TORQUE ALLOWABLE
 TI = TORQUE INDICATED
 A = CENTER OF TORQUE WRENCH HEAD TO
 CENTER OF HANDLE OR HANDLE PIVOT
 B = CENTER TO CENTER OF ADAPTER
 K = EFFECTIVITY FACTOR OF B



Torque Wrench Adapter Correction Factor - All RB211-535 Engines
 Figure 2

757-200 STRUCTURAL REPAIR MANUAL

GENERAL - FASTENER HOLE SIZES - RB211-535 ENGINES

1. References

Reference	Title
51-40-08, GENERAL	Countersinking

2. General

- A. Hole sizes for rivets, bolts, lockbolts and Hi-Lok bolts shown in Figure 1/51-40-05, GENERAL are usable for those fasteners which are common to the RB211-535C37 and E4 structures for hinged cowls, translating cowls, and thrust reverser C-ducts and to the Boeing 757 airplane. Hole sizes for rivets, fastener pins and threaded fastener pins and sleeves which are used only on the RB211-535C37 and E4 engine nacelle structures are given in Figure 1/GENERAL, Tables I to VIII.
- B. Hole sizes for standard solid shank aluminum, titanium, CRES steel, and Monel rivets are given in Figure 1/GENERAL, Table I.
- C. Hole sizes for CSR902, CSR903 (E-Z Buck) rivets and CSR922, CSR924, CSR925 (Cherry-Buck) rivets are given in Figure 1/GENERAL, Table II.
- D. Hole sizes for low-profile shear head alloy steel blind bolts are given in Figure 1/GENERAL, Table III.
- E. Hole sizes for Cherry-Lock blind rivets are given in Figure 1/GENERAL, Table IV, and holes sizes for Cherry-Max blind rivets are given in Figure 1/GENERAL, Table V.
- F. Hole sizes for Hi-Shear blind bolts are given in Figure 1/GENERAL, Table VI.
- G. Hole sizes for the hexagon drive fasteners (Hi-Lok) bolts which are used on the RB211-535C37 and E4 engine nacelle are given in Figure 1/GENERAL, Table VII.
- H. Hole sizes for Huck ASP (adjustable clamping force positive lock) threaded fasteners are given in Figure 1/GENERAL, Table VIII.
- I. Refer to 51-40-08, GENERAL for countersinking and fillet relief for fastener holes of fasteners used only on the RB211-535C37 and E4 engine nacelle.
- J. Refer to Figure 2/51-40-05, GENERAL for surface defect criteria for fastener holes.
- K. Refer to Figure 1 (Sheet 7), Detail I for fastener hole perpendicularity requirements.

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HOLE SELECTION CRITERIA		
FASTENER TYPE	FIGURE	TABLE
SOLID SHANK RIVETS	1	I
CHERRY-BUCK AND E-Z BUCK RIVETS	1	II
LOW PROFILE SHEAR HEAD ALLOY STEEL BLIND BOLT	1	III
BLIND RIVETS (CHERRY LOCK)	1	IV
CHERRY MAX RIVETS	1	V
BLIND BOLTS (HI-SHEAR)	1	VI
HEX DRIVE FASTENER (HI-LOK)	1	VII
ASP THREADED FASTENERS	1	VIII

Fastener Hole Sizes - All RB211-535 Engines
Figure 1 (Sheet 1 of 7)

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STRUCTURAL REPAIR MANUAL

DASH NO.	NOMINAL DIAMETER	ACTUAL RIVET DIAMETER	HOLE DIAMETER LIMITS			
			STANDARD		0.0156 IN. OVERSIZE	
			MIN.	MAX.	MIN.	MAX.
-3	0.0937	0.094 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.098	0.103	---	---
-4	0.1250	0.125 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.128	0.135	---	---
-5	0.1562	0.156 $\begin{smallmatrix} +.004 \\ -.001 \end{smallmatrix}$	0.159	0.171	---	---
-6	0.1875	0.187 $\begin{smallmatrix} +.004 \\ -.001 \end{smallmatrix}$	0.191	0.202	0.221	0.233
-8	0.2500	0.250 $\begin{smallmatrix} +.004 \\ -.001 \end{smallmatrix}$	0.254	0.265	0.284	0.296
-10	0.3125	0.312 $\begin{smallmatrix} +.004 \\ -.001 \end{smallmatrix}$	0.316	0.327	0.346	0.358
-11	0.3750	0.375 $\begin{smallmatrix} +.004 \\ -.001 \end{smallmatrix}$	0.377	0.390	0.407	0.421

HOLE SIZES FOR STANDARD SOLID SHANK ALUMINUM,
TITANIUM, CRES AND MONEL RIVETS
(MS20427, MS20470, MS20615, NAS1097, NAS1199, NAS1200)
TABLE I

Fastener Hole Sizes - All RB211-535 Engines
Figure 1 (Sheet 2 of 7)

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STRUCTURAL REPAIR MANUAL

DASH NO.	NOMINAL DIAMETER	CHERRY BUCKS (CSR922, CSR924, CSR925)			E-Z BUCKS (CSR902, CSR903)		
		ACTUAL DIAMETER	HOLE DIAMETER		ACTUAL DIAMETER	HOLE DIAMETER	
			MIN.	MAX.		MIN.	MAX.
-3	0.0937	---	---	---	0.094 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.95	0.98
-4	0.1250	---	---	---	0.125 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.128	0.131
-5	0.1562	0.1640 $\begin{smallmatrix} +.0000 \\ -.0005 \end{smallmatrix}$	0.1600	0.1630	0.156 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.158	0.161
-6	0.1875	0.1895 $\begin{smallmatrix} +.0000 \\ -.0005 \end{smallmatrix}$	0.1855	0.1885	0.187 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.190	0.194
-8	0.2500	0.2495 $\begin{smallmatrix} +.0000 \\ -.0005 \end{smallmatrix}$	0.2455	0.2485	---	---	---
-10	0.3125	0.3120 $\begin{smallmatrix} +.0000 \\ -.0005 \end{smallmatrix}$	0.3080	0.3110	---	---	---
-12	0.3750	0.3745 $\begin{smallmatrix} +.0000 \\ -.0005 \end{smallmatrix}$	0.3705	0.3735	----	---	---

HOLE SIZES FOR CHERRY BUCK AND E-Z BUCK RIVETS
 (CSR922, CSR924, CSR925 AND CSR902, CSR903)
 TABLE II

DASH NO.	NOMINAL SIZE	DIAMETER	HOLE SIZE
-6	0.1875	0.197-0.199	0.199-0.202
-8	0.2500	0.258-0.260	0.260-0.263

S4B100-T AND S7B100-T LOW PROFILE SHEAR HEAD ALLOY STEEL BLIND BOLT
 (FOR THIN TOP SHEET APPLICATIONS)
 TABLE III

Fastener Hole Sizes - All RB211-535 Engines
Figure 1 (Sheet 3 of 7)

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STRUCTURAL REPAIR MANUAL

DASH NO.	NOMINAL RIVET DIAMETER	HOLE DIAMETER FOR NAS1398,NAS1399,CR2164,CR2564,CR2604		HOLE DIAMETER FOR NAS1738,NAS1739	
		MIN.	MAX.	MIN.	MAX.
-4	0.1250	0.129	0.132	0.144	0.148
-5	0.1562	0.159	0.163	0.177	0.181
-6	0.1875	0.191	0.195	0.205	0.209
-8	0.2500	0.257	0.261	0.272	0.276

HOLE SIZES FOR BLIND RIVETS (CHERRY LOCK)
TABLE IV

DASH NO.	DIAMETER OF ORIGINAL FASTENER CR3522,CR3523	HOLE SIZE	DIAMETER OF ORIGINAL FASTENER CR3552,CR3553	HOLE SIZE
-4	0.126 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.129-0.132	0.140 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.143-0.146
-5	0.157 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.160-0.164	0.173 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.176-0.180
-6	0.189 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.192-0.196	0.201 $\begin{smallmatrix} +.003 \\ -.001 \end{smallmatrix}$	0.205-0.209

HOLE SIZES FOR NOMINAL AND OVERSIZE BLIND RIVETS
(CHERRY MAX CR3522, CR3523, CR3552, CR3553)
TABLE V

Fastener Hole Sizes - All RB211-535 Engines
Figure 1 (Sheet 4 of 7)

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DASH NO.	SLEEVE DIAMETER		HOLE DIAMETER	
	NOMINAL	ACTUAL	MINIMUM	MAXIMUM
-5	0.1562	0.166-0.169	0.170	0.173
-6	0.1875	0.193-0.196	0.197	0.201
-8	0.2500	0.254-0.257	0.258	0.264
-10	0.3125	0.335-0.338	0.339	0.345
-12	0.3750	0.387-0.390	0.391	0.397
-1032	0.3125	0.309-0.312	0.313	0.319

HOLE SIZES FOR HI SHEAR BLIND BOLTS
 BB301, BB302, BB309, BB351, BB352, NB1101, NB1102 NB1114
 (USING SLEEVES BB321, BB322, B335, BN330)
 TABLE VI

Fastener Hole Sizes - All RB211-535 Engines
Figure 1 (Sheet 5 of 7)

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STRUCTURAL REPAIR MANUAL

DASH NO.	DIAMETERS		HOLE SIZE	1/64 IN. OVERSIZE	1/32 IN. OVERSIZE	3/64 IN. OVERSIZE
	NOMINAL	SHANK				
-5	0.1562	0.1625-0.1635	0.157-0.160	0.169-0.172	0.185-0.188	0.200-0.204
-6	0.1875	0.1885-0.1895	0.187-0.190	0.200-0.203	0.216-0.219	0.231-0.234
-8	0.2500	0.2485-0.2495	0.247-0.250	0.263-0.266	0.278-0.281	0.294-0.297

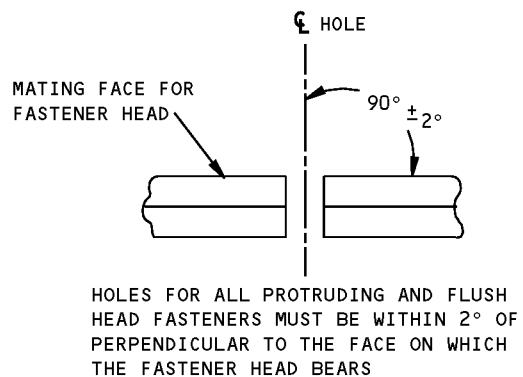
HEX DRIVE FASTENERS (HI-LOK)
 (HL10, HL12, HL13, HL15, HL30, HL40, HL41,
 HL48, HL49, HL641, HL644
 TABLE VII

DASH NO.	NOMINAL SIZE	ACTUAL SIZE	HOLE SIZE
-6	0.2031	0.2005-0.2025	0.203-0.208
-8	0.2656	0.2630-0.2650	0.266-0.271

ASP THREADED FASTENERS
 (ASPFF, 2ASPFF, 2ASP509F, ASPFP, ASP100P, 2ASPFP, 2ASPFP509P)
 TABLE VIII

Fastener Hole Sizes - All RB211-535 Engines
Figure 1 (Sheet 6 of 7)

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STRUCTURAL REPAIR MANUAL



FASTENER HOLE PERPENDICULARITY
DETAIL I

Fastener Hole Sizes - All RB211-535 Engines
Figure 1 (Sheet 7 of 7)

757-200 STRUCTURAL REPAIR MANUAL

GENERAL - FASTENER EDGE MARGINS - RB211-535 ENGINES

1. References

Reference	Title
51-40-06, GENERAL	Fastener Edge Margins

2. General

- A. Fastener edge margin as used in this manual is the distance from the center of the fastener hole to the nearest edge of a sheet, plate, casting, forging or machined part. Edge margin is used as a guide for the installation of fastener holes along the edge of a part or structure. Unless minimum edge distance is maintained for fastener holes, the part will fail at less than the load for which the part or structure was designed.
- B. Protruding head bolts, screws and rivets utilize the full tear-out strength of the material, if the gage of the sheet metal or thickness of the part is considered. The developed strength of a single fastener which joins two or more parts, is a function of the strength of the fastener and the strength of the material or parts being jointed. The shear strength of the thinner gages of sheet metal (or thickness of parts) are less than the shear strength of the fastener, so shear failure in the joint would occur at the shear limits of the materials being joined, rather than at the shear limits of the fastener. Tables showing the proper edge margins to use for single shear and double shear fastener application and the fastener/material combinations for metals used in the Boeing 757 airplane are applicable to the RB211-535C37 and E4 engine nacelle. The tables appear in 51-40-06, GENERAL.
- C. Countersinking the fastener hole in the materials being joined by flush fasteners, encroaches on the tear-out material between the fastener hole and the edge of the part and requires that the edge margin must be increased to compensate for the loss of tear-out strength. Tables showing the proper edge margins to use for countersunk fasteners in single shear application and the fastener/material combinations for metals used in the Boeing 757 airplane are applicable to the RB211-535C37 and E4 engine nacelle. The tables appear in 51-40-06, GENERAL.
- D. Composite materials used in the components of the RB211-535C37 and E4 engine nacelle such as hinged cowl, translating cowl, and thrust reverser C-duct, require the use of greater edge margin to fully develop the shear strength of each fastener/material joint. The following tables give the edge margin to be used for single shear application of protruding head and countersunk head fasteners. Refer to Figure 1/GENERAL, Tables 1 and 2.

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STRUCTURAL REPAIR MANUAL

RIVETED OR BOLTED MATERIAL		EDGE MARGIN FOR PROTRUDING HEAD FASTENERS IN SINGLE SHEAR						
		FASTENER DIAMETER (INCH)						
		3/32	1/8	5/32	3/16	1/4	5/16	3/8
GRAPHITE FABRIC EPOXY COMPOSITE	LAMINATE THICKNESS (INCH)							
KEVLAR FABRIC EPOXY COMPOSITE	0.06	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.09	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.12	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.15	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.18	0.25	0.34	0.42	0.51	0.68	0.84	1.01
GRAPHITE/ KEVLAR EPOXY COMPOSITE	0.21	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.24	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.27	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.30	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.40	0.25	0.34	0.42	0.51	0.68	0.84	1.01
	0.50	0.25	0.34	0.42	0.51	0.68	0.84	1.01

EDGE MARGINS FOR PROTRUDING HEAD BOLTS,
RIVETS AND SCREWS IN COMPOSITE MATERIAL

TABLE I

Fastener Edge Margins - All RB211-535 Engines
Figure 1 (Sheet 1 of 2)

757-200
STRUCTURAL REPAIR MANUAL

RIVETED OR BOLTED MATERIAL		EDGE MARGIN FOR COUNTERSUNK HEAD FASTENERS IN SINGLE SHEAR						
		FASTENER DIAMETER (INCH)						
		3/32	1/8	5/32	3/16	1/4	5/16	3/8
GRAPHITE FABRIC EPOXY COMPOSITE	LAMINATE THICKNESS (INCH)							
KEVLAR FABRIC EPOXY COMPOSITE	0.06	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.09	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.12	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.15	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.18	0.28	0.38	0.47	0.56	0.75	0.94	1.13
GRAPHITE/ KEVLAR EPOXY COMPOSITE	0.21	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.24	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.27	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.30	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.40	0.28	0.38	0.47	0.56	0.75	0.94	1.13
	0.50	0.28	0.38	0.47	0.56	0.75	0.94	1.13

EDGE MARGINS FOR COUNTERSUNK HEAD BOLTS,
RIVETS AND SCREWS IN COMPOSITE MATERIAL

TABLE II

Fastener Edge Margins - All RB211-535 Engines
Figure 1 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

GENERAL - STRENGTH OF FASTENERS - RB211-535 ENGINES

1. General

- A. The fastener strength values given in this section are the unit developed fastener/material joint strength in shear loading or in tension applications. The unit developed fastener strength value takes into account the bearing strength of the material in which the fastener is installed. Where the material in bearing will fail before fastener shear failure, the lower value is shown as the shear strength of the installed fastener.
- B. The fastener strength values given assume that the correct hole sizes have been used and that edge margin requirements have been met. Refer to 51-40-05 for hole sizes of fasteners which are common to the RB211-535C37 and E4 engine nacelle and the Boeing 757 airplane. Refer to 51-41-05 for hole sizes of fasteners which are used only on the RB211-535C37 and E4 engine nacelle. Refer to 51-40-06 for edge margin requirements of fasteners which are common to the Boeing 757 airplane and the RB211-535C37 and E4 engine nacelle. Refer to 51-41-06 for edge margin requirements of fasteners which are used only on the RB211-535C37 and E4 engine nacelle.
- C. Refer to 51-40-08 for countersinking and hole fillet relief requirements for fasteners which are common to the RB211-535C37 and E4 engine nacelle and the Boeing 757 airplane. Refer to 51-41-08 for countersinking and hole fillet requirements for fasteners which are used only on the RB211-535C37 and E4 engine nacelle.
- D. To fully utilize the design strength of a fastener, the size and preparation of the fastener installation hole must be carefully controlled in the structural parts which the fastener joins together. Where design requirements permit some movement of misalignment of the attaching parts, a general clearance fit hole is used which can have a diameter as much as 0.006-inch larger than the shank of the fastener. Where design requirements are more stringent, a close-reamed hole is used which can have a diameter 0.005 to 0.0010-inch larger than the fastener shank. Interference fit holes are used which are 0.001 to 0.003-inch smaller in diameter than the shank of the fastener. Special installation tools force the fastener into the interference fit hole expanding the hole in the process to create a very stable attachment.
- E. An index of the figures and tables which contain the fastener strength data is provided to identify the location of the data for each type of fastener. Refer to

Table 1: Index of Figures and Tables

Figure 1/GENERAL	
Table I	- Rivet/Sheet Material Shear Joint Strength Table Index
Figure 2/GENERAL	
Table I	- Single Shear Strength of Solid Rivets
Table II	- Single Shear Strength of Blind Rivets
Table III	- Shear and Tension Strength of Hi-Lok Fastener Pins
Table IV	- Ultimate Single Shear Strength of Threaded Fasteners
Table V	- ASP Fasteners Shear Strength (108 KSI)
Table VI	- ASP Fasteners Tensile Strength
Table VII	- NAS1581 Shear and Tensile Strength
Table VIII	- Light-Weight GP Pin Shear and Tensile Strenght (RB211-535E4).
Figure 3/GENERAL	
Table I	- Single and Double Shear Joint Allowables for Protruding Head MS20470DD Rivets in Clad 2024-T42 and Higher Strength Aluminum Alloy Sheet

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(Continued)

Table II	- Single Shear Joint Allowables for Protruding Head MS20615M Rivets in Pure Titanium Sheet
Table III	- Single Shear Joint Allowables for Protruding Shear Head Cherrybuck Fasteners in Clad 2024-T3 or Higher Strength Aluminum Alloy Sheet
Table IV	- Single Shear Joint Allowables for NAS1097AD Flush Crown Head Rivets in 100° Machine Countersunk Clad 2024-T3 or Higher Strength Alloy
Table V	- Single Shear Joint Allowables for NAS1097 Flush Shear Head Rivets in 100° Machine Countersunk Clad 2024-T3 or Higher Strength Aluminum Alloy
Table VI	- Single Shear Joint Allowables for NAS1199 and NAS1200 Flush Rivets in 100° Machine Countersunk CRES Sheet
Table VII	- Single Shear Joint Allowables for NAS1200M and MS20427M Flush Rivets in 100° Machine Countersunk Commercially Pure Titanium
Table VIII	- Single Shear Joint Allowables for CSR924 and CSR922 Cherrybuck Rivets in 100° Machine Countersunk Clad 2024-T3 or Higher Strength Aluminum Alloy Sheet
Table IX	- Single Shear Joint Allowables for Protruding Head NAS1398C Rivets in Alloy Steel Sheet
Table X	- Single Shear Joint Allowables for NAS1738C and CR2839 Protruding Head Rivets in 95 KSI Titanium Sheet
Table XI	- Single Shear Joint Allowables for NAS1399C, CR2662 and CR2664 Rivets in 100° Machine Countersunk Alloy Steel Sheet
Table XII	- Single Shear Joint Allowables for NAS1399C, NAS1739A, CR2248 and CR2838 Rivets in 100° Machine Countersunk Clad 2024-T3 and Higher Strength Aluminum Alloy Sheet
Table XIII	- Single Shear Joint Allowables for CR2164 Rivets in 100° Machine Countersunk Clad 2024-T3 and Higher Strength Aluminum Alloy Sheet
Table XIV	- Single Shear Joint Allowables for CR2564 Rivets in 100° Machine Countersunk Steel Sheet
Table XV	- Single Shear Joint Allowables for MS90353/B100-T Rivets in 100° Machine Countersunk Clad or Bare 2024-T3 or 2024-T351 Aluminum alloy Sheet
Table XVI	- Static Joint Strength of Protruding Head (NAS1198) A-286 Solid Rivets in A-286 Alloy Sheet
Table XVII	- Single Shear and Tensile Strength (LBS.) in Steel Coupons for CR2545 Unisink Rivets
Figure 4/GENERAL	
Table I	- Blind Bolt Shear Strength in Installations NB1101, NB1102, NB1114

757-200 STRUCTURAL REPAIR MANUAL

FASTENER				MATERIAL			
TYPE	PART NUMBER	MATERIAL	TYPE HEAD	2024	CRES	TI PURE	ALLOY STEEL
				TABLE			
SOLID RIVETS	CSR925	TITANIUM	PROTRUDING	11			
	MS20470DD	2024-T31	PROTRUDING	9			
	MS20615M	MONEL	PROTRUDING			10	
	CSR922	TITANIUM	100° FLUSH	16			
	CSR924	TITANIUM	100° FLUSH	16			
	MS20427F	A286	100° FLUSH		14		
	MS20427M	MONEL	100° FLUSH			15	
	NAS1097AD	2117-T3	100° FLUSH	12			
	NAD1097B	5056-H32	100° FLUSH	13			
	NAS1199	A286	100° FLUSH		14		
	NAS1200	A286	100° FLUSH		14		
	NAS1200M	MONEL	100° FLUSH			15	
BLIND RIVETS	CR2164	2017A	100° FLUSH	21			
	CR2564	MONEL	100° FLUSH				22
	CR2664	A286	100° FLUSH				19
	MS90353/B100T	STEEL	100° FLUSH	23			
	NAS1399C	A286	100° FLUSH				19
	NAS1739A	2219-T62	100° FLUSH	20			
	NAS1739B	5056F	100° FLUSH	20			
	NAS1398C	A286	PROTRUDING				17
	NAS1738C	INCONEL	PROTRUDING			18	

RIVET/SHEET MATERIAL SHEAR JOINT STRENGTH TABLE INDEX
TABLE I

Fastener/Material Joint Strength - All RB211-535 Engines
Figure 1

757-200 STRUCTURAL REPAIR MANUAL

DIAMETER OF RIVET (IN.)		1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
RIVET MATERIAL	CODE	SHEAR ULTIMATE STRENGTH (Lb)							
5056F _{SU} = 28 KSI ^a	B	99	203	363	556	602	1450	2290	3280
2117-T3F _{SU} = 30 KSI ^a	AD	106	217	388	596	862	1550	2460	3510
2017-T3F _{SU} = 38 KSI ^a	D	135	275	494	755	1090	1970	3110	4450
2024-T31F _{SU} = 41 KSI ^{ab}	DD	145	296	531	815	1180	2120	3360	4800
A286F _{SU} = 90 KSI		317	651	1170	1790	2580	4670	7370	10500
MONEL F _{SU} = 49 KSI		173	355	635	973	1400	2540	4020	5730

NOTES

- (a) = VALUES ARE FOR AS DRIVEN CONDITION, ON A PROBABILITY BASIS (B VALUES).
- (b) = DRIVEN IN THE AS QUENCHED CONDITION.
- F_{SU} = FORCE SHEAR ULTIMATE.

SINGLE SHEAR STRENGTH OF SOLID RIVETS
TABLE I

DIAMETER OF RIVET (IN.)	3/32	1/8	5/32
PART NUMBER	SINGLE SHEAR STRENGTH (Lb)		
CSR902B, CSR903B	362	648	993
CR3523, CR3522	730	1134	1626
CR2539, CR2538	895	1353	1823

SINGLE SHEAR STRENGTH OF BLIND RIVETS
TABLE II

Fastener Shear Strength - All RB211-535 Engines
Figure 2 (Sheet 1 of 4)

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STRUCTURAL REPAIR MANUAL

HI-LOK NUMBER	SHEAR STRENGTH, KSI	TENSION STRENGTH, KSI
HL10	95	---
HL12	95	160
HL13	95	160
HL15	156	260
HL30	125	---
HL40	95	---
HL41	95	---
HL48	95	160
HL49	95	160
HL641	95	---
HL644	125	125

SHEAR AND TENSION STRENGTH OF HI-LOK FASTENER PINS
TABLE III

SHEAR STRESS, KSI			95	125	156	160
FASTENER SIZE		BASIC SHANK AREA (INCH ²)	ULTIMATE SINGLE SHEAR STRENGTH (Lb)			
IN.	A					
0.125	1/8	0.012272	1166	1534	1914	1964
0.138	# 6	0.014957	1421	1870	2333	2393
0.156	5/32	0.019175	1822	2397	2991	3068
0.164	# 8	0.021124	2007	2640	3295	3380
0.188	3/16	0.027612	2623	3452	4310	4418
0.190	# 10	0.028353	2694	3544	4420	4536
0.216	# 12	0.036644	3481	4580	5720	5863
0.219	7/32	0.037582	3570	4700	5860	6013
0.250	1/4	0.049087	4660	6140	7660	7854
0.312	5/16	0.076699	7290	9590	11970	12272

ULTIMATE SINGLE SHEAR STRENGTH OF THREADED FASTENERS
TABLE IV

NOTE

A FRACTIONAL EQUIVALENT OF SCREW NUMBER.

Fastener Shear Strength - All RB211-535 Engines
Figure 2 (Sheet 2 of 4)

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STRUCTURAL REPAIR MANUAL

DASH NO.	DIAMETER (IN.) OF PIN SHANK	AREA OF PIN SHANK	SHEAR STRENGTH (Lb)
-6	13/64 (0.2031)	0.03240	3499
-8	17/64 (0.2656)	0.05540	5983
-10	21/64 (0.3281)	0.08455	9131

NOTE

ASP = ADJUSTABLE CLAMPING FORCE SELF-SUSTAINING POSITIVE LOCK (FOR HONEYCOMB SANDWICH CONSTRUCTION)

ASP FASTENERS SHEAR STRENGTH (108 KSI)
TABLE V

DASH NO.	DIAMETER (IN.)	2ASP509 (2ASPFP509P)	ASP100P	ASPFF (2ASPFF)	ASPFP (2ASPFP)
-6	13/64 (0.2031)	2210	1400	2210	2210
-8	17/64 (0.2656)	4080	----	4080	----
-10	21/64 (0.3281)	5350	----	5350	----

ASP FASTENERS TENSILE STRENGTH
TABLE VI

Fastener Shear Strength - All RB211-535 Engines
Figure 2 (Sheet 3 of 4)

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STRUCTURAL REPAIR MANUAL

DASH NO.	SHANK AREA (INCH ²)	SHEAR STRENGTH (Lb)	BASIC MINOR AREA	TENSILE STRENGTH (Lb)
-3	0.0284	2977	0.0186	3441
-4	0.0491	5152	0.0342	6331

NAS1581 SHEAR AND TENSILE STRENGTH
TABLE VII

FASTENER	DOUBLE SHEAR STRENGTH IN LBS, USING 3SLC-C COLLAR				
PIN DIAMETER	0.164	0.190	0.250	0.312	0.375
LGPL2SC-V	4010	5380	9300	14600	21000
LGPL2SP-V	4010	5380	9300	14600	21000
LGPL9SC-V	4010	5380	9300	14600	21000
LGPL9SP-V	4010	5380	9300	14600	21000
	TENSILE STRENGTH IN LBS, USING SLFC-MV COLLAR				
LGPL2SC-V	1290	1600	3000	5000	7000
LGPL2SP-V	1400	1600	3000	5000	9000
LGPL9SC-V	1750	2000	3750	6250	8750
LGPL9SP-V	1750	2000	3750	6250	8750

LIGHTWEIGHT GP PIN SHEAR AND TENSILE STRENGTH (RB211-535E4)
TABLE VIII

Fastener Shear Strength - All RB211-535 Engines
Figure 2 (Sheet 4 of 4)

757-200 STRUCTURAL REPAIR MANUAL

PROTRUDING HEAD

FASTENER - MS20470DD (2024-T31 AL)					
MATERIAL - CLAD 2024-T3 AND HIGHER STRENGTH AL ALLOY					
FASTENER NOMINAL DIAMETER (INCH)	3/32	1/8	5/32	3/16	1/4
SHEET THICKNESS (INCH) B	SHEAR ULTIMATE STRENGTH, Lb				
SINGLE SHEAR	0.020	175	235	291	---
	0.025	219	293	363	---
	0.032	296	376	465	752
	0.040	296	470	582	940
	0.050	---	529	727	1176
	0.063	---	---	815	1481
	0.080	---	---	---	1881
	0.090	---	---	---	2120
DOUBLE SHEAR	0.020	175	235	---	---
	0.025	219	293	363	---
	0.032	281	376	465	---
	0.040	351	470	582	941
	0.050	439	587	727	1176
	0.080	---	940	1164	1398
	0.090	---	1062	1309	1573
	0.125	---	---	1630	2184
MAXIMUM RIVET STRENGTH (SINGLE SHEAR)	296	529	815	1100	2120
MAXIMUM RIVET STRENGTH (DOUBLE SHEAR)	439	1062	1630	2184	2939

SINGLE AND DOUBLE SHEAR JOINT ALLOWABLES FOR PROTRUDING HEAD MS20470DD
RIVETS IN CLAD 2024-T42 AND HIGHER STRENGTH ALUMINUM ALLOY SHEET
TABLE I **A**

NOTES

- A** ALLOWABLES CORRESPOND TO SHEAR OR BEARING, WHICHEVER IS LOWER
- B** THINNEST SHEET IN SINGLE SHEAR OR MIDDLE SHEET IN DOUBLE SHEAR
- C** TEST DATA BASED ON 1.5 X YIELD

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 1 of 17)

757-200
STRUCTURAL REPAIR MANUAL

PROTRUDING HEAD

FASTENER – PROTRUDING HEAD MONEL RIVET MS20615M				
MATERIAL – PURE TITANIUM SHEET				
FASTENER NOMINAL DIAMETER (INCH)	3/32	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SHEAR ULTIMATE STRENGTH, Lb			
0.063	---	---	973	1400
MAXIMUM RIVET STRENGTH (SINGLE SHEAR)	335	635	973	1400

SINGLE SHEAR JOINT ALLOWABLES FOR PROTRUDING HEAD MS20615M RIVETS
 IN PURE TITANIUM SHEET
 TABLE II A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 2 of 17)

757-200 STRUCTURAL REPAIR MANUAL

PROTRUDING HEAD

FASTENER – CSR925			
MATERIAL – CLAD 2024-T3 OR HIGHER STRENGTH ALLOY			
FASTENER NOMINAL DIAMETER (INCH)	5/32	3/16	1/4
SHEET THICKNESS (INCH)	ULTIMATE STRENGTH, Lb		
0.050	807	—	—
0.063	1020	1180	—
0.071	1150	1335	—
0.080	1300	1505	1970
0.090	1465	1695	2220
0.100	1630	1885	2470
0.125	2007	2360	3095
0.160	—	2694	3975
0.190	—	—	4660
MAXIMUM RIVET SHEAR STRENGTH	2007	2694	4660
SHEET THICKNESS (INCH)	YIELD STRENGTH (Lb)		
0.050	619	—	—
0.063	747	889	—
0.071	827	981	—
0.080	916	1085	1495
0.090	1015	1200	1645
0.100	1115	1315	1795
0.125	1360	1600	2175
0.160	—	2000	2705
0.190	—	—	3155

SINGLE SHEAR JOINT ALLOWABLES FOR PROTRUDING SHEAR HEAD CHERRYBUCK
FASTENERS IN CLAD 2024-T3 OR HIGHER STRENGTH ALUMINUM ALLOY SHEET
TABLE III A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 3 of 17)

757-200
STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER – FLUSH CROWN-HEAD AD RIVET, NAS1097AD			
MATERIAL – CLAD 2024-T3 OR HIGHER STRENGTH ALUMINUM ALLOY SHEET			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SINGLE SHEAR ULTIMATE STRENGTH, Lb		
0.032	300	---	---
0.040	359	457	---
0.050	388	560	702
0.063	---	596	800
0.071	---	---	862
MAXIMUM RIVET STRENGTH (SINGLE SHEAR)	388	596	862

SINGLE SHEAR JOINT ALLOWABLES FOR NAS1097AD FLUSH CROWN-HEAD RIVETS
IN 100° MACHINE COUNTERSUNK CLAD 2024-T3 OR HIGHER STRENGTH ALLOY
TABLE IV A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 4 of 17)

757-200 STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER - 100° FLUSH SHEAR HEAD, NAS1097B (5056 AL)						
MATERIAL - CLAD 2024-T3 AND HIGHER STRENGTH AL ALLOY						
FASTENER NOMINAL DIAMETER (INCH)	1/8		5/32		3/16	
	AD	B	AD	B	AD	B
SHEET THICKNESS (INCH) A	SINGLE SHEAR ULTIMATE STRENGTH, Lb					
0.020	---		---		---	
0.025	---		---		---	
0.032	300		---		---	
0.040	359		457		---	
0.050	388		560		702	
0.063	---		596		800	
0.080	---		---		862	
0.090	---		---		---	
0.125	---		---		---	
MAXIMUM RIVET STRENGTH (SINGLE SHEAR)	388	203	596	303	862	556

SINGLE SHEAR JOINT ALLOWABLES FOR NAS1097 FLUSH SHEAR HEAD
RIVETS IN 100° MACHINE COUNTERSUNK CLAD 2024-T3 OR
HIGHER STRENGTH ALUMINUM ALLOY
TABLE V A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 5 of 17)

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STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER – NAS1199,NAS1200,NAS20427F				
MATERIAL – CRES SHEET				
FASTENER NOMINAL DIAMETER (INCH)	3/32	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SINGLE SHEAR ULTIMATE STRENGTH, Lb			
0.160	1536	2056	2544	1400

SINGLE SHEAR JOINT ALLOWABLES NAS1199 AND NAS1200 FLUSH RIVETS IN
 100° MACHINE COUNTERSUNK CRES SHEET
 TABLE VI A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 6 of 17)

757-200
STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER - 100° FLUSH HEAD, NAS1200M, MS20427M (MONEL)			
MATERIAL - TITANIUM, COMMERCIALLY PURE			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH) B	SINGLE SHEAR ULTIMATE STRENGTH, Lb		
0.050	573	818	1118
0.063	626	885	1198
0.071	635	926	1242
MAXIMUM RIVET STRENGTH (SINGLE SHEAR)	635	973	1400

SINGLE SHEAR JOINT ALLOWABLES FOR NAS1200M AND MS20427M FLUSH RIVETS IN
 100° MACHINE COUNTERSUNK COMMERCIALLY PURE TITANIUM
 TABLE VII A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 7 of 17)

757-200 STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER – CSR924, CSSR922			
MATERIAL – CLAD 2024-T3 OR HIGHER STRENGTH ALLOY			
FASTENER NOMINAL DIAMETER (INCH)	5/32	3/16	1/4
SHEET THICKNESS (INCH)	ULTIMATE STRENGTH, Lb		
0.050	737	---	---
0.063	1019	1118	---
0.071	1152	1319	---
0.080	1279	1509	1837
0.090	1419	1673	2168
0.100	1560	1834	2500
0.125	1898	2242	3036
0.160	2007	2680	3786
0.190	---	2694	4404
0.250	---	---	4660
MAXIMUM RIVET SHEAR STRENGTH	2007	2694	4660
SHEET THICKNESS (INCH)	YIELD STRENGTH (Lb)		
0.050	511	---	---
0.063	712	778	---
0.071	786	922	---
0.080	840	1039	1276
0.090	900	1109	1513
0.100	960	1178	1750
0.125	1110	1352	1979
0.160	1321	1596	2300
0.190	---	1805	2575
0.250	---	---	3125

SINGLE SHEAR JOINT ALLOWABLES FOR CSR924 AND CSR922 CHERRYBUCK RIVETS IN
100° MACHINE COUNTERSUNK CLAD 2024-T3 OR HIGHER STRENGTH ALUMINUM ALLOY SHEET

TABLE VIII A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 8 of 17)

757-200
STRUCTURAL REPAIR MANUAL

PROTRUDING HEAD

FASTENER - NAS1738C, CR2663 (A286)			
MATERIAL - ALLOY STEEL F _{tu} 180 KSI			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SHEAR ULTIMATE STRENGTH, Lb		
0.020	511	566	591
0.025	697	794	869
0.032	785	1112	1255
0.040	860	1211	1628
0.050	956	1325	1772
0.063	970	1480	1958
0.071	---	1490	2070
0.080	---	---	2150
MAXIMUM RIVET SHEAR STRENGTH	970	1490	2150

SINGLE SHEAR JOINT ALLOWABLES FOR PROTRUDING HEAD
 NAS1398C RIVETS IN ALLOY STEEL SHEET

TABLE IX A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 9 of 17)

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STRUCTURAL REPAIR MANUAL

PROTRUDING HEAD

FASTENER - NAS1738C, CR2839			
MATERIAL - TITANIUM, 95 KSI			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SINGLE SHEET ULTIMATE STRENGTH, Lb		
0.050	605	725	865
0.063	760	940	1085
0.071	860	1055	1255

SINGLE SHEAR JOINT ALLOWABLES FOR NAS1738C AND CR2839 PROTRUDING
HEAD RIVETS IN 95 KSI TITANIUM SHEET

TABLE X A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 10 of 17)

757-200 STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER - NAS1399C, CR2662, CR2664 (A286)			
MATERIAL - ALLOY STEEL $F_{tu} > 180$ KSI			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SHEAR ULTIMATE STRENGTH, Lb		
0.032	160 C	---	---
0.040	205 C	249 C	---
0.050	438 C	328 C	372 C
0.063	698	702 C	580 C
0.071	840	908	855 C
0.080	970	1108	1164 C
0.090	---	1333	1438
0.100	---	1490	1710
0.125	---	---	2150
MAXIMUM RIVET SHEAR STRENGTH	970	1490	2150

SINGLE SHEAR JOINT ALLOWABLES FOR NAS1399C, CR2662 AND CR2664
RIVETS IN 100° MACHINE COUNTERSUNK ALLOY STEEL SHEET

TABLE XI A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 11 of 17)

757-200 STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER – NAS1739A,NAS1739B,CR2248,CR2838			
MATERIAL – CLAD 2024-T3 AND HIGHER STRENGTH ALLOYS			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SHEAR ULTIMATE STRENGTH, Lb C		
0.025	162	---	---
0.032	207	255	---
0.040	259	318	370
0.050	324	397	462
0.063	409	502	582
0.071	460	565	657
0.080	504	637	739
0.090	---	717	832
0.100	---	762	925
0.125	---	---	1026
FASTENER SHEAR STRENGTH	554	837	1128

SINGLE SHEAR JOINT ALLOWABLES FOR NAS1399C, NAS1739A, CR2248 AND CR2838
RIVETS IN 100° MACHINE COUNTERSUNK CLAD 2024-T3 AND HIGHER STRENGTH
ALUMINUM ALLOY SHEET
TABLE XII A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 12 of 17)

757-200 STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER – CR2164			
MATERIAL – CLAD 2024-T3 AND HIGHER STRENGTH ALUMINUM ALLOYS			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	ULTIMATE STRENGTH, Lb		
0.020	---	---	---
0.025	---	---	---
0.032	142	---	---
0.040	178	220	---
0.050	223	274	330
0.063	319	349	418
0.071	379	420	471
0.080	423	506	547
0.090	459	600	660
0.100	494	652	775
0.125	---	755	969
0.160	---	---	1090
RIVET SHEAR STRENGTH	494	755	1090
SHEET NOMINAL THICKNESS (INCH)	YIELD STRENGTH (Lb)		
0.020	---	---	---
0.025	---	---	---
0.032	50	---	---
0.040	62	76	---
0.050	116	95	115
0.063	196	186	153
0.071	244	246	226
0.080	300	313	306
0.090	361	389	398
0.100	423	466	489
0.125	---	657	717
0.160	---	---	1034

SINGLE SHEAR JOINT ALLOWABLES FOR CR2164 RIVETS IN 100° MACHINE COUNTERSUNK CLAD 2024-T3 AND HIGHER STRENGTH ALUMINUM ALLOY SHEET
TABLE XIII A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 13 of 17)

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STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER – CR2564			
MATERIAL – STEEL SHEET			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SINGLE SHEET ULTIMATE STRENGTH, Lb		
0.125	---	1000	1310
0.156	---	1090	1490
0.187	---	---	1580
MAXIMUM RIVET STRENGTH (SINGLE SHEAR)	710	1090	1580

SINGLE SHEAR JOINT ALLOWABLES FOR CR2564 RIVETS IN
100° MACHINE COUNTERSUNK STEEL SHEET

TABLE XIV **A**

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 14 of 17)

757-200 STRUCTURAL REPAIR MANUAL

100° MACHINE COUNTERSUNK

FASTENER - S4B100-T OR S7B100-T ALLOY STEEL (MS90353)					
MATERIAL - CLAD OR BARE 2024-T3 OR 2024-T351					
FASTENER NOMINAL DIAMETER (INCH)	5/32	3/16	1/4	5/16	3/8
SHEET THICKNESS (INCH)	SHEAR ULTIMATE STRENGTH, Lb				
0.040	320 C	624 C	---	---	---
0.050	586 C	823 C	---	---	---
0.063	789 C	976 C	1378 C	---	---
0.071	945 C	1071 C	1500 C	---	---
0.080	1132 C	1252 C	1638 C	---	---
0.090	1336 C	1492 C	1789 C	---	---
0.100	1543 C	1735 C	1983 C	---	---
0.125	1914	2343 C	2697 C	2829 C	---
0.160	2281	2935	3540 C	4290 C	3937 C
0.190	---	3062	4185	5542 C	5400 C
0.250	---	---	5300	7210	8400 C
0.312	---	---	---	8280	10530 C
0.375	---	---	---	---	11930
MAXIMUM RIVET SHEAR STRENGTH	2281	3062	5300	8280	11930

SINGLE SHEAR JOINT ALLOWABLES FOR MS90353/B100-T RIVETS IN 100° MACHINE
COUNTERSUNK CLAD OR BARE 2024-T3 OR 2024-T351 ALUMINUM ALLOY SHEET
TABLE XV A

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 15 of 17)

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STRUCTURAL REPAIR MANUAL

FASTENER - NAS1198			
MATERIAL - A286 ALLOY, SOLUTION TREATED AND AGED			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SHEAR ULTIMATE STRENGTH, Lb		
0.020	478	----	----
0.025	590	740	----
0.032	745	932	1132
0.040	923	1152	1397
0.050	1023	1428	1677
0.063	1131	1578	1821
0.071	1170	1660	1909
0.080	----	1752	2008
0.090	----	1790	2118
0.100	----	----	2229
0.125	----	----	2504
0.160	----	----	2580
RIVET SHEAR STRENGTH	1170	1790	2580

STATIC JOINT STRENGTH OF PROTRUDING HEAD (NAS1198)
A-286 SOLID RIVETS IN A-286 ALLOY SHEET
RB211-535E4 ENGINES

TABLE XVI

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 16 of 17)

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STRUCTURAL REPAIR MANUAL

FASTENER – UNISINK CR2545			
MATERIAL – STEEL COUPONS			
FASTENER NOMINAL DIAMETER (INCH)	1/8	5/32	3/16
SHEET THICKNESS (INCH)	SINGLE SHEAR STRENGTH, Lb		
0.093	895	1290	1575
0.125	895	1353	1823
0.156	895	1353	1823
0.187	---	1353	1823
0.219	---	----	1823
TENSILE STRENGTH, Lb	490	740	1000

SINGLE SHEAR AND TENSILE STRENGTH (LBS.) IN STEEL COUPONS
FOR CR2545 UNISINK RIVETS
RB211-535E4 ENGINES

TABLE XVII

Material, Thickness and Applicable Fasteners - All RB211-535 Engines
Figure 3 (Sheet 17 of 17)

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STRUCTURAL REPAIR MANUAL

BLIND BOLT

DASH NO.	NOMINAL DIAMETER (IN.)	SHANK AREA (INCH ²)	SHEAR STRENGTH (Lb)		
			BB301, BB302, BB351 (125 KSI)	BB309 (95 KSI)	NB1101 (160 KSI)
-5	0.1562	0.0191624	2395	1820	3066
-6	0.1875	0.0276116	3452	2623	4418
-8	0.2500	0.0490873	6136	4663	7854
-10	0.3125	0.076699	9587	7286	12272
-12	0.3750	0.1104466	13806	10492	17672
-1032	0.3125	0.076699	9587	7286	12272

BLIND BOLT SHEAR STRENGTH IN INSTALLATIONS NB1101, NB1102, NB1114
TABLE I

Blind Bolt Shear Strength - All RB211-535 Engines
Figure 4

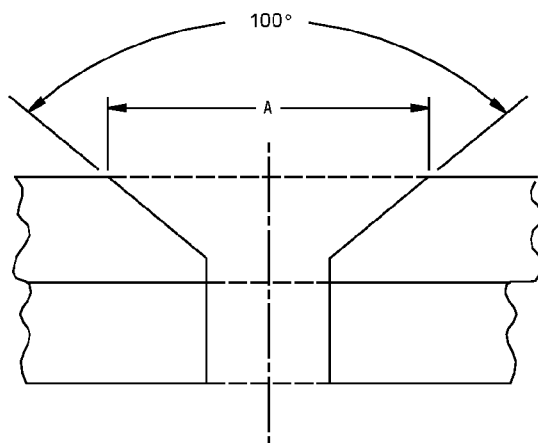
757-200
STRUCTURAL REPAIR MANUAL**GENERAL - COUNTERSINKING - RB211-535 ENGINES****1. References**

Reference	Title
51-40-08, GENERAL	Countersinking

2. General

- A. The countersinking information presented in this section is for those fasteners used exclusively in the RB211-535C37 and E4 powerplant nacelle. The remaining fasteners in the nacelle are similar to those used in the Boeing 757 airplane and the required countersinking information is contained in 51-40-08, GENERAL.
- B. Countersinking dimensions are provided for the following fasteners:
- (1) Countersink dimensions for CSR902B (MS20426) and CSR904B (NAS1097) Cherry E-Z Buck rivets, refer to Figure 1/GENERAL.
 - (2) Countersink dimensions for CSR922 and CSR922F (MS20426) and for CSR924 and CSR924F (NAS1097) Cherry-Buck rivets, refer to Figure 2/GENERAL.
 - (3) Rivet hole relief radius dimensions for CSR925 and CSR925F Cherry-Buck rivets, refer to Figure 3/GENERAL.
 - (4) Countersink dimensions for 2ASP-FF-DT and 2ASP-509-DT pin and sleeve for ASP (adjustable clamping force positive lock) fasteners, refer to Figure 4/GENERAL.
 - (5) Fastener hole relief radius dimensions for 2ASP-PP-DT pin and sleeve for ASP fasteners, refer to Figure 5/GENERAL.
 - (6) Countersink dimensions for lightweight GP pins, refer to Figure 6/GENERAL.

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COUNTERSINK FOR MS20426 AND NAS1097 TYPE FLUSH HEAD RIVETS
DETAIL I

NOM RIVET DIA (INCH)	RIVET SHANK DIA (INCH)	INCLUDED HEAD ANGLE	COUNTERSINK DIA (A)		RELIEF RADIUS	
			MIN (IN)	MAX (IN)	MIN	MAX
0.0937	0.094	100°	0.165	0.179	N/A	N/A
0.1250	0.125	100°	0.207	0.225	N/A	N/A
0.1562	0.156	100°	0.263	0.286	N/A	N/A
0.1875	0.187	100°	0.330	0.353	N/A	N/A

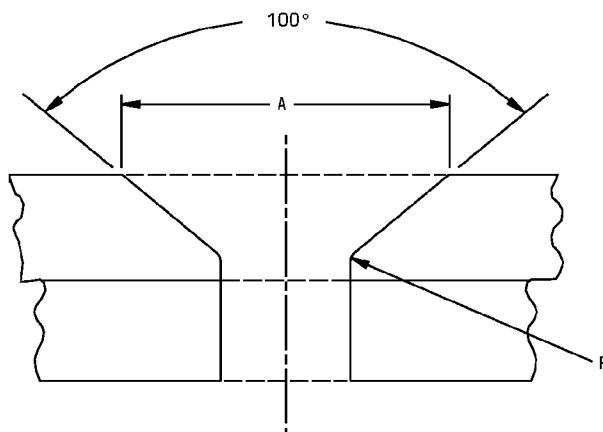
COUNTERSINK DIMENSIONS FOR CSR902B (MS20426) RIVETS
TABLE I

NOM RIVET DIA (INCH)	RIVET SHANK DIA (INCH)	INCLUDED HEAD ANGLE	COUNTERSINK DIA (A)		RELIEF RADIUS	
			MIN (IN)	MAX (IN)	MIN	MAX
0.0937	0.094	100°	0.126	0.144	N/A	N/A
0.1250	0.125	100°	0.174	0.192	N/A	N/A
0.1562	0.156	100°	0.225	0.243	N/A	N/A
0.1875	0.187	100°	0.275	0.298	N/A	N/A

COUNTERSINK DIMENSIONS FOR CSR904B (NAS1097) RIVETS
TABLE II

Countersink Dimensions for Cherry E-Z Buck Rivets - All RB211-535 Engines Figure 1

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COUNTERSINK FOR MS20426 AND NAS1097 TYPE FLUSH HEAD RIVETS
DETAIL I

NOM RIVET DIA (INCH)	RIVET SHANK DIA (INCH)	INCLUDED HEAD ANGLE	COUNTERSINK DIA (A)		RELIEF RADIUS	
			MIN (IN)	MAX (IN)	MIN	MAX
0.1562	0.1640	100°	0.271	0.286	0.030	0.040
0.1875	0.1895	100°	0.336	0.353	0.035	0.045
0.2500	0.2495	100°	0.456	0.476	0.035	0.045
0.3125	0.3120	100°	0.540	0.564	0.045	0.055
0.3750	0.3745	100°	0.670	0.694	0.045	0.055

COUNTERSINK DIMENSIONS FOR CSR922 AND CSR922F (MS20426) RIVETS
TABLE I

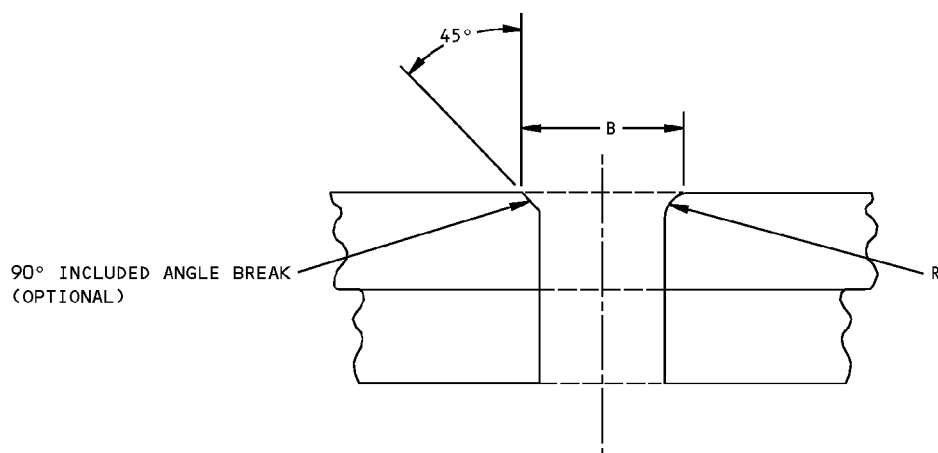
NOM RIVET DIA (INCH)	RIVET SHANK DIA (INCH)	INCLUDED HEAD ANGLE	COUNTERSINK DIA (A)		RELIEF RADIUS	
			MIN (IN)	MAX (IN)	MIN	MAX
0.1562	0.1640	100°	0.230	0.244	0.030	0.040
0.1875	0.1895	100°	0.282	0.299	0.035	0.045
0.2500	0.2495	100°	0.373	0.392	0.035	0.045
0.3125	0.3120	100°	0.447	0.471	0.045	0.055
0.3750	0.3745	100°	0.534	0.558	0.045	0.055

COUNTERSINK DIMENSIONS FOR CSR924 AND CSR924F (NAS1097) RIVETS
TABLE II

Countersink Dimensions for Cherrybuck Rivets - All RB211-535 Engines Figure 2

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RIVET HOLE RELIEF RADIUS FOR PROTRUDING HEAD RIVETS
DETAIL I

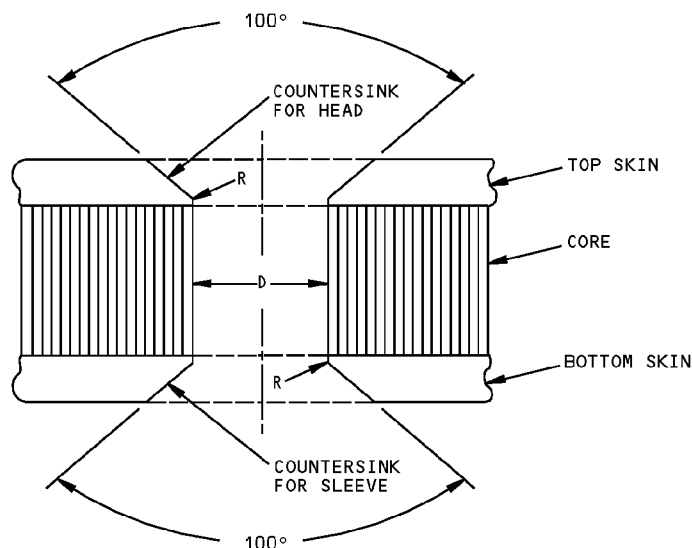
NOM RIVET DIA (INCH)	RIVET SHANK DIA (INCH)	RELIEF ANGLE BREAK (B)		RELIEF RADIUS (R)	
		MIN (IN)	MAX (IN)	MIN (IN)	MAX (IN)
0.1562	0.1640	0.205	0.215	0.025	0.035
0.1875	0.1895	0.248	0.258	0.030	0.040
0.2500	0.2495	0.308	0.318	0.030	0.040
0.3125	0.3120	0.380	0.390	0.035	0.045
0.3750	0.3745	0.444	0.454	0.035	0.045

RELIEF DIMENSIONS FOR PROTRUDING HEAD CSR925 AND CSR925F RIVETS
TABLE I

Rivet Hole Relief Dimensions for Cherrybuck Rivets - All RB211-535 Engines

Figure 3

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COUNTERSINK HOLE FOR ASP FASTENER PIN AND SLEEVE
DETAIL I

MAX PIN DIA (D)(IN)	MAX SLEEVE DIA (D)(IN)	HEAD ANGLE	COUNTERSINK DIA (A)		RELIEF RADIUS (R)	
			PIN (IN)	SLEEVE (IN)	PIN (IN)	SLEEVE (IN)
0.2025	0.2025	100°	0.302	0.302	0.025	0.025
0.2650	0.2650	100°	0.399	0.399	0.025	0.025
0.3275	0.3275	100°	0.479	0.479	0.025	0.025

COUNTERSINK DIMENSIONS FOR 2ASP-FF-DT PIN AND SLEEVE
TABLE I

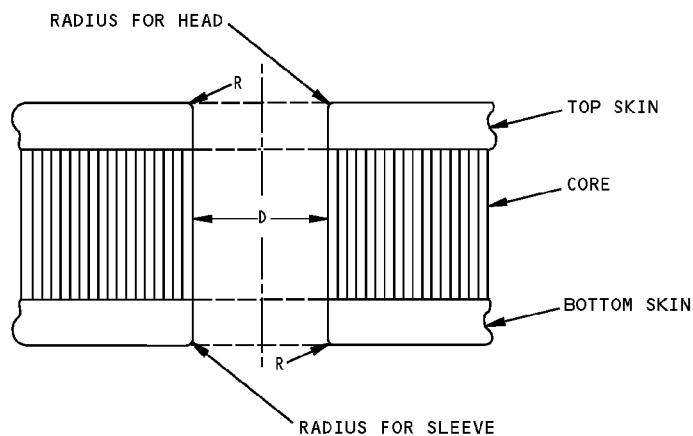
MAX PIN DIA (D)(IN)	MAX SLEEVE DIA (D)(IN)	ANGLE	COUNTERSINK DIA (A)		RELIEF RADIUS (R)	
			PIN (IN)	SLEEVE (IN)	PIN (IN)	SLEEVE (IN)
0.2025	0.2025	100°	0.386	0.386	0.025	0.025
0.2650	0.2650	100°	0.507	0.507	0.025	0.025
0.3275	0.3275	100°	0.634	0.634	0.025	0.025

COUNTERSINK DIMENSIONS FOR 2ASP-509F-DT PIN AND SLEEVE
TABLE II

Countersink Dimensions for ASP Fasteners - All RB211-535 Engines Figure 4

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RELIEF RADIUS FOR PROTRUDING HEAD ASP PIN AND SLEEVE
DETAIL I

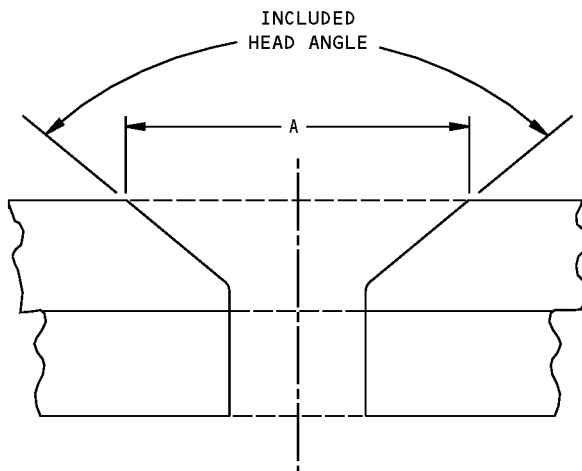
MAX PIN DIA (D)(IN)	MAX SLEEVE DIA A (D)(IN)	RELIEF RADIUS (R)	
		PIN (IN)	SLEEVE (IN)
0.2025	0.2025	0.025	0.025
0.2650	0.2650	0.025	0.025
0.3275	0.3275	0.025	0.025

RELIEF RADIUS DIMENTIONS FOR 2ASP-PP-DT PIN AND SLEEVE
TABLE I

Relief Radius Dimensions for ASP Protruding Head Fasteners - All RB211-535 Engines

Figure 5

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COUNTERSINK FOR GP LIGHTWEIGHT PINS
DETAIL I

LGP PIN PART NUMBER	NOMINAL DIAMETER	INCLUDED HEAD ANGLE	COUNTERSINK DIA (IN.)	
			MIN (IN.)	MAX (IN.)
LGPL2SC-V05	0.165	100°	0.2026	0.2028
LGPL2SC-V06	0.190	100°	0.2439	0.2441
LGPL2SC-V08	0.250	100°	0.3313	0.3315
LGPL2SC-V10	0.312	100°	0.4045	0.4047
LGPL2SC-V12	0.375	100°	0.4852	0.4854

COUNTERSINK DIMENSIONS FOR LGPL2SC-V PINS
TABLE I

LGP PIN PART NUMBER	NOMINAL DIAMETER	INCLUDED HEAD ANGLE	COUNTERSINK DIA (IN.)	
			MIN (IN.)	MAX (IN.)
LGPL9SC-V05B	0.165	130°	0.2558	0.2560
LGPL9SC-V06B	0.190	130°	0.2980	0.2982
LGPL9SC-V08B	0.250	130°	0.4048	0.4050
LGPL9SC-V10B	0.312	130°	0.4789	0.4791
LGPL9SC-V12B	0.375	130°	0.5940	0.5942

COUNTERSINK DIMENSIONS FOR LGPL9SC-V PINS
TABLE II

Countersink Dimensions for LGPL2SC-V and LGPL9SC-V Pins - RB211-535E4 Engines
Figure 6

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GENERAL - COLDWORKING OF HOLES FOR FATIGUE IMPROVEMENT - RB211-535 ENGINES

1. General

- A. The fatigue properties of an aluminum structure can be improved by compressing the material locally around the periphery of the fastener holes. The method used is known as cold working of fastener holes. This is achieved by pulling a mandrel through an undersize hole, thus enlarging the hole and compressing the surrounding metal.
- B. Though the process is used elsewhere in the airplane structure, it is not used in the hinged cowls, translating cowls, or thrust reverser C-duct structure of the RB211-535C37 and E4 powerplant nacelle components.



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GENERAL - SYMMETRY AND INCIDENT CHECK PROCEDURES

1. General

- A. Symmetry and incidence checks measure differences between selected points on the left and right sides of the airplane structure. These checks will aid in evaluating structural deformations that may have occurred on the airplane.
- B. Symmetry and incidence checks may be made if structural deformation is suspected after heavy landings, severe flight maneuvers, unsatisfactory in-flight operation, or repairs to major structural components. Large variations between measurements may indicate major structural damage.
- C. A symmetry check compares measurements made at corresponding locations on the left and right sides of the airplane.
- D. An incidence check compares angles of incidence at corresponding locations on the left and right sides of the airplane on the wing and horizontal stabilizer.

2. Prepare the Airplane

- A. The airplane should be located in an enclosed area on a hard and level surface. Jacking and leveling of the airplane is not required. The area should be free of air movement and variations in temperature.
 - (1) Shut off all fans and air conditioning equipment in the building.
 - (2) Close all outside doors during windy weather.
- B. If no enclosed area is available, conform to the following:
 - (1) Position airplane on a hard and level surface.
 - (2) Head airplane into wind, if any.
 - (3) Perform checks:
 - (a) when wind velocity is less than 10 knots.
 - (b) at night, on cloudy days, or with shade covering the entire airplane.
- C. Do not perform checks for at least one hour after airplane has been exposed to direct sunlight or after any engine has been in operation.
- D. Tow airplane 10 ft straight forward or straight backward to eliminate gear twist.
- E. Statically ground airplane as given in AMM 20-41-00.
- F. Install all landing gear ground locks and door locks as given in AMM 32-00-00.
- G. Defueling is not required, but the fuel load must be equally disposed on each side of the airplane.

NOTE: A minimum of 600 gallons of fuel in each wing tank is needed to cover the hydraulic system heat exchangers. Ground hydraulic power must be used if heat exchangers are not covered.

- H. Setting flight control surfaces.

WARNING: BEFORE OPERATING, ALL PERSONNEL MUST BE CLEAR OF THE OPERATING ENVELOPE OF ALL CONTROL SURFACES AND MOVING PARTS. PERSONAL INJURY MAY OCCUR.

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(WARNING PRECEDES)

CAUTION: TO PREVENT STRUCTURAL DAMAGE, ALL TOOLS, WORK STANDS, ETC., MUST BE CLEAR OF THE OPERATING ENVELOPE OF ALL CONTROL SURFACES AND MOVING PARTS.

- (1) Retract leading edge slats, flaps, and spoilers. Position ailerons, rudder, and elevators in their neutral positions.
- I. Measure the exposed inner cylinder on both main landing gear shock struts (Figure 3/GENERAL). If a discrepancy of over 1.00 inch exists between measurements, inflate or deflate the shock struts as given in AMM 12-15-00 to bring them within limits.
- J. Close all entry and cargo doors.

3. Symmetry Check

A. General

- (1) A symmetry check requires equipment included in Figure 4/GENERAL.
- (2) See Figure 1/GENERAL for location of symmetry points and for dimensions to be measured. Locate symmetry point S2 by placing masking tape between two screws shown in Figure 1/GENERAL, Detail VII or Detail XI. Measure to find midpoint between screws. Mark point (S2) on masking tape.
- (3) Take measurements with a 150-foot steel tape and a 25-pound spring scale used to measure tape tension. The spring scale is attached to the steel tape. Measurements can be taken at identical tape tension to minimize tape sag differences between measurements on each side of the airplane.

B. Measurement Procedure

- (1) Review symmetry check diagram, Figure 1/GENERAL, to identify measurements using common points. Sequence of measurements should be made to take advantage of measurements from a common point.
- (2) Position lift devices, ladders, stands, etc. for access to symmetry points.
- (3) Attach spring scale to the tape end to be used to apply tension. Place the other end of the tape against the selected symmetry point and apply 15 pounds tension. Take readings ensuring that the tape is pulled past and against the point being measured.

NOTE: Use pointer tool attached per para (4) for measurements A, B and K (RB211-535 Engine).

- (4) Attach pointer tool, Figure 4/GENERAL, Detail II, to tape and align zero mark on pointer with foot-mark on tape.

NOTE: Pointer tool is required when making measurements A, B and K (RB211-535 Engine) only.

- (5) Record measurements.
- (6) Calculate the difference after making measurements on a set of comparative points.
- (7) Recheck measurements if the actual difference is greater than the values shown in Figure 5/GENERAL.
- (8) See Paragraph 6./GENERAL, for interpretation of results.

C. General

- (1) A symmetry check requires equipment included in Figure 4/GENERAL.



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STRUCTURAL REPAIR MANUAL

- (2) See Figure 1/GENERAL for location of symmetry points and for dimensions to be measured. Locate symmetry point S2 by placing masking tape between two screws shown in Figure 1/GENERAL, Detail VII. Measure to find midpoint between screws. Mark point (S2) on masking tape.
- (3) Take measurements with a 150-foot steel tape and a 25-pound spring scale used to measure tape tension. The spring scale is attached to the steel tape. Measurements can be taken at identical tape tension to minimize tape sag differences between measurements on each side of the airplane.

D. Measurements

(1) Measurement A

CAUTION: DO NOT STAND ON THE WINGS OR HORIZONTAL STABILIZERS WHEN YOU DO THE MEASUREMENTS. TOO MUCH WEIGHT ON THESE SURFACES CAN CAUSE A RESULT THAT IS NOT ACCURATE. USE STANDARD, ADJUSTABLE, WORK STANDS OR SCAFFOLDS.

- (a) Symmetry points for this measurement are S5 and S6.
- (b) Use of pointer tool is required for this measurement.

NOTE: Align pointer tool parallel with tape for accurate readings.

- (c) Point S5 is common point for measurement B.
- (d) Point S6 is common point for measurement E.

(2) Measurement B

- (a) Symmetry points for this measurement are S5 and S8.
- (b) Use of pointer tool is required for this measurement.

NOTE: Align pointer tool parallel with tape for accurate readings.

- (c) Point S5 is common point for measurement A.

(3) Measurement C

- (a) Symmetry points for this measurement are S1 and S7.
- (b) Point S7 is common point for measurement D.

(4) Measurement D

- (a) Symmetry points for this measurement are S3 and S7.
- (b) Point S7 is common point for measurement C.
- (c) Point S3 is common point for measurement H and J.

(5) Measurement E

CAUTION: DO NOT STAND ON THE WINGS OR HORIZONTAL STABILIZERS WHEN YOU DO THE MEASUREMENTS. TOO MUCH WEIGHT ON THESE SURFACES CAN CAUSE A RESULT THAT IS NOT ACCURATE. USE STANDARD, ADJUSTABLE, WORK STANDS OR SCAFFOLDS.

- (a) Symmetry points for this measurement are S5 and S9.
- (b) Point S6 is common point for measurement A.
- (c) Point S9 is common point for measurement F.

(6) Measurement F



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- (a) Symmetry points for this measurement are S4 and S9.
- (b) Point S9 is common point for measurement E.
- (7) Measurement G
 - (a) Symmetry points for this measurement are S2 and S12.
 - (b) Point S12 requires the use of tow ring target, Figure 4/GENERAL, Detail I.
 - (c) Point S2 is common point for measurement K.
- (8) Measurement H
 - (a) Symmetry points for this measurement are S3 and S13.
 - (b) Point S13 requires the use of tow ring target, Figure 4/GENERAL, Detail I.
- (9) Measurement H
 - (a) Point S3 is common point for measurements D and J.
- (10) Measurement J
 - (a) Symmetry points for this measurement are S3 and S11.
 - (b) Point S3 is common point for measurements D and H.
- (11) Measurement K
 - (a) Symmetry points for this measurement are S2 and S10.
 - (b) Use of pointer tool is required for this measurement on RB211-535 engines.
NOTE: Align pointer tool parallel with tape for accurate readings.
 - (c) Point S2 is common point for measurement G.

4. **Incidence Check**

A. General

- (1) An incidence check requires the equipment included in Figure 4/GENERAL. Use 118 inch support for wing measurements and 46 inch support for horizontal stabilizer measurements.
- (2) See Figure 2/GENERAL for locations of incidence points I1 and I2.

B. Wing Incidence Measurement Procedure

CAUTION: A MAXIMUM OF TWO PERSONS SHOULD BE ALLOWED ON THE WING DURING THE INCIDENCE CHECK, EXCESSIVE WEIGHT MAY RESULT IN ERRONEOUS READINGS.

- (1) Determine line of measurement per Figure 2/GENERAL, Detail II.
- (2) Position inclinometer support along measurement line with the forward pointer at I1. Ensure that the support is perpendicular to the wing surface.

NOTE: To ensure that comparative readings between the left and right side wings are made, mark forward end of inclinometer support with masking tape.

- (3) Place inclinometer on support, take readings and record.
- (4) If the actual difference is greater than the values shown in Figure 5/GENERAL, recheck both measurements (left and right side).
- (5) Refer to Paragraph 6./GENERAL para 6 for interpretation of results.

C. Horizontal Stabilizer Incidence Measurement Procedures



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STRUCTURAL REPAIR MANUAL

CAUTION: A MAXIMUM OF TWO PERSONS SHOULD BE ALLOWED ON THE HORIZONTAL STABILIZER DURING THE INCIDENCE CHECK. EXCESSIVE WEIGHT MAY RESULT IN ERRONEOUS READINGS.

- (1) Determine line measurement as given in Figure 2/GENERAL Detail III.
- (2) Position inclinometer support along measurement line with the forward pointer at I2. Ensure that the support is perpendicular to the wing surface.

NOTE: To ensure that comparative readings between the left and right side stabilizers are made, mark forward end of inclinometer support with masking tape.

- (3) Place inclinometer on support, take readings and record.
- (4) If the actual difference is greater than the values shown in Figure 5/GENERAL, recheck both measurements (left and right side).
- (5) Refer to Paragraph 6./GENERAL for interpretation of results.

5. Terminating Procedure

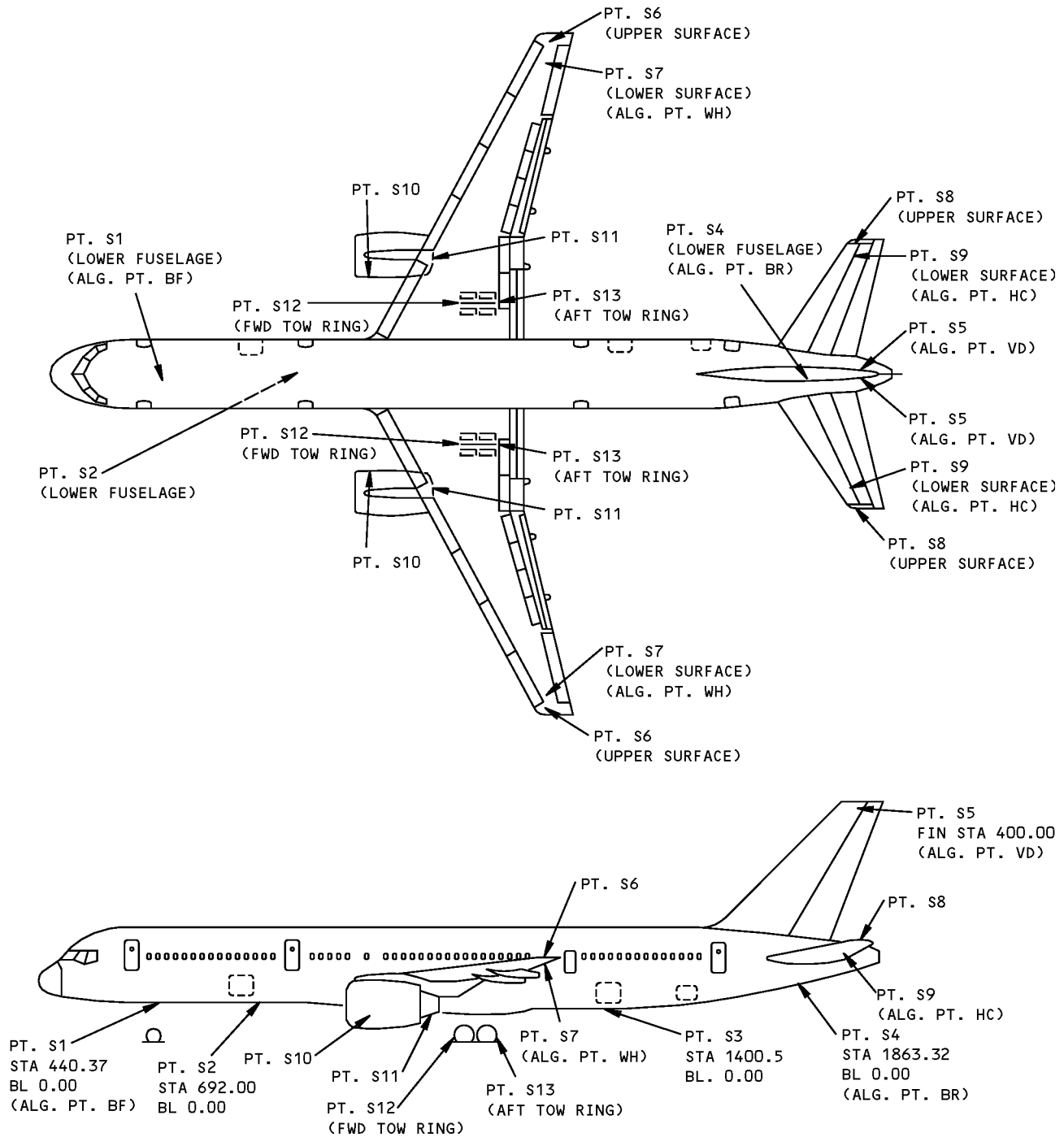
- A. Restore the airplane to normal as given in the AMM.

6. Interpretation of Results

- A. Where actual differences are equal to or less than values shown in Figure 5/GENERAL, the airplane may be restored to normal and returned to service.
- B. Where actual differences are greater than values shown in Figure 5/GENERAL, further investigation is warranted. Analyze the dimension taken to isolate possible areas of concern; thoroughly examine structure for damage. Typical indications of structural distress are:
 - (1) Buckled or cracked skins, spar webs or chords, stiffeners, castings, forgings or machined parts.
 - (2) Loose or tilted fasteners.
 - (3) Fastener failure in tension or shear.
 - (4) Fuel leaks in the wing fuel tank areas.
 - (5) Excessive air leaks in pressurized body areas noted by stains on body skin.
 - (6) Cracked paint indicating relative movement of components.
 - (7) Interference of moving parts of a mechanism.
 - (8) Interference in door and access panel closures due to surrounding structural distortion.
 - (9) Excessive control surface trim.
 - (10) Misalignment or overlapping of control surfaces.
- C. When inspection shows no signs of structural damage accounting for the measured difference found by the symmetry or incidence check, consult operator engineering department to determine if the airplane may be returned to service.

NOTE: Symmetry differences which exceed the maximum normal values by a small amount do not necessarily reflect an unsatisfactory structural or aerodynamic condition.

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NOTE

- SEE TABLE I FOR FURTHER DETAILS OF POINT LOCATIONS

- (ALG. PT. XX) IS DEFINED AS ALIGNMENT POINT XX

Symmetry Check Point Locations
Figure 1 (Sheet 1 of 16)



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STRUCTURAL REPAIR MANUAL

MEASUREMENT	POINTS MEASUREMENTS ARE MADE BETWEEN	DETAIL NO.
A	S5 AND S6	I
B	S5 AND S8	II
C	S1 AND S7	III
D	S3 AND S7	IV
E	S6 AND S9	V
F	S4 AND S9	VI
G	S2 AND S12	VII
H	S3 AND S13	VIII
J	S3 AND S11	IX AND X
K	S2 AND S10	IX AND XI

TABLE I

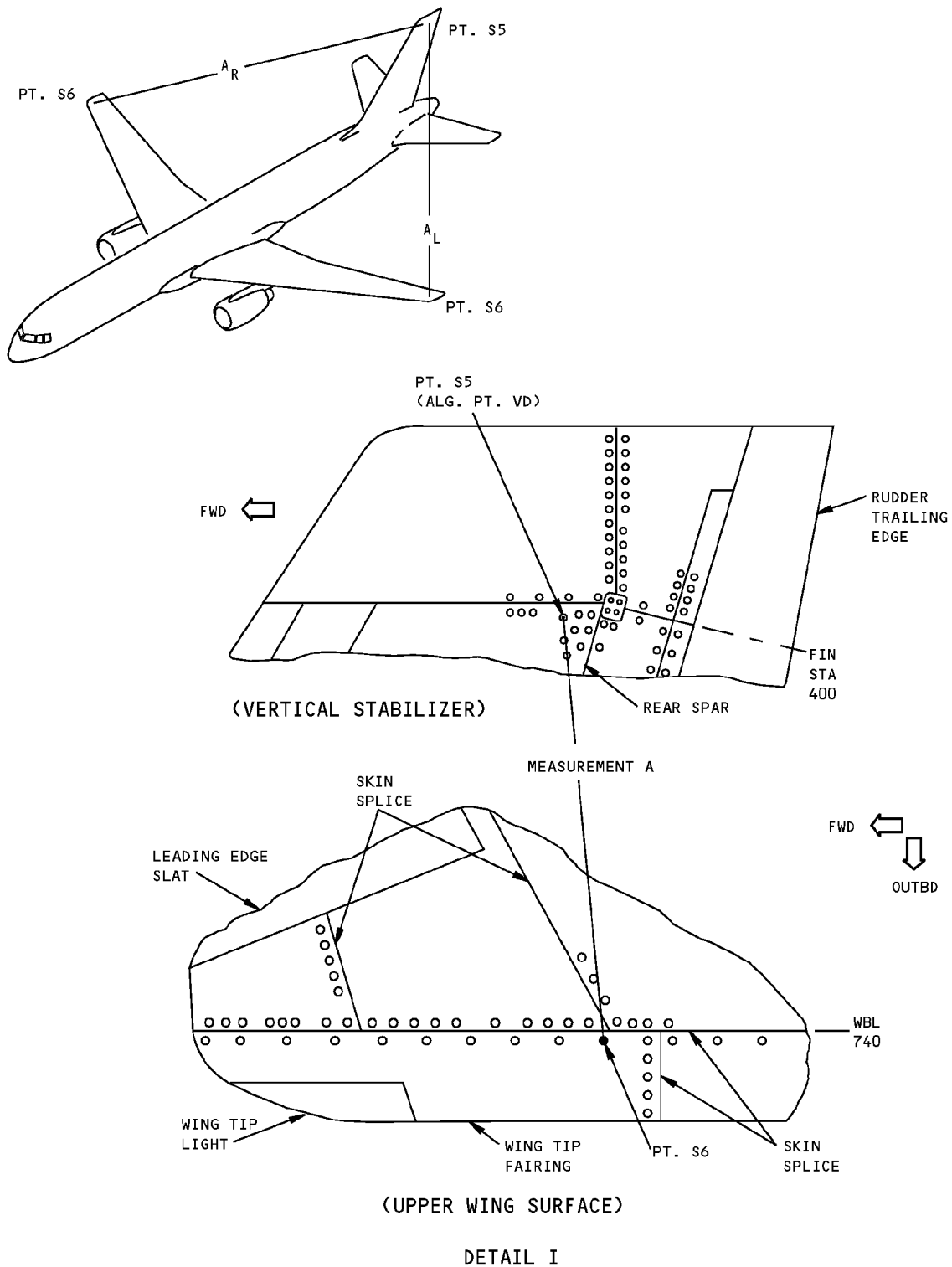
Symmetry Check Point Locations
Figure 1 (Sheet 2 of 16)

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51-50-01

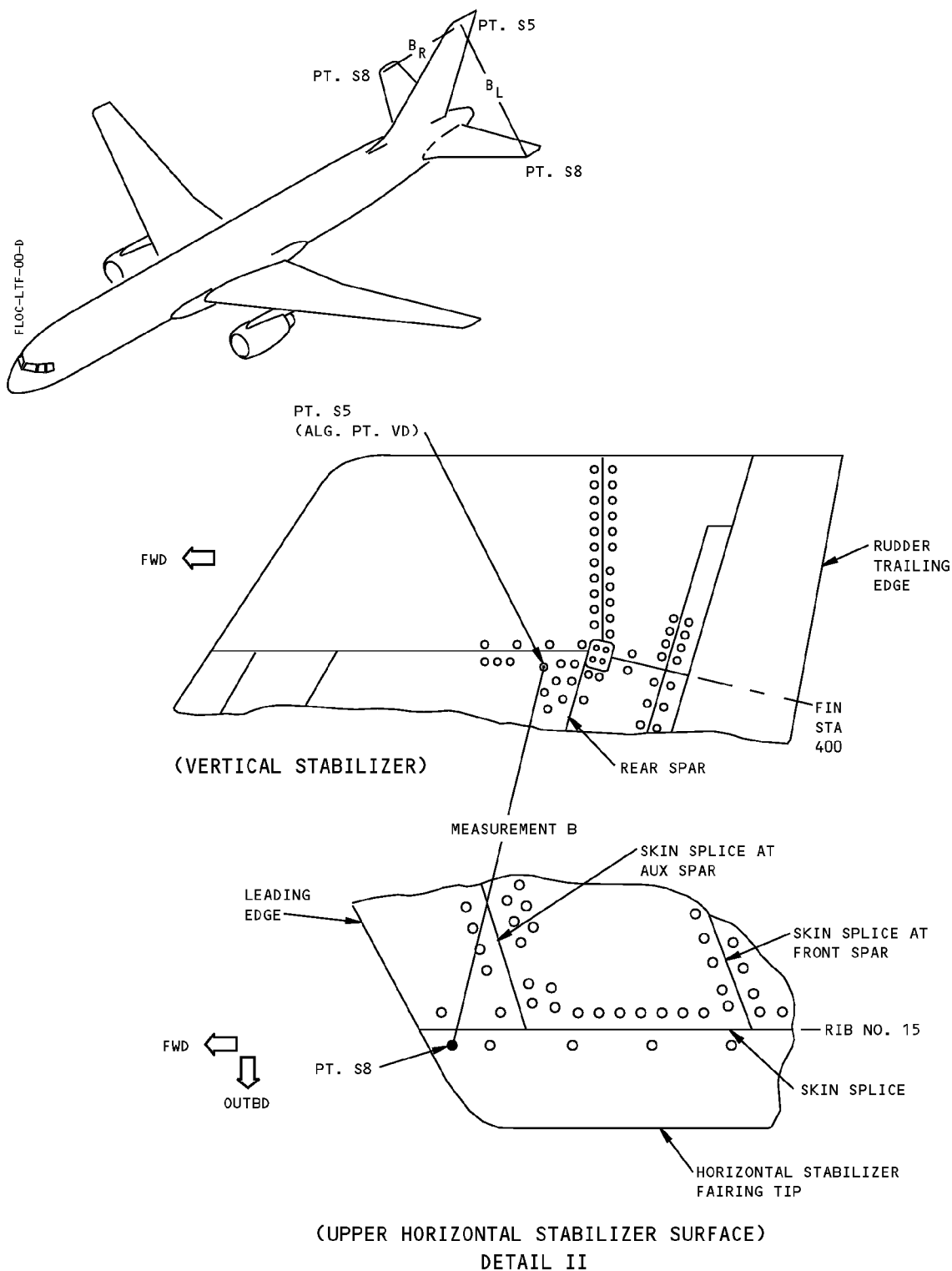
GENERAL
Page 7
Jan 20/2005

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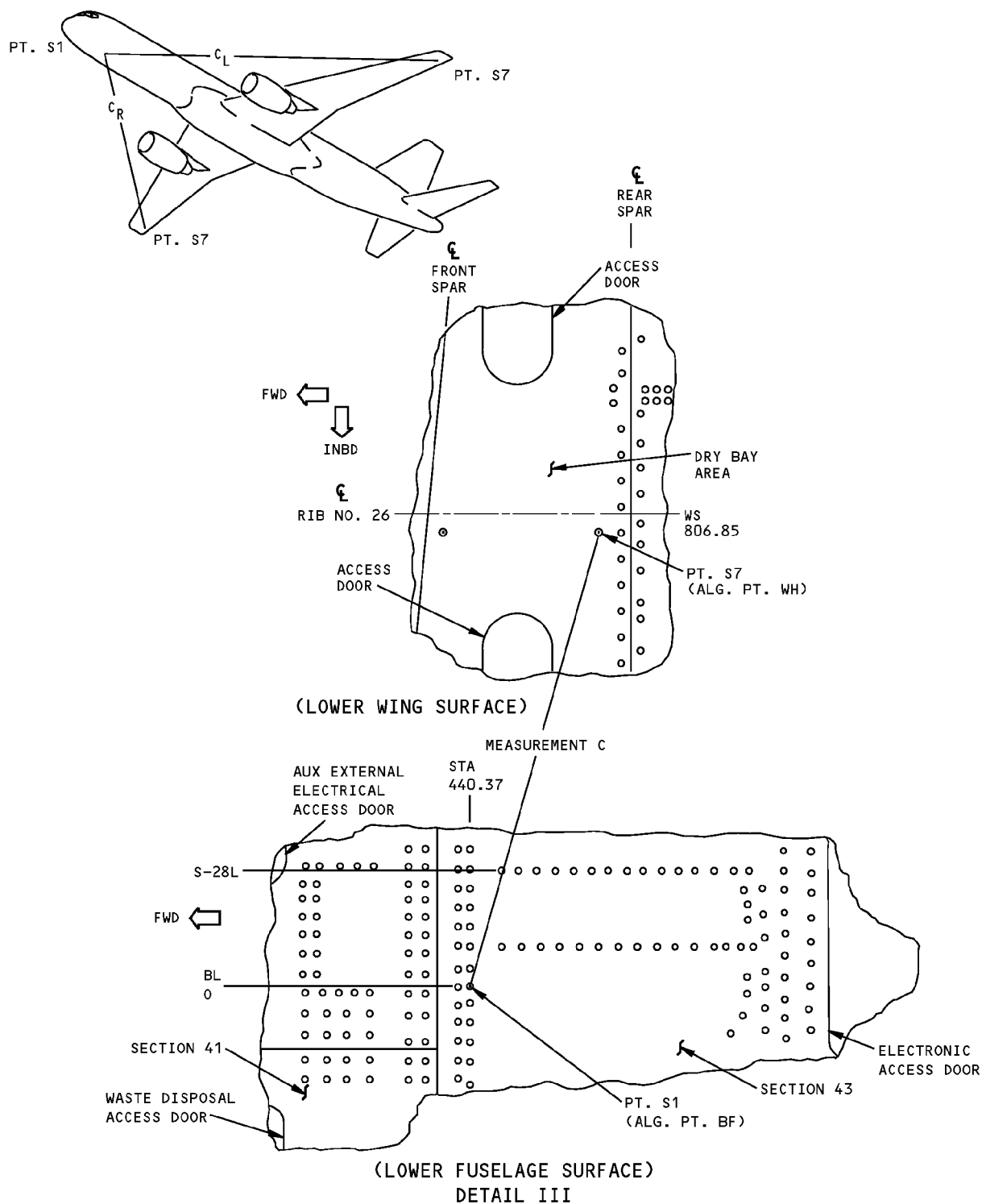
Symmetry Check Point Locations
Figure 1 (Sheet 3 of 16)

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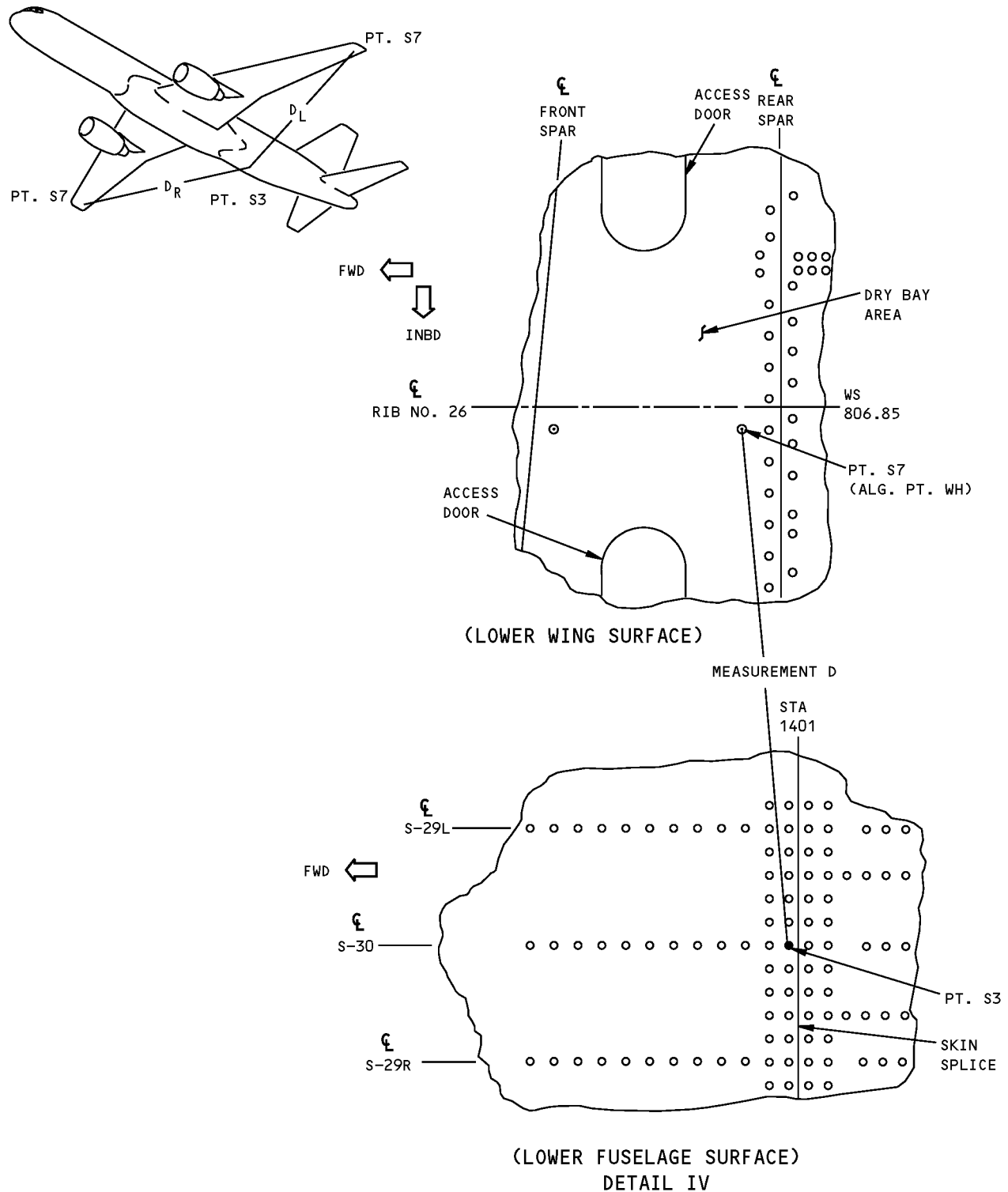
Symmetry Check Point Locations
Figure 1 (Sheet 4 of 16)

757-200 STRUCTURAL REPAIR MANUAL



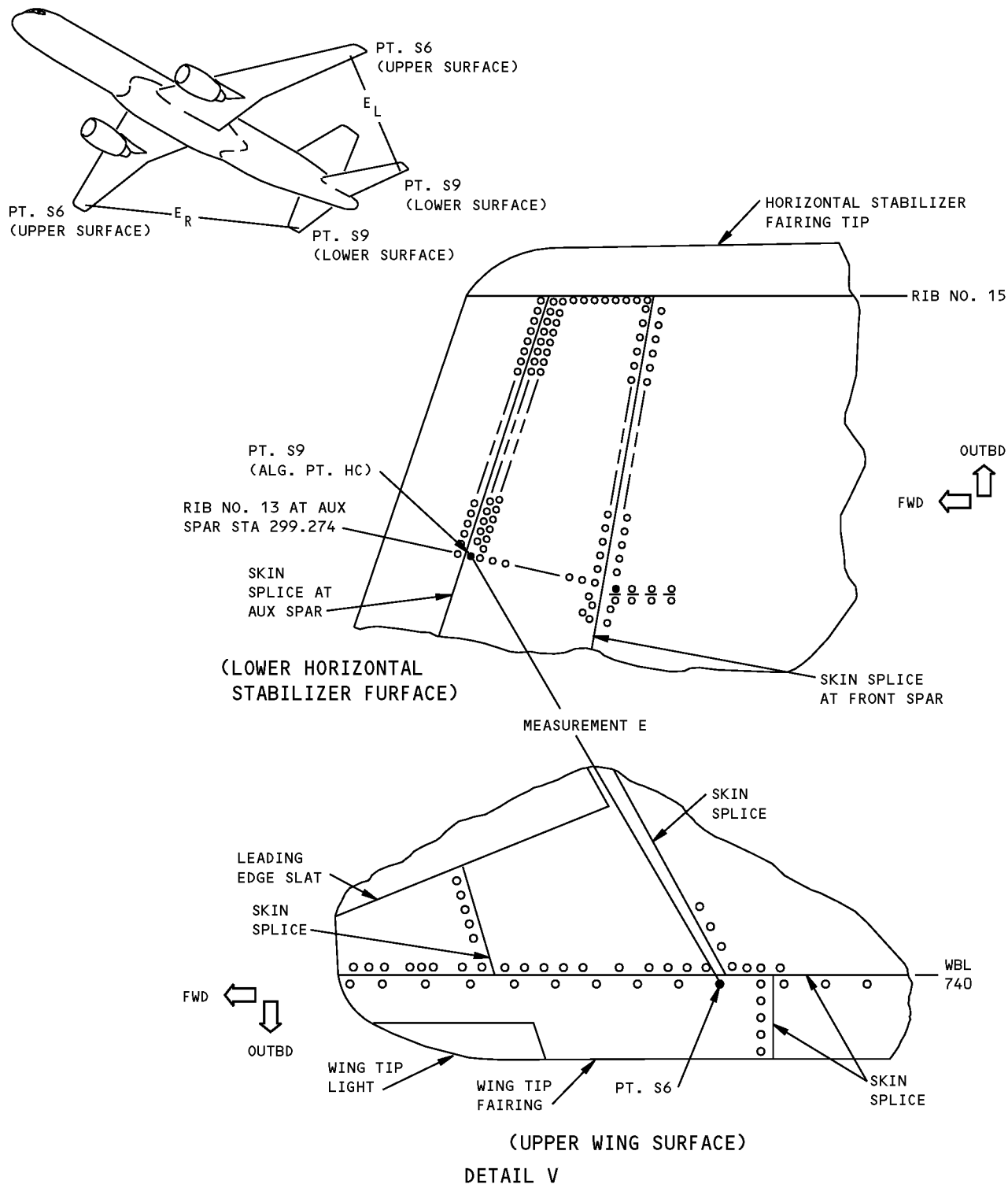
Symmetry Check Point Locations
Figure 1 (Sheet 5 of 16)

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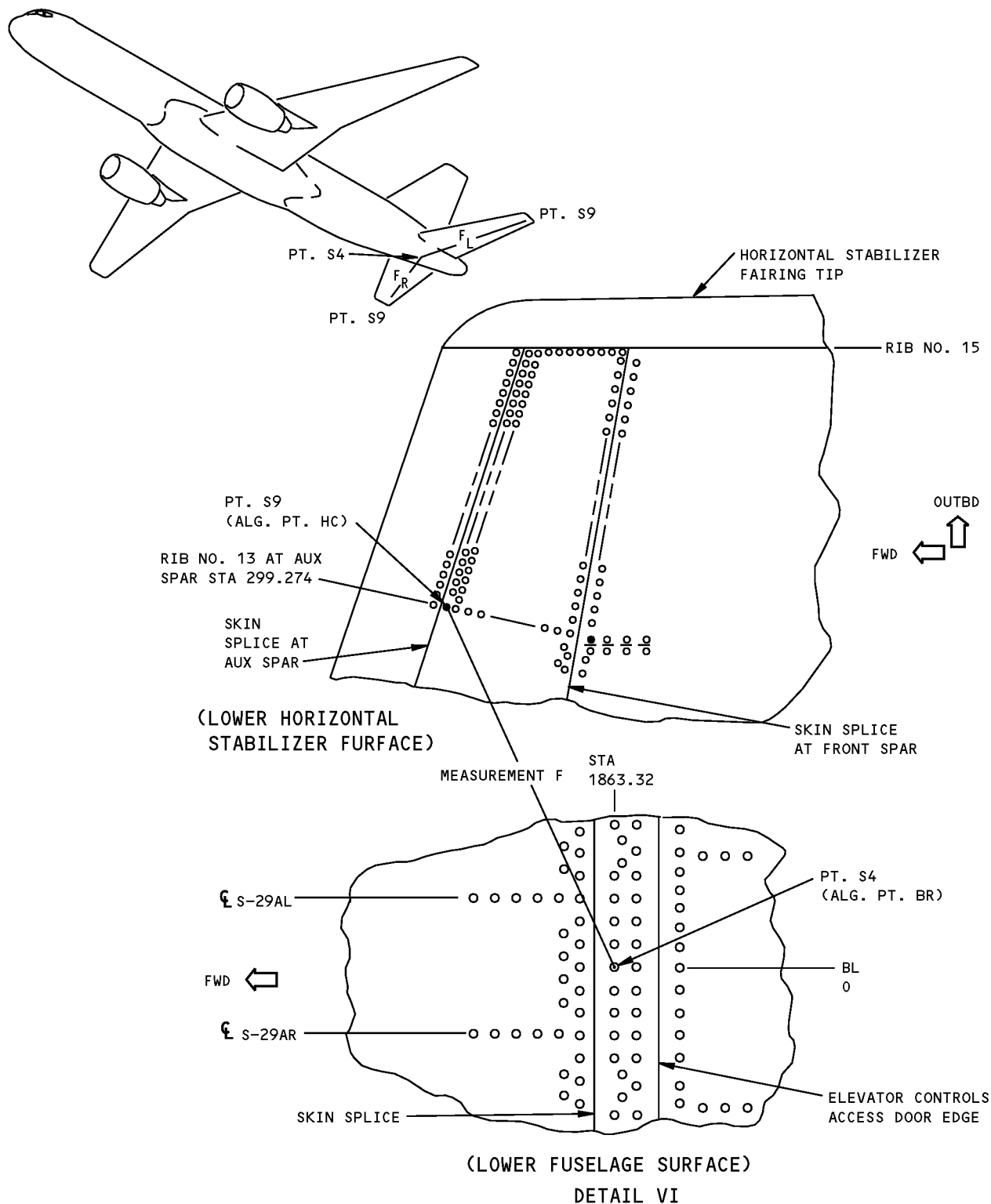
Symmetry Check Point Locations
Figure 1 (Sheet 6 of 16)

757-200 STRUCTURAL REPAIR MANUAL



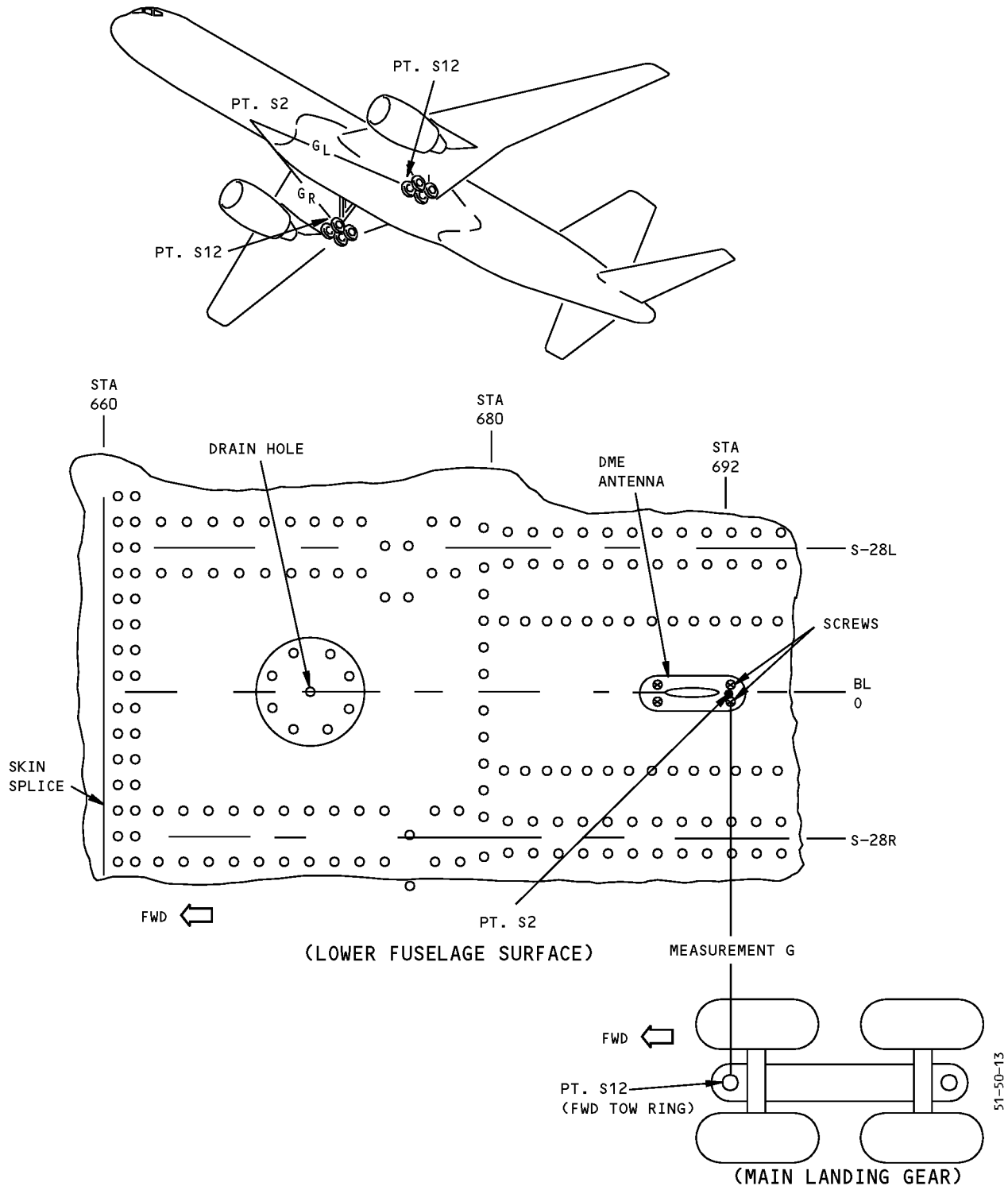
Symmetry Check Point Locations
Figure 1 (Sheet 7 of 16)

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Symmetry Check Point Locations
Figure 1 (Sheet 8 of 16)

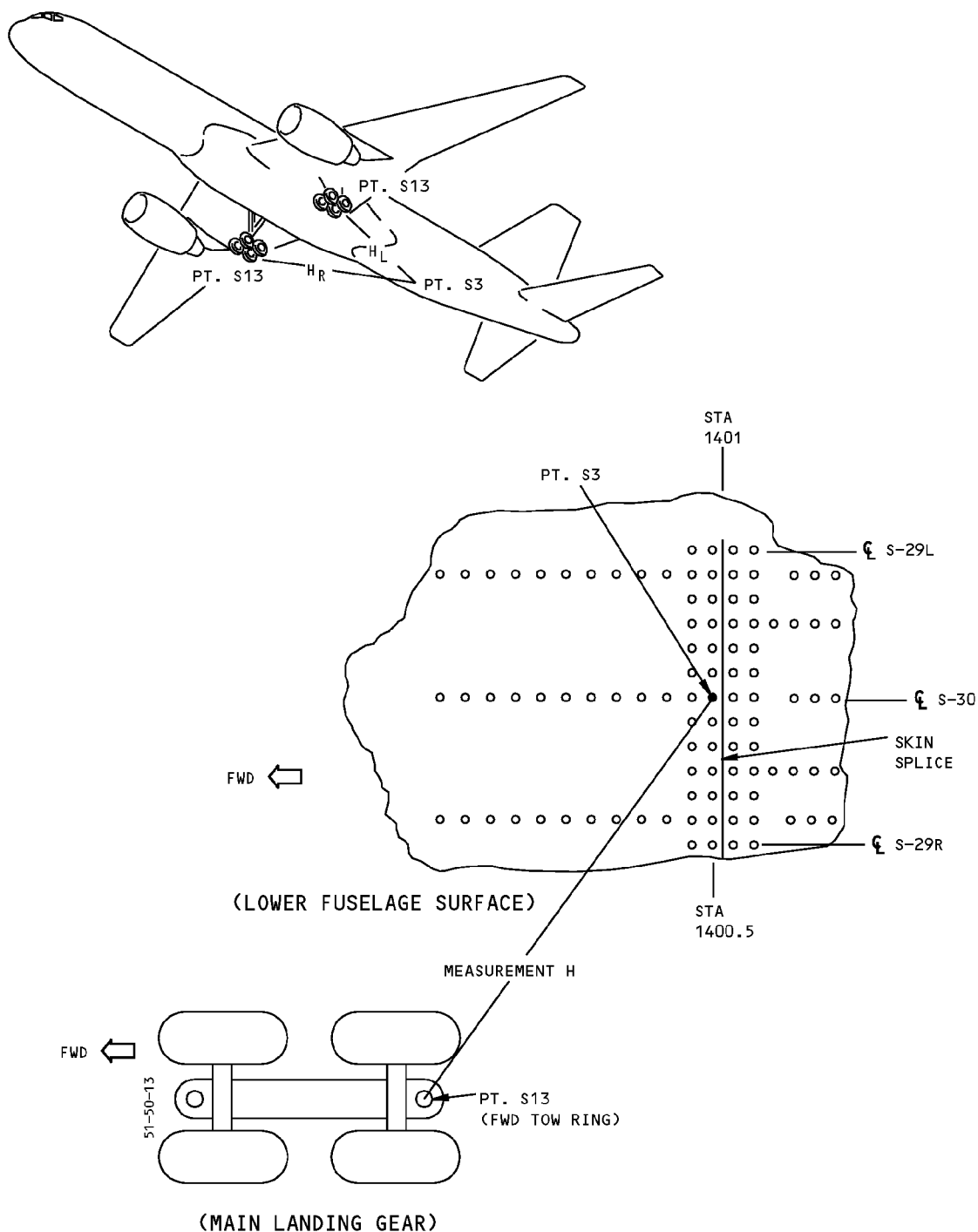
757-200 STRUCTURAL REPAIR MANUAL



DETAIL VII

Symmetry Check Point Locations
Figure 1 (Sheet 9 of 16)

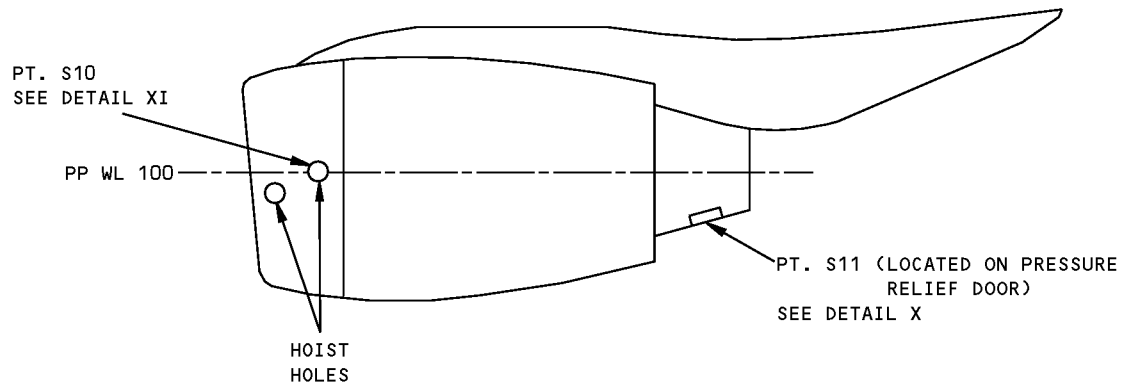
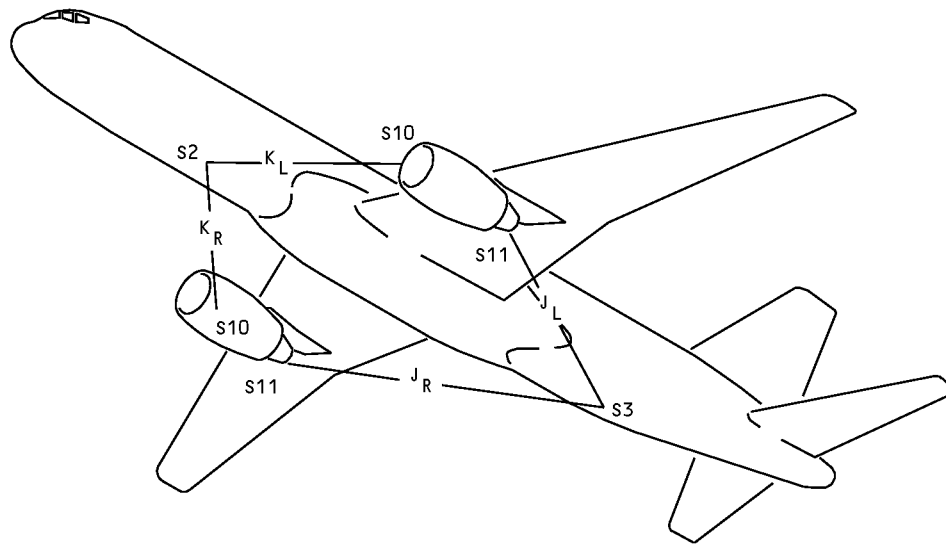
757-200 STRUCTURAL REPAIR MANUAL



DETAIL VIII

Symmetry Check Point Locations
Figure 1 (Sheet 10 of 16)

757-200
STRUCTURAL REPAIR MANUAL

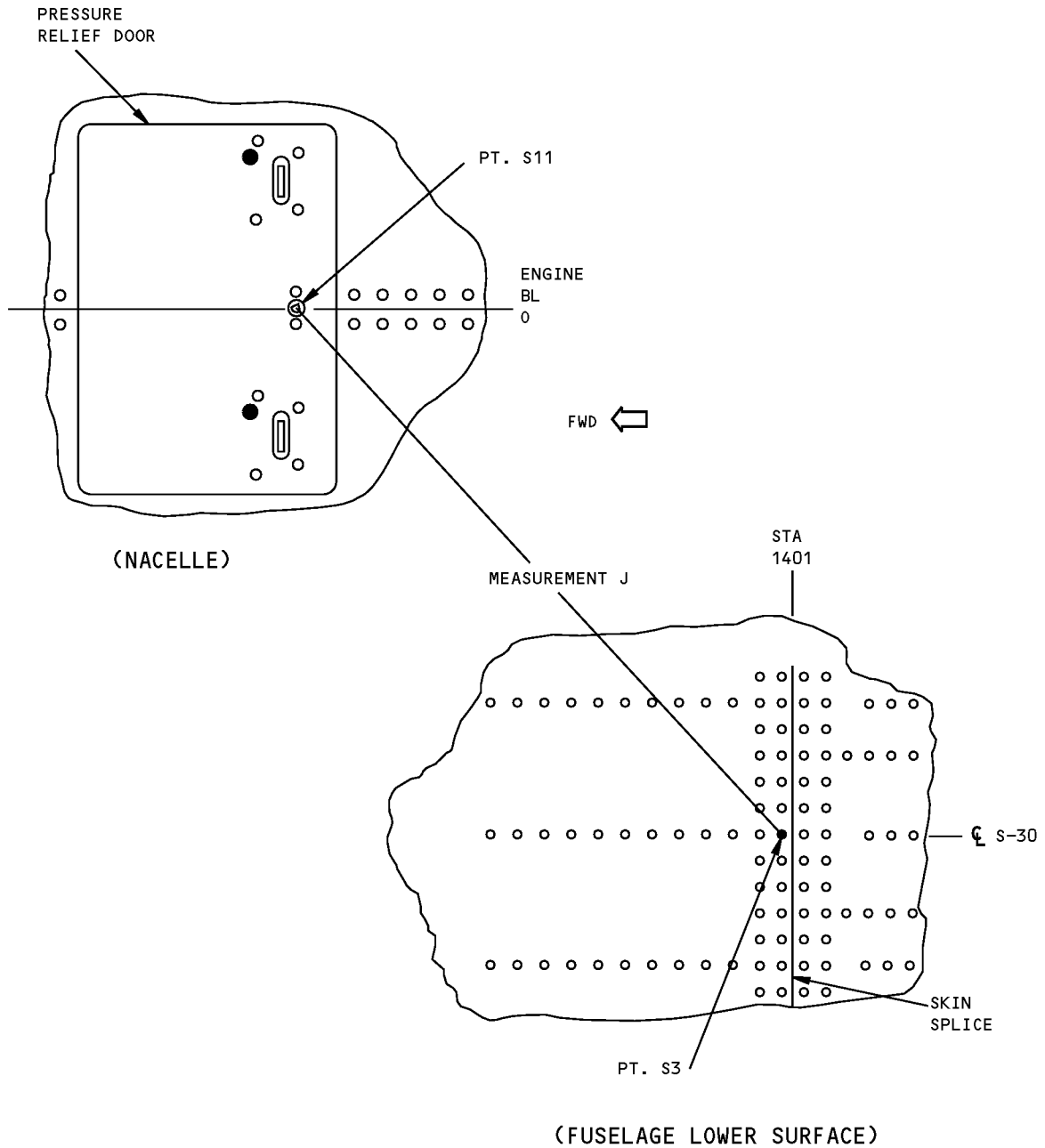


ROLLS-ROYCE RB211-535C ENGINES ONLY

DETAIL IX

Symmetry Check Point Locations
Figure 1 (Sheet 11 of 16)

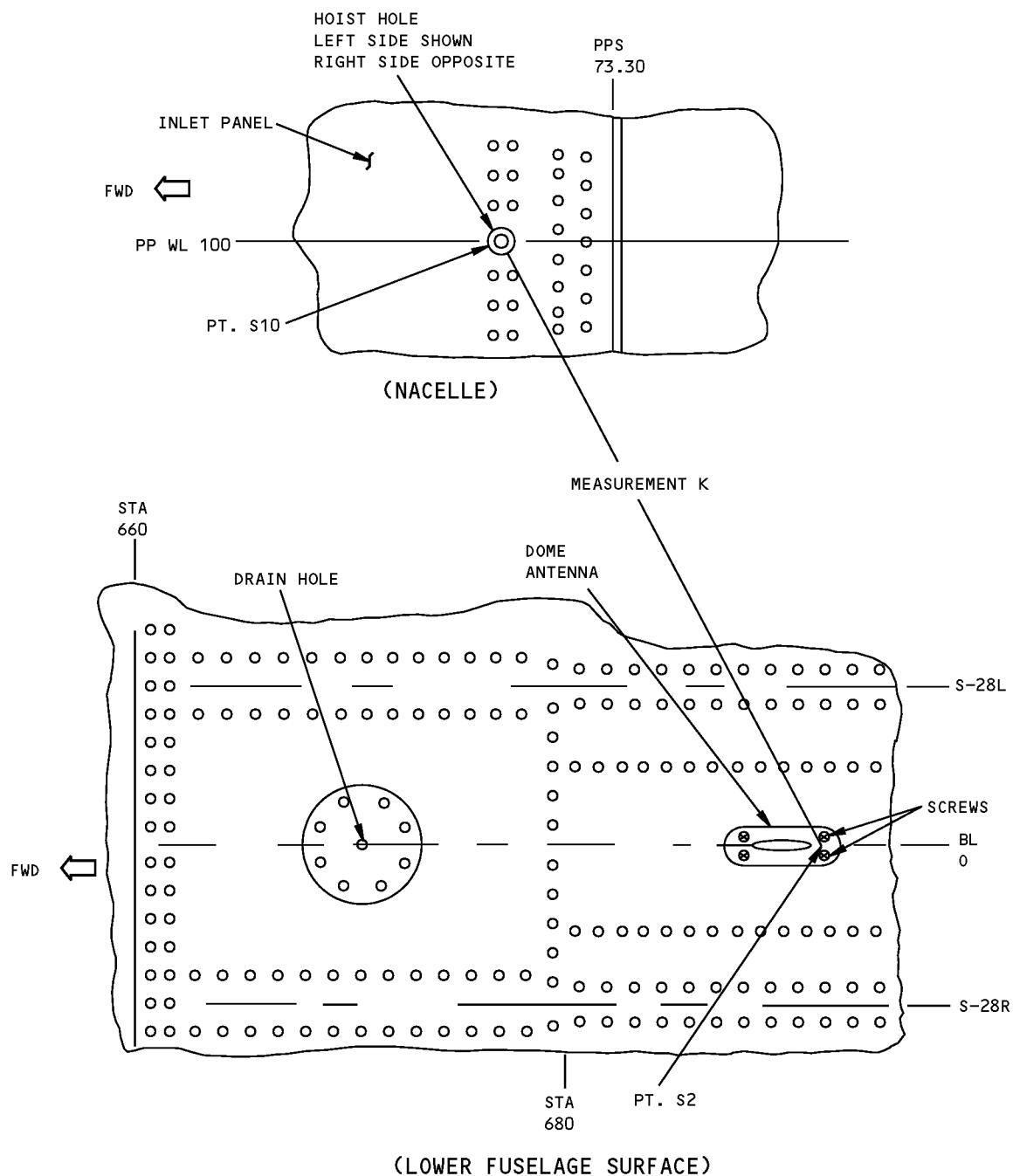
757-200 STRUCTURAL REPAIR MANUAL



DETAIL X

**Symmetry Check Point Locations
Figure 1 (Sheet 12 of 16)**

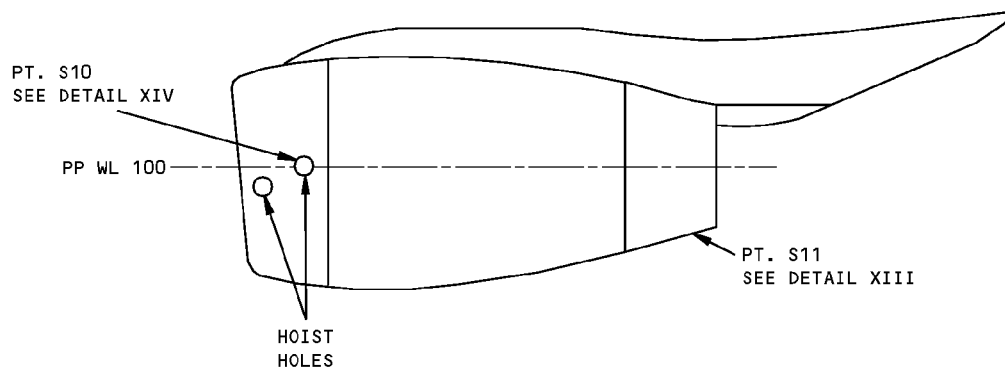
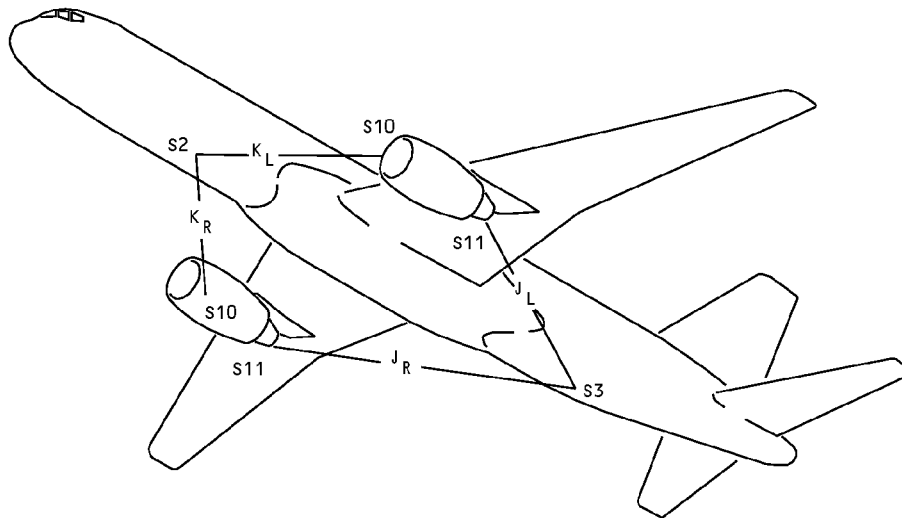
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DETAIL XI

Symmetry Check Point Locations
Figure 1 (Sheet 13 of 16)

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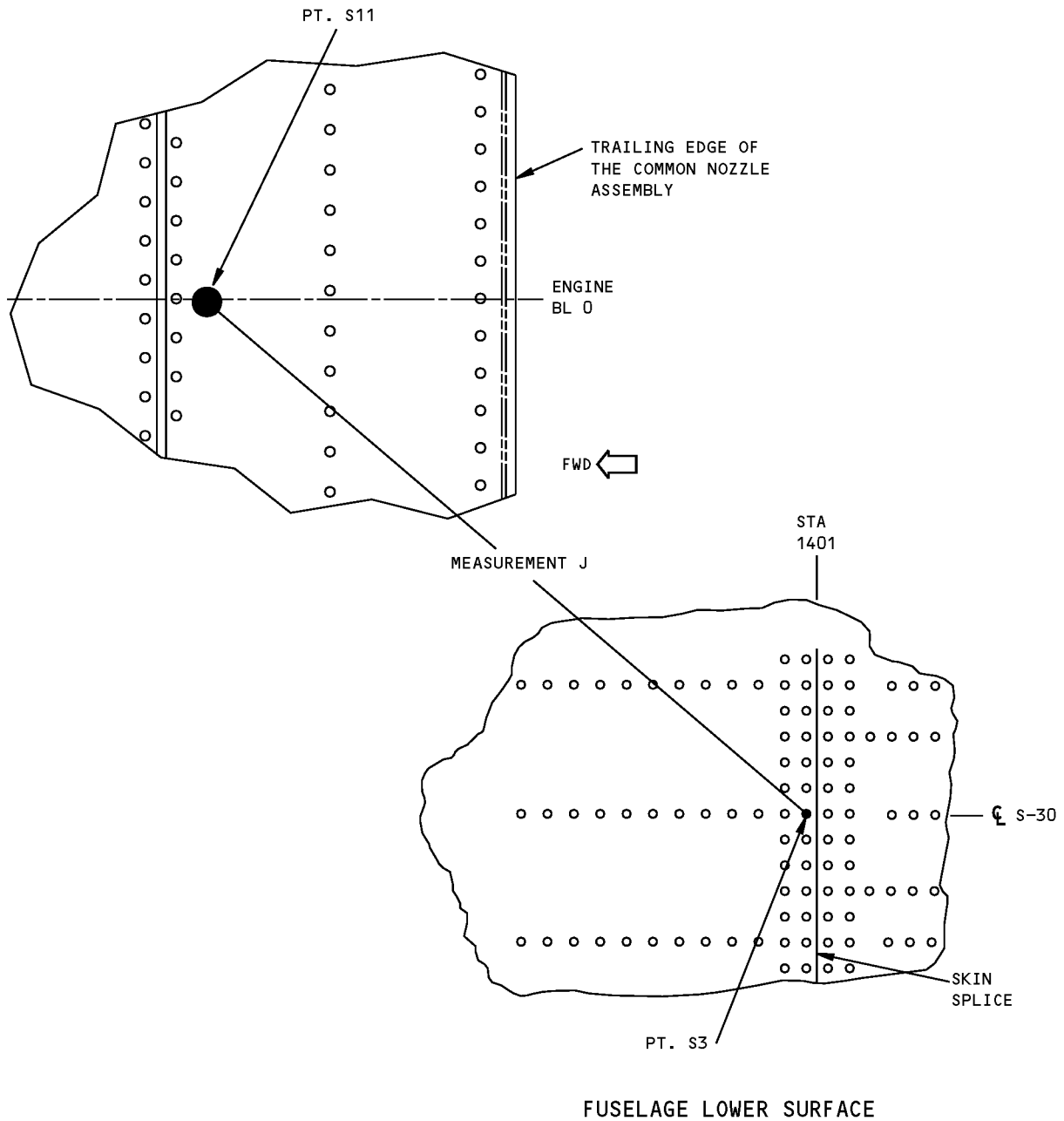


ROLLS-ROYCE RB211-535E4 ENGINES ONLY

DETAIL XII

**Symmetry Check Point Locations
Figure 1 (Sheet 14 of 16)**

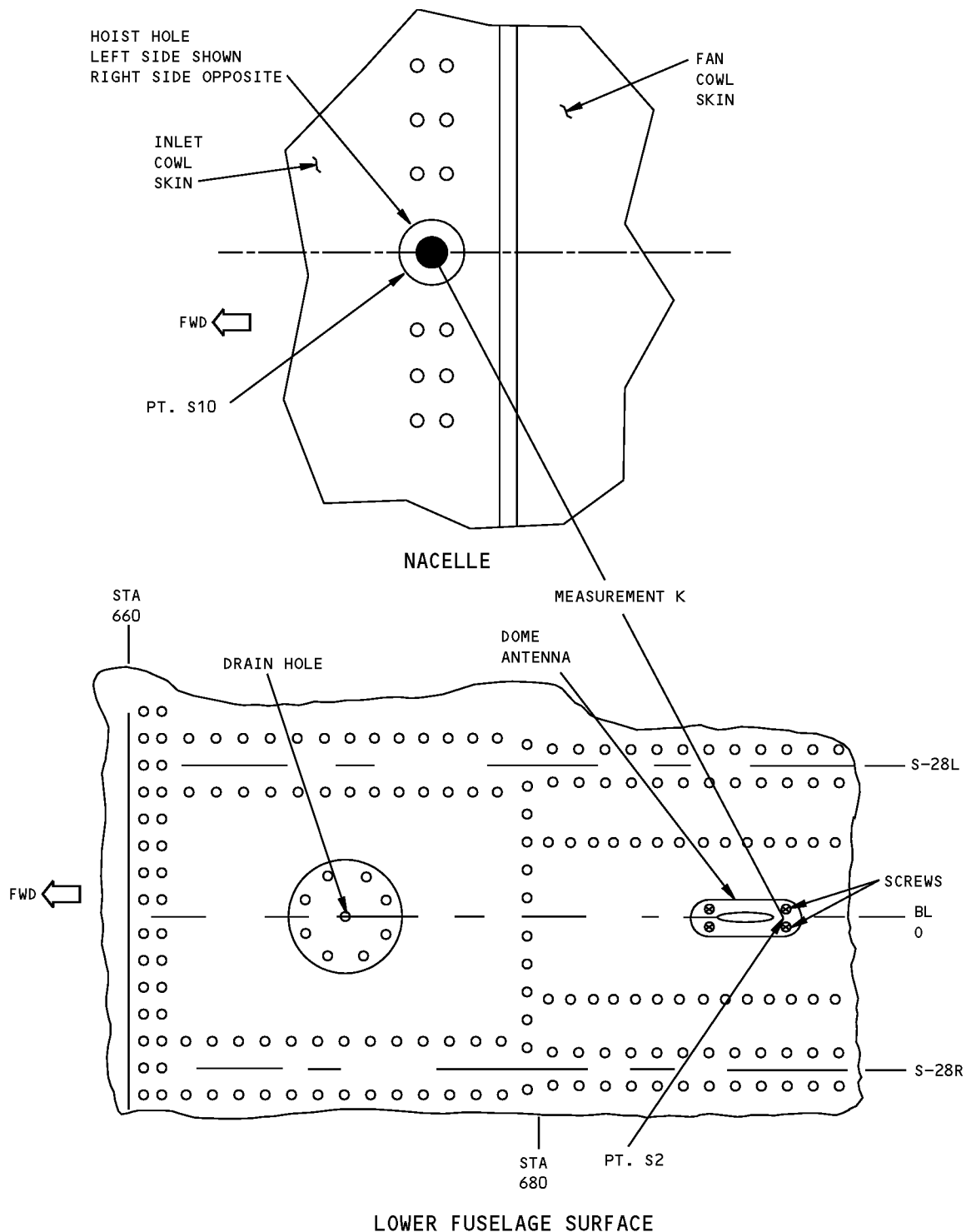
757-200 STRUCTURAL REPAIR MANUAL



DETAIL XIII

Symmetry Check Point Locations
Figure 1 (Sheet 15 of 16)

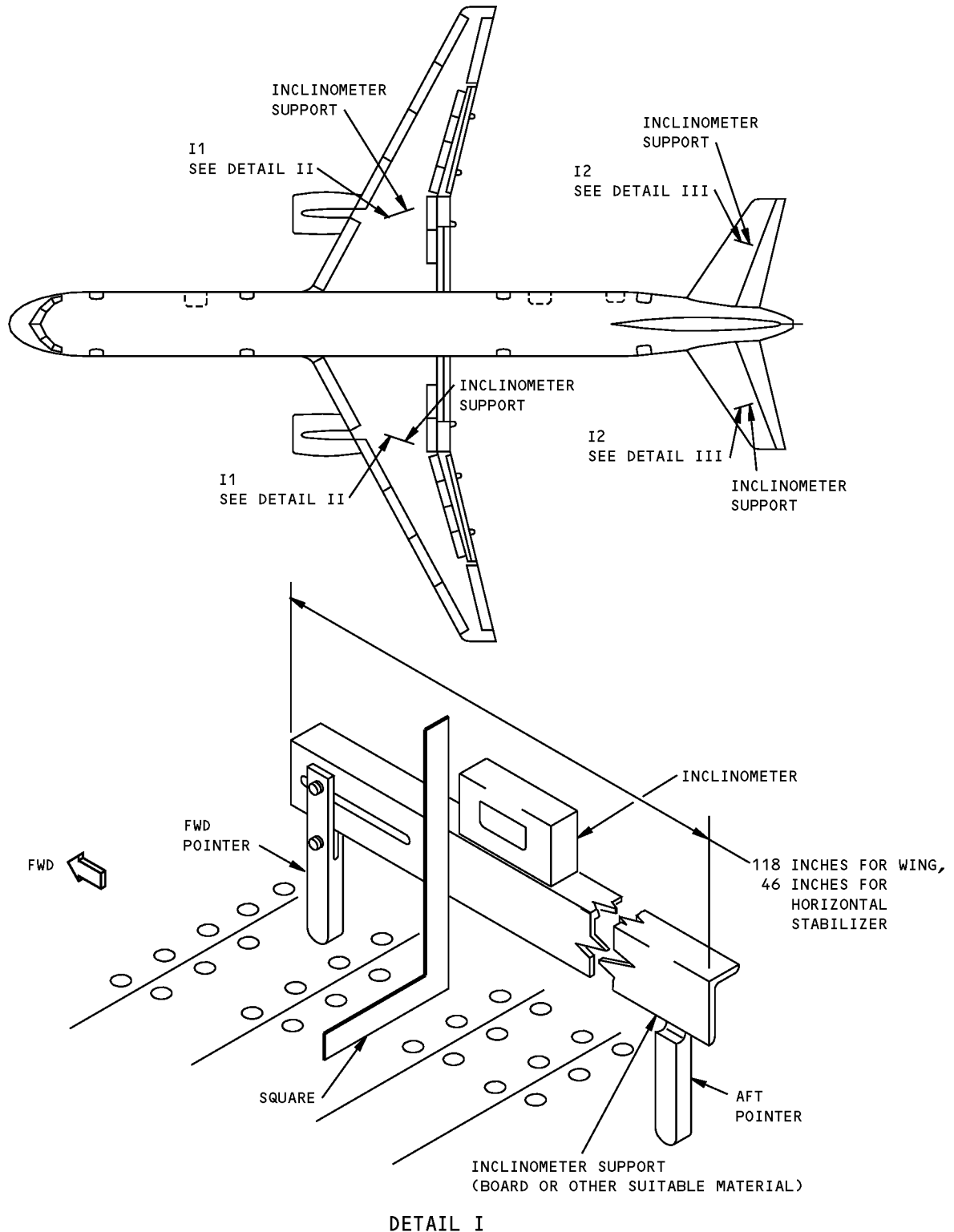
757-200 STRUCTURAL REPAIR MANUAL



DETAIL XIV

**Symmetry Check Point Locations
Figure 1 (Sheet 16 of 16)**

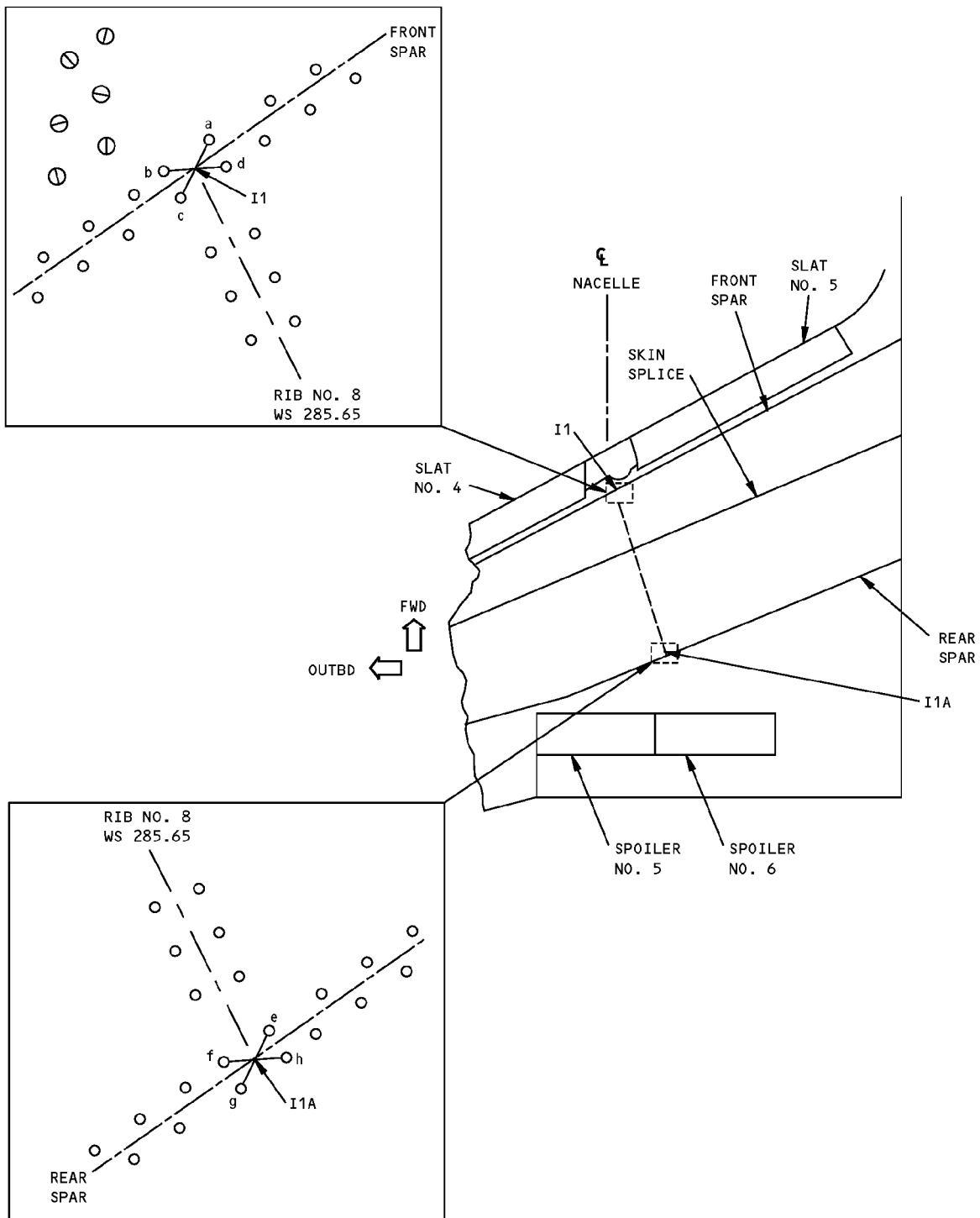
757-200 STRUCTURAL REPAIR MANUAL



DETAIL I

**Incidence Check Point Locations
Figure 2 (Sheet 1 of 3)**

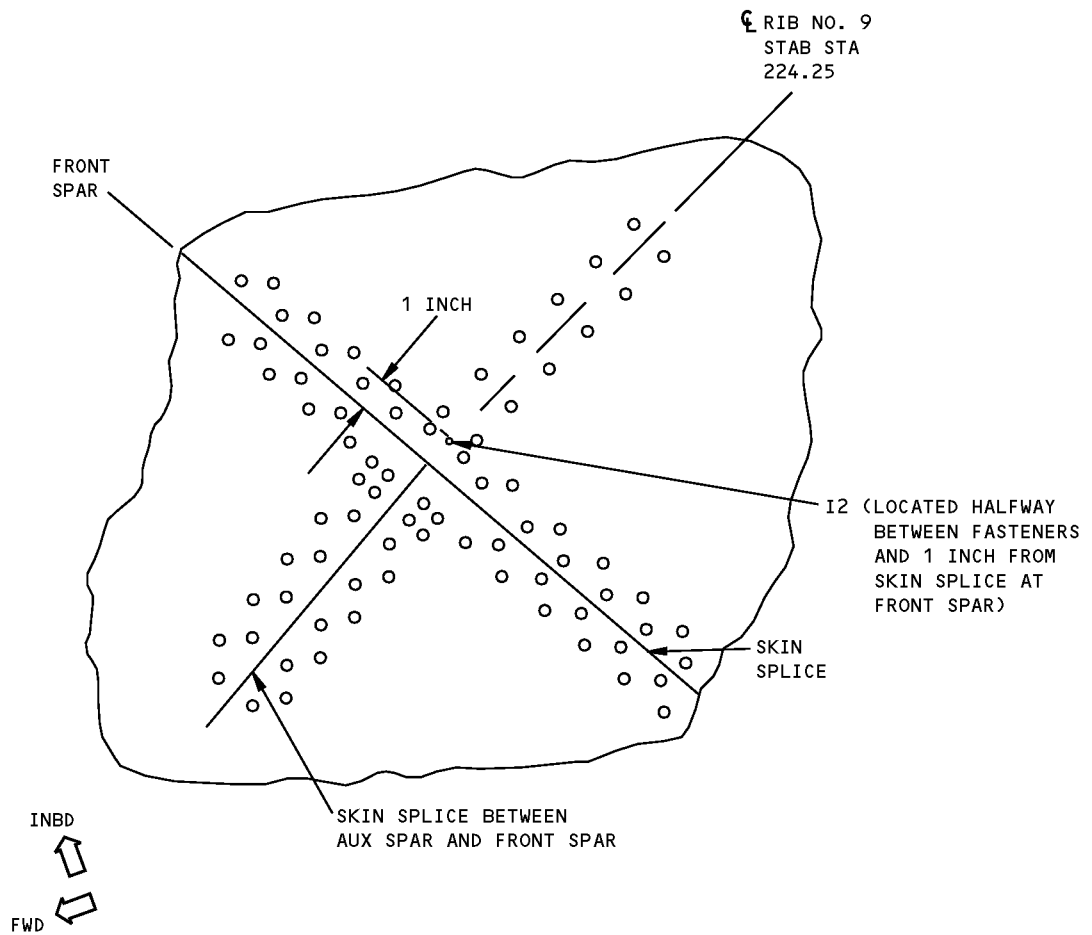
757-200 STRUCTURAL REPAIR MANUAL



DETAIL II

Incidence Check Point Locations
Figure 2 (Sheet 2 of 3)

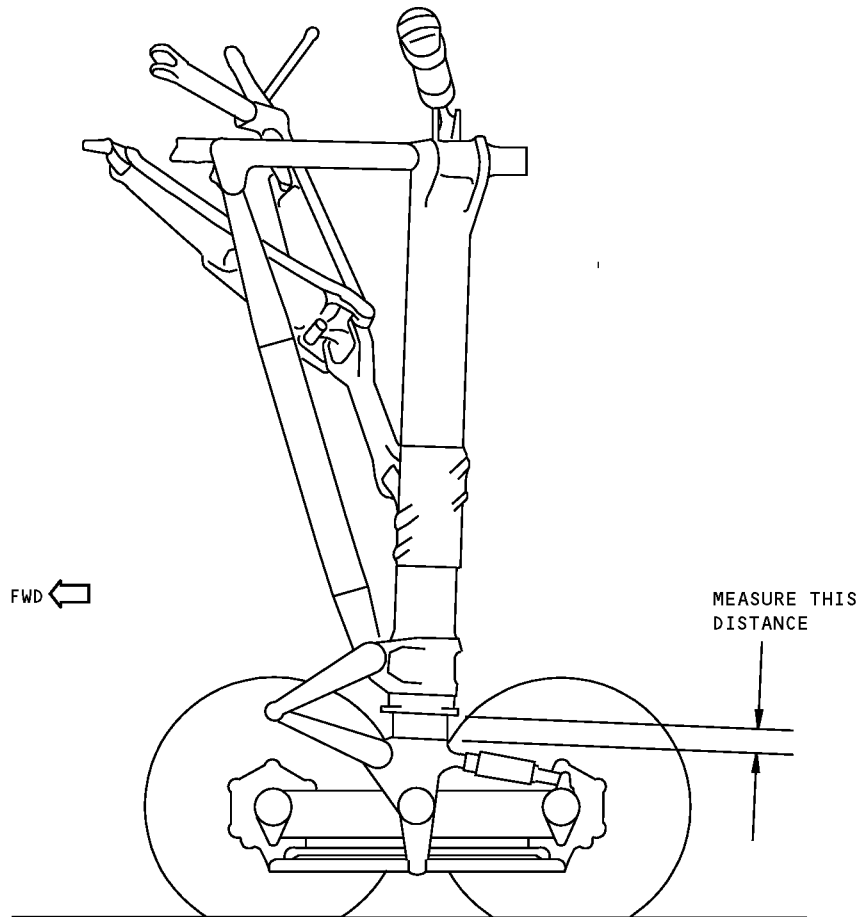
757-200 STRUCTURAL REPAIR MANUAL



DETAIL III

Incidence Check Point Locations
Figure 2 (Sheet 3 of 3)

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STRUCTURAL REPAIR MANUAL



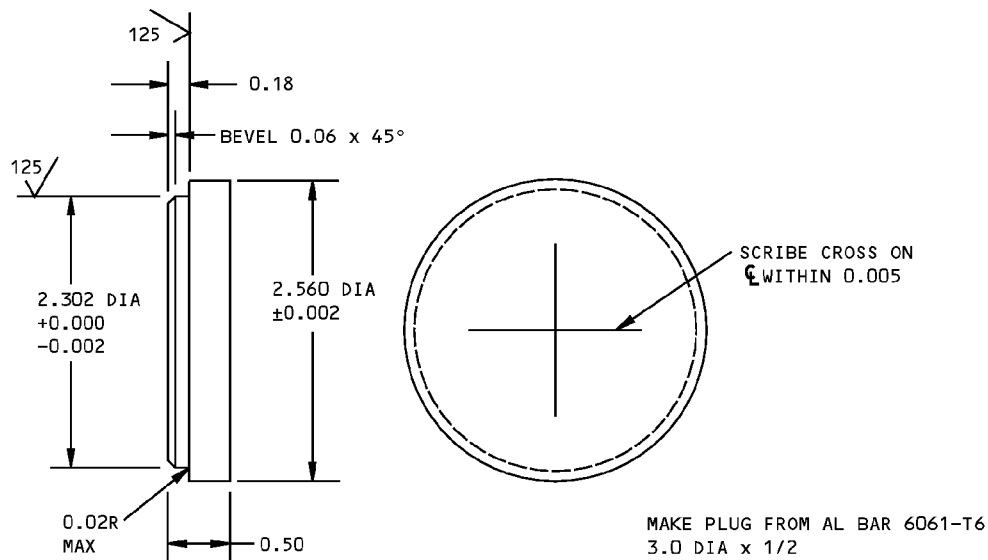
MAIN LANDING GEAR
VIEW LOOKING INBOARD

Shock Strut Leveling
Figure 3

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ITEM	NO. REQD	IDENTIFICATION	SOURCE
SCAFFOLDING	2	_____	ANY SOURCE
TAPE MEASURE, 100-FOOT STEEL	1	LUFKIN, GRADUATED IN 0.10 INCH	ANY SOURCE
25-POUND SPRING SCALE	1	CHATILLION	ANY SOURCE
INCLINOMETER	1	HIGHER - MODEL TB108	ANY SOURCE
WING INCLINOMETER SUPPORT	1	SEE DETAILS IV, V, VI AND VII	FABRICATE
HORIZONTAL STABILIZER INCLINOMETER SUPPORT	1	SEE DETAILS IV, V, VI AND VII	FABRICATE
MASKING TAPE	1	_____	ANY SOURCE
SQUARE	1	_____	ANY SOURCE
TOW RING TARGET	1	SEE DETAIL I	FABRICATE
POINTER	1	SEE DETAIL II AND III	FABRICATE

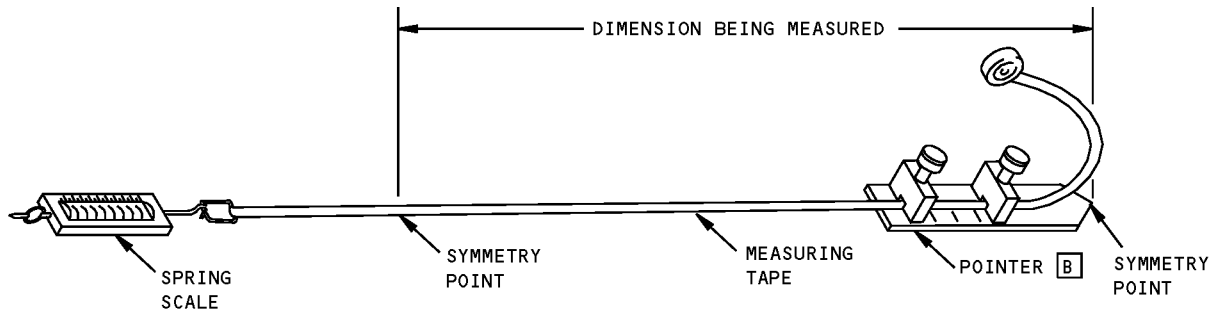
LIST OF EQUIPMENT
TABLE I



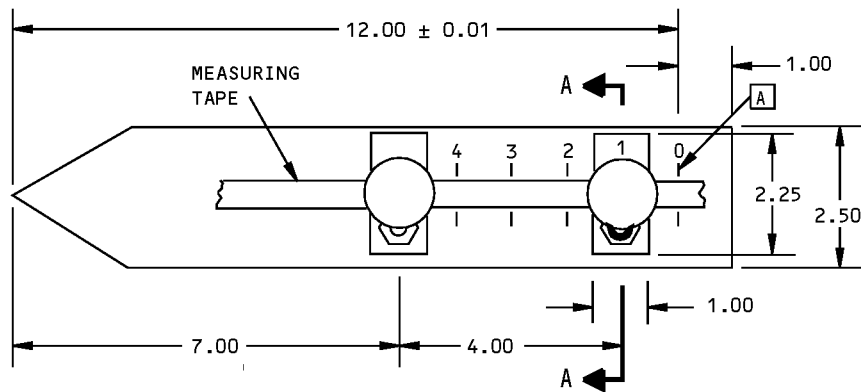
TOW RING TARGET
DETAIL I

Symmetry and Incidence Check Equipment
Figure 4 (Sheet 1 of 4)

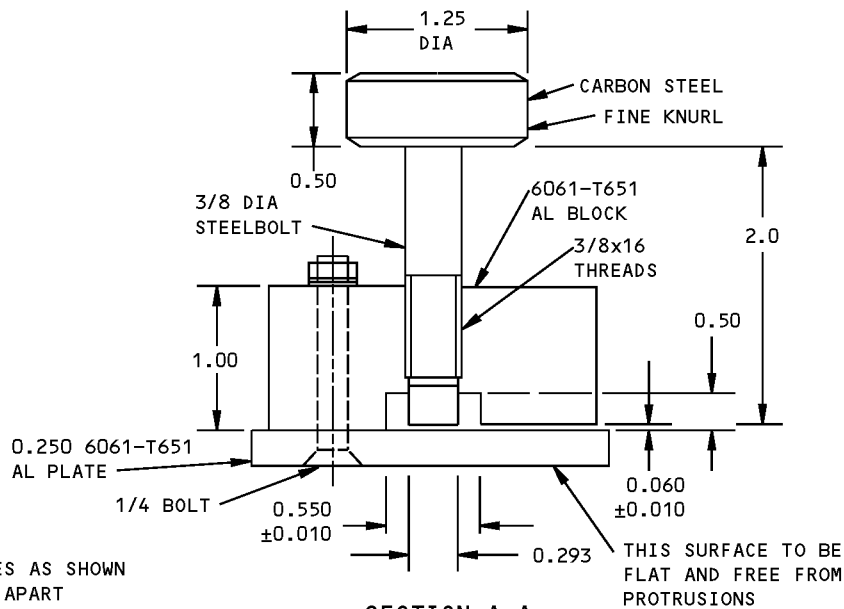
757-200 STRUCTURAL REPAIR MANUAL



MEASURING TAPE ASSY
DETAIL II



POINTER
DETAIL III



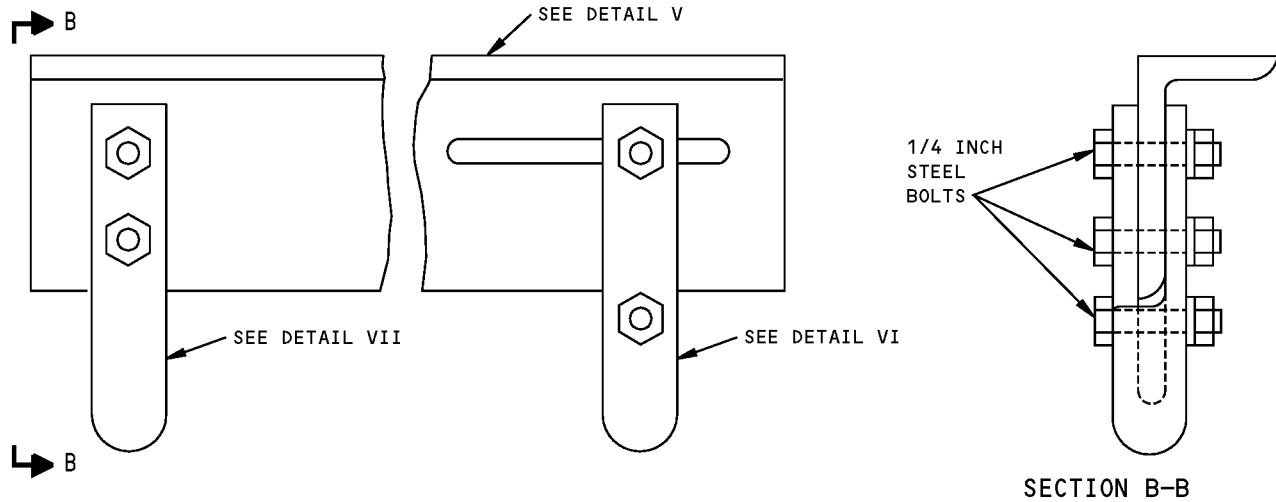
NOTES

- [A] SCRIBE FIVE LINES AS SHOWN
ONE INCH ± 0.01 APART
- [B] USE BOEING TOOL NO. ZPTFT012T2200
OR MANUFACTURE LOCALLY PER
DETAIL III

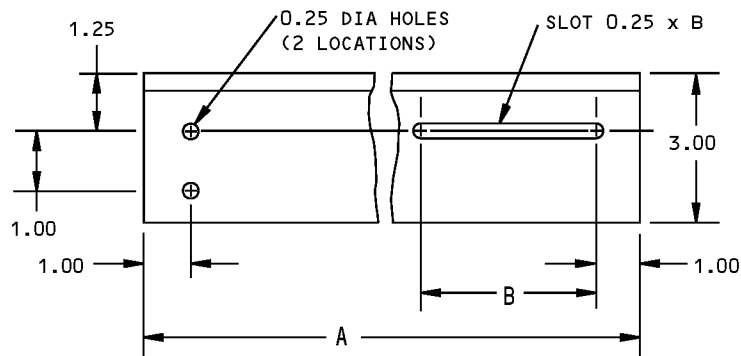
SECTION A-A
ROTATED 90° CW

Symmetry and Incidence Check Equipment
Figure 4 (Sheet 2 of 4)

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DETAIL IV



SEE TABLE II FOR A AND B DIMS.

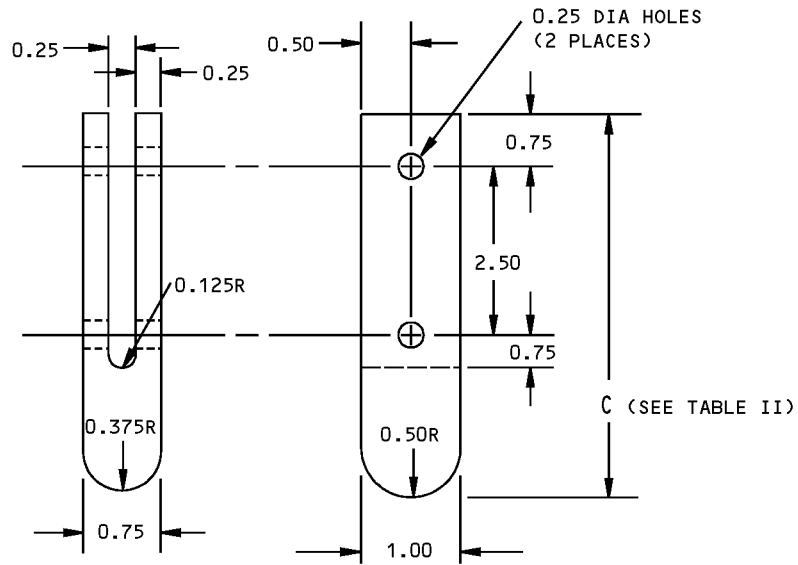
MAKE FROM AND10134-3002
7075-T6 OR 2024-T3
DETAIL V

ASSEMBLY	A	B	C
WING	118.00	41.00	8.00
HORIZONTAL STABILIZER	46.00	19.00	5.00

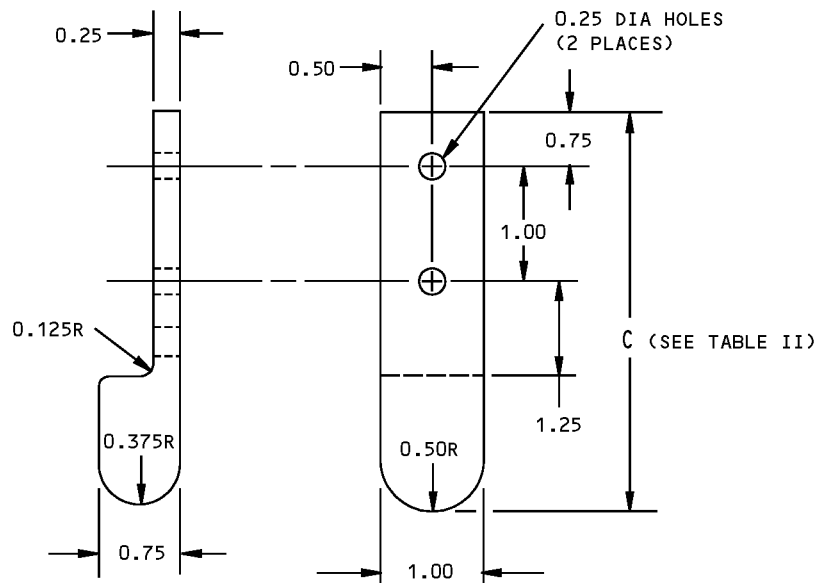
TABLE II

Symmetry and Incidence Check Equipment
Figure 4 (Sheet 3 of 4)

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STRUCTURAL REPAIR MANUAL



MAKE FROM MILD STEEL
ITEM 3
DETAIL VI



MAKE FROM MILD STEEL
ITEM 4
DETAIL VII

Symmetry and Incidence Check Equipment
Figure 4 (Sheet 4 of 4)



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STRUCTURAL REPAIR MANUAL

DIMENSION	MAXIMUM NORMAL SYMMETRY DIFFERENCE
A	1.50
B	1.30
C	1.30
D	1.30
E	1.50
F	1.00
G	1.00
H	1.00
J	1.20
K	1.50
I1	0° - 20'
I2	0° - 20'

Symmetry and Incidence Differences
Figure 5



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STRUCTURAL REPAIR MANUAL

GENERAL - SUPPORT OF AIRPLANE FOR REPAIRS

1. General

- A. This section provides the procedures necessary to support the airplane in jig position prior to making major repairs on the fuselage, wing, and empennage.
- B. Refer to AMM 07-11-01 for jacking procedures.
- C. Refer to AMM 08-21-00 for airplane leveling.
- D. Refer to Figure 1/GENERAL for jack locations and support equipment locations.
- E. Refer to Figure 2/GENERAL for maximum allowable loads on support equipment.
- F. Refer to Figure 3/GENERAL for specifications necessary to construct support equipment.
- G. Refer to Figure 4/GENERAL for alignment point locations.

2. References

Reference	Title
AMM 07-11-01	Aircraft Maintenance Manual
AMM 08-21-00	Aircraft Maintenance Manual
AMM 28-26-00	Aircraft Maintenance Manual

3. Support of Fuselage in Jig Position

- A. Jack the airplane as given in AMM 07-11-01.
- B. Level the airplane laterally and longitudinally. Refer to AMM 08-21-00 for location of plumb bob attach point and leveling scale.
- C. Install fuselage cradle supports.
 - (1) Make fuselage cradles and support structure from the specifications in Figure 3/GENERAL if they are not already existing.
 - (2) Position jigs under fuselage at the locations specified in Figure 1/GENERAL.

NOTE: Remove the wing-to-body fairing where interference with cradles exists.

- (3) Raise the support cradles until contact is made with fuselage skin.
- D. Align the fuselage.

WARNING: PRIMARY FUSELAGE JACKS MUST NOT BE REMOVED AT ANY TIME WHILE AIRPLANE IS SUPPORTED IN JIG POSITION. MAXIMUM ALLOWABLE LOADS FOR SUPPORTS WILL BE EXCEEDED. REFER TO FIGURE 2, TABLES I, II, AND III FOR MAXIMUM ALLOWABLE LOADS.

- (1) Raise the supplementary supports so that the supports are carrying a portion of the load that was carried by the jacks. Do not exceed the maximum allowable loads for support equipment. Refer to Figure 2/GENERAL, Tables I, II and III.

NOTE: The stabilization jack at point D may be removed as an option.

- (2) Establish a reference plane slightly below alignment point BF. Refer to Figure 4/GENERAL for location of alignment points. Use an engineers level or equivalent.
 - (3) Measure the distance between point BF and the reference plane. Record the distance.
 - (4) Measure the distance between point BA and the reference plane. Determine the height of point BA above point BF and compare to Figure 4/GENERAL, Table I. Do the same for point BB.

STRUCTURAL REPAIR MANUAL

- (5) Adjust cradle support height until point BA is at the height above point BF as specified in Figure 4/GENERAL, Table I.

NOTE: Slight deviations may be corrected by adjusting the support at a frame forward of, or at BS 900. Larger deviations may be corrected by adjusting supports at both the forward and aft body sections and jacks at points B and C. In all cases, ensure that jacks at locations A, B, and C remain seated so that the maximum allowable loads for the support equipment as specified in Figure 2/GENERAL, Table I, are not exceeded.

- (6) Measure the distance between point BP and the reference plane. Determine the height that point BP is above point BF. Compare that value to the value in Figure 4/GENERAL, Table I.
- (7) Adjust the cradle support at a frame aft of or at BS 1180 until point BP is at the height above point BF as required per Figure 4/GENERAL, Table I. Do not exceed the maximum allowable load for support equipment as given in Figure 2/GENERAL, Table I.
- (8) Measure the distance between point BR and the reference plane. Determine the height of point BR above point BF and compare to the value given in Figure 4/GENERAL, Table I.
- (9) If point BR is slightly out of alignment but point BP is in alignment, adjust BR by installing the horizontal stabilizer supports at stabilizer sta 176.25. Do not exceed the maximum allowable loads for support equipment as given in Figure 2/GENERAL, Tables I, II, and III.
- (10) Recheck the distance between point BF and reference plane. If measurement is different from the original reading, repeat steps (3) thru (9).
- (11) If point BF measurement is still the same as the initial measurement, recheck points BA, BP, and BR. Make small adjustments to support equipment to bring these points into alignment (Ref: steps (4) thru (9)).
- (12) After completion of repairs, clear work area of checkstands, tools and equipment. Raise the primary jacks at points A, B, and C until all the weight is carried by the jacks. Lower supports and clear supports from the work area. Reinstall jack at point D if previously removed, prior to removing the supports.
- (13) Refer to AMM 07-11-01 for procedures to lower the airplane down from jacks.

4. Support of Wing in Jig Position

- A. Defuel the airplane. Refer to AMM 28-26-00.
- B. Jack the airplane. Refer to in AMM 07-11-01.
- C. Level the airplane laterally and longitudinally. Refer to AMM 08-21-00.
- D. Install wing cradle supports.
- (1) Make wing cradle supports as given in Figure 3/GENERAL as needed.
- (2) Position the supports under the wings at the locations specified in Figure 1/GENERAL.
- (3) Raise the supports until contact is made with wing surface.
- E. Align the wing.

NOTE: When making structural repairs in vicinity of engine strut attach structure, it may be necessary to remove engines.

757-200 STRUCTURAL REPAIR MANUAL

WARNING: PRIMARY FUSELAGE JACKS MUST NOT BE REMOVED AT ANY TIME WHILE AIRPLANE IS SUPPORTED IN JIG POSITION. MAXIMUM ALLOWABLE LOADS FOR SUPPORTS WILL BE EXCEEDED. REFER TO FIGURE 2/GENERAL, TABLES I, II, AND III FOR MAXIMUM ALLOWABLE LOADS.

- (1) Raise the supports so that they are carrying a portion of the load carried by the jacks. Do not exceed the maximum allowable loads for support as specified in Figure 2/GENERAL, Table II.
- (2) Establish a reference plane below the wing surface using an engineer's level or equivalent.
- (3) Measure the distance from point WB to the reference plane. Refer to Figure 4/GENERAL, Table II for wing alignment point locations.
- (4) Take measurements at points WC and WD. Adjust the support at W.S. 397.5 until these two points are at or near the specified height above point WB as specified in Figure 4/GENERAL, Table II.
- (5) Take measurements at points WE, WF, WG, and WH. Adjust the support at W.S. 623.5 until these points are at or near the specified height above point WB per Figure 4/GENERAL, Table II.
- (6) Recheck alignment point WB to ensure that the distance from WB to the reference plane has not changed. If it has changed use the new measurement to make final wing support adjustments.
- (7) Take measurements at the remaining alignment points. Adjust the supports as necessary to bring points into alignment per Figure 4/GENERAL, Table II.
- (8) After completion of repair, clear work area of checkstands, tools and equipment.
- (9) Lower wing support cradles simultaneously until all the weight is resting on the primary jacks at points A, B, and C, and there is enough clearance between supports and lower wing surface to remove supports from beneath the wings.
- (10) Refer to AMM 07-11-01 for procedures to lower the airplane down from jacks.

5. **Support of Horizontal Stabilizer in Jig Position**

- A. Set stabilizer trim to the neutral position.
- B. Jack the airplane as given in AMM 07-11-01.
- C. Level the airplane laterally and longitudinally. Refer to AMM 08-21-00.
- D. Construct the support jigs as shown in Figure 3/GENERAL if not already existing.
- E. Position support jigs under stabilizer. See to Figure 1/GENERAL.

NOTE: Both left and right stabilizer supports must be raised and lowered at the same time.

- F. Align the stabilizers.

- (1) Establish a reference plane below the stabilizer lower surface.
- (2) Measure the distance from point HB to the reference plane.
- (3) Measure the distance from points HA and HC to the reference plane.
- (4) Adjust the stabilizer supports until the alignment points are at the height above point HB as specified in Figure 4/GENERAL, Table III. Do not exceed maximum loads. See Figure 2/GENERAL, Table III for maximum allowable loads.

NOTE: If only one stabilizer is to be repaired, it is not necessary to get the other stabilizer into exact alignment. However, it must be supported to prevent twisting of the fuselage.

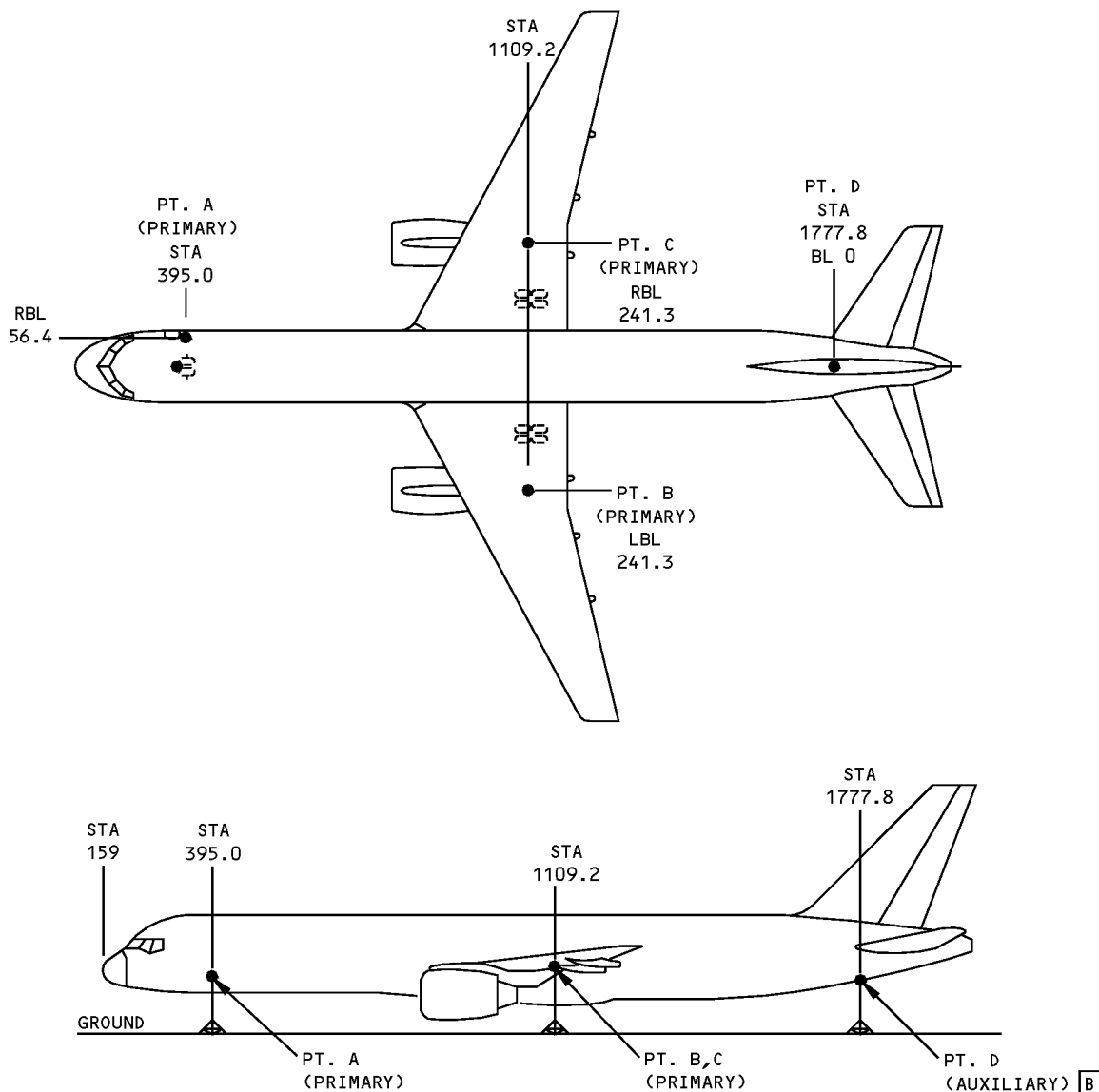
- (5) After completion of repair, clear work area of workstands, equipment and tools.
- (6) Slowly release pressure from stabilizer supports until stabilizer is free from supports and supports have enough clearance to be moved away from the stabilizer.



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STRUCTURAL REPAIR MANUAL

- (7) Refer to AMM 07-11-01 for lowering airplane down from jacks.

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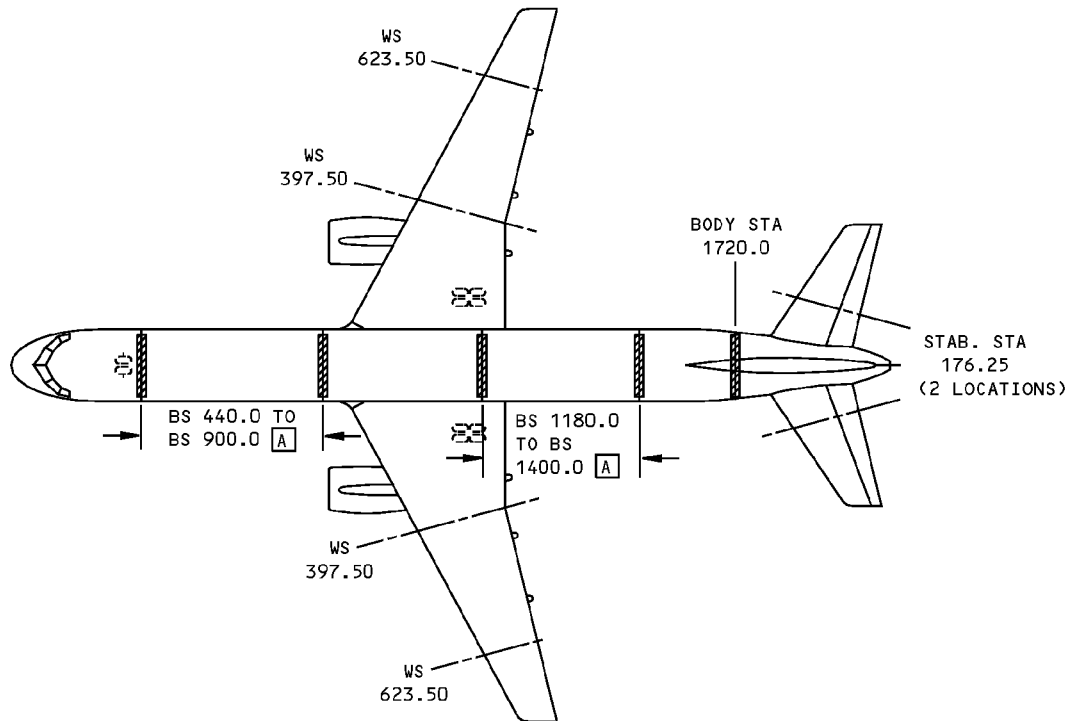
PRIMARY AND AUXILIARY JACK POINT LOCATIONS
DETAIL I

NOTES

- REFER TO 07-11-01 OF THE 757 MAINTENANCE MANUAL FOR JACKING PROCEDURES
- A** REMOVE WING-TO-BODY FAIRING AS REQUIRED
- B** INSTALL JACK AT POINT D WHEN STABILIZATION IS REQUIRED

Location of Jacking Points and Support Equipment for Airplane in Jig Position
Figure 1 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



SUPPLEMENTARY SUPPORT EQUIPMENT LOCATION
DETAIL II

ITEM	NO. REQ'D	MATERIAL/DESCRIPTION	SOURCE
FUSELAGE SUPPORT JIGS AND CRADLES	AT LEAST 4	SEE FIG. 3, DETAILS I THRU VIII	FABRICATE
WING AND HORIZONTAL STABILIZER JIGS	6	SEE FIG. 3, DETAILS IX AND X	FABRICATE
SCREW JACK OR HYDRAULIC JACK	2 REQ'D FOR EACH SUPPORT	10 TON AUTOMOTIVE JACK - SEE FIG. 3	ANY SOURCE

PROCURE EQUIPMENT
TABLE I

Location of Jacking Points and Support Equipment for Airplane in Jig Position
Figure 1 (Sheet 2 of 2)



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STRUCTURAL REPAIR MANUAL

SUPPLEMENTARY SUPPORT LOCATION	MAXIMUM ALLOWABLE LOAD IN JIG POSITION (POUNDS)
BS 440 TO BS 900 AND BS 1180 TO BS 1400	A
BODY STATION 1720.0	4,000

FUSELAGE SUPPLEMENTARY SUPPORT LOADS
TABLE I

SUPPLEMENTARY SUPPORT LOCATION	MAXIMUM ALLOWABLE LOAD IN JIG POSITION (POUNDS)
WING STATION 397.5	5,000
WING STATION 623.5	5,000

WING SUPPLEMENTARY SUPPORT LOADS
TABLE II

SUPPLEMENTARY SUPPORT LOCATION	MAXIMUM ALLOWABLE LOAD IN JIG POSITION (POUNDS)
HORIZONTAL STABILIZER STATION 176.25	1,000

STABILIZER SUPPLEMENTARY SUPPORT LOADS
TABLE III

NOTE

- A** WITHIN THE CONSTANT CROSS SECTION (BS 440 TO BS 900 AND BS 1180 TO 1400) CRADLES MAY BE CENTERED ON ANY FRAME AND LOADED TO A MAXIMUM OF 5,000 LBS. USE A MINIMUM OF 4 CRADLES

Maximum Loads on Jacks and Supplementary Supports
Figure 2



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STRUCTURAL REPAIR MANUAL

BODY STATION 440.0 TO BODY STATION 900.0		BODY STATION 1180.0 TO BODY STATION 1400.0 <input type="checkbox"/>		BODY STATION 1720.0	
X (DIM) BBL	Y (DIM) BWL	X (DIM) BBL	Y (DIM) BWL	X (DIM) BBL	Y (DIM) BWL
0.0	0.0	0.0	0.0	0.0	0.0
1.5	0.0	2.2	0.0	1.9	0.0
3.0	0.1	4.3	0.1	4.5	0.2
5.2	0.2	6.4	0.3	6.4	0.4
7.4	0.4	8.5	0.5	8.3	0.6
9.6	0.6	10.6	0.8	10.2	0.9
11.0	0.8	12.7	1.1	12.1	1.3
13.2	1.2	14.0	1.4	14.0	1.7
15.4	1.6	16.0	1.9	16.6	2.4
17.5	2.1	18.1	2.4	18.4	3.0
18.9	2.4	20.0	2.9	20.3	3.7
21.0	3.0	22.6	3.8	22.1	4.4
23.1	3.6	24.6	4.5	24.0	5.2
25.1	4.3	26.4	5.3	26.4	6.3
27.2	5.1	28.3	6.1	28.1	7.2
29.2	5.9	30.1	7.0	29.9	8.2
31.1	6.8	32.6	8.3	32.2	9.6
33.1	7.7	34.3	9.3	33.3	10.4
35.0	8.7	36.0	10.4	34.4	11.2
36.8	9.8	38.3	11.9	35.6	12.0
38.1	10.5	40.6	13.6	36.6	12.8
39.9	11.6	42.2	14.9	38.3	14.1
43.4	14.0	44.3	16.7	40.4	15.9
46.2	16.2	46.4	18.6	42.3	17.5
47.8	17.6	47.8	20.1	44.0	19.2

COORDINATES FOR FUSELAGE CRADLE SUPPORTS
TABLE I

Construction of Cradle Support Equipment
Figure 3 (Sheet 1 of 8)



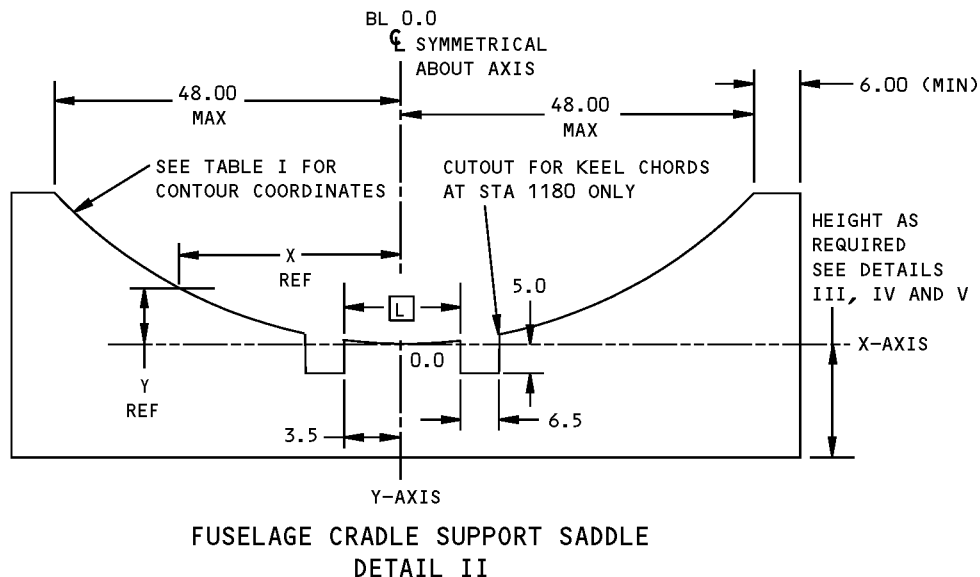
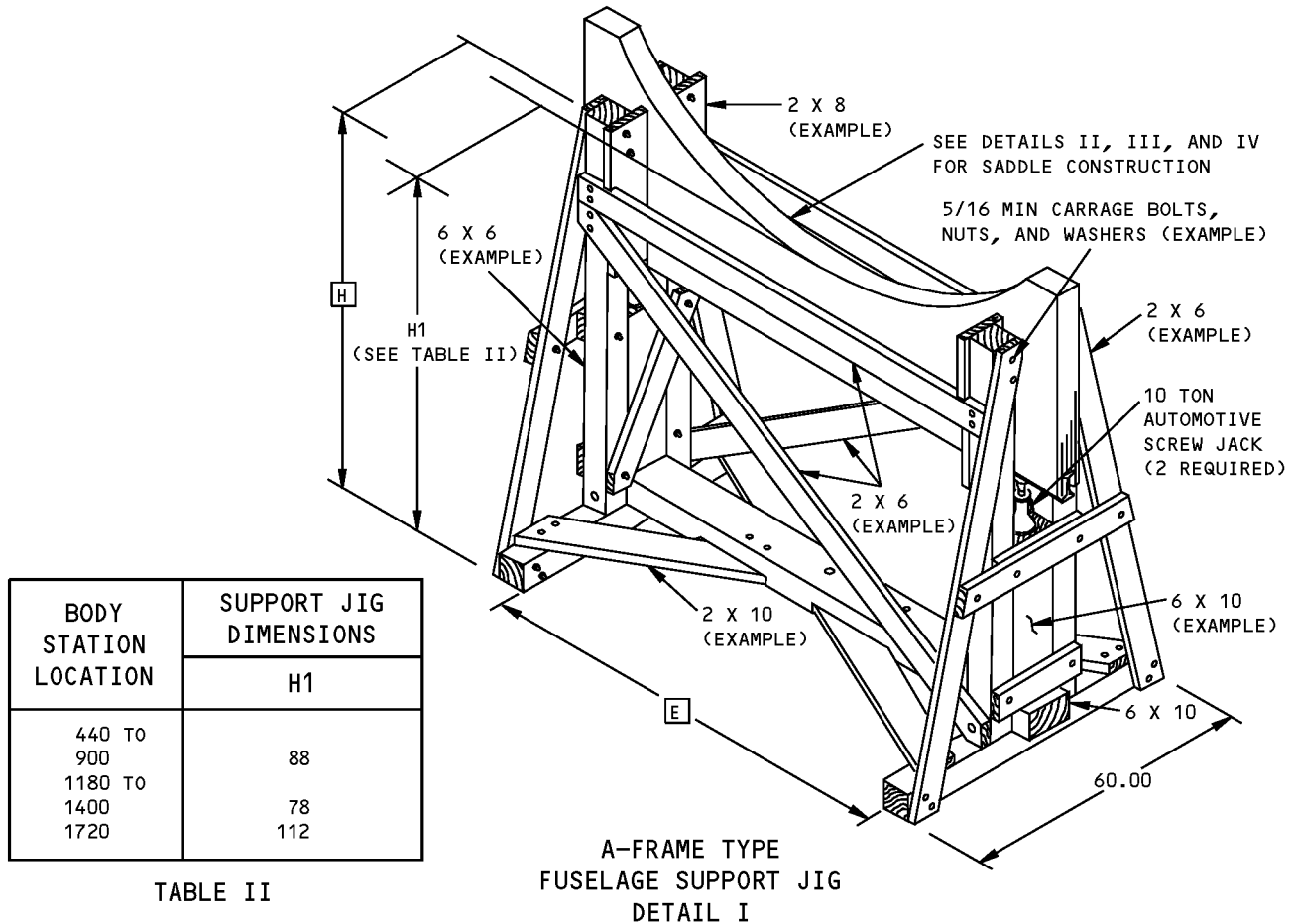
757-200 STRUCTURAL REPAIR MANUAL

NOTES

- PROCURE CLEAR LUMBER FREE FROM KNOTS, SHAKES OR CHECKS WITH PHYSICAL PROPERTIES EQUIVALENT TO STRUCTURAL GRADE DOUGLAS FIR, WEST COAST REGION. SIZES ARE AMERICAN LUMBER STANDARDS – SURFACE FOUR SIDES.
- [A] MINIMUM SIZE – 8 IN. X 10 IN. TIMBER
- [B] COORDINATES ORIGINATE AT REAR SPAR AND END AT FRONT SPAR.
- [C] ALL CRIBBING BELOW CROSS BEAMS CAN BE ANY AVAILABLE TIMBER NOT LESS THAN 6 IN. X 6 IN.
- [D] SPACING OF LOWEST TIMBERS DEPENDS UPON BEARING STRENGTH OF GROUND SURFACE. IF NOT ON CONCRETE USE SOLID ROWS OF TIMBERS SEVERAL LAYERS HIGH.
- [E] EQUAL TO CONTOURED PORTION OF CRADLE.
- [F] PAD WITH 1/2 INCH THICK FELT OR RUBBER AND COVER WITH 10 OZ. CANVAS DUCK.
- [G] CONSTRUCT WITH FIVE 1.0 INCH THICK, AB GRADE OR BETTER, EXTERIOR PLYWOOD.
- [H] HEIGHT OF FRAMING AT STA 900 AND 1180 TO BE DETERMINED BY THE NEED TO CLEAR WING-TO-BODY FAIRINGS.
- [I] DIMENSION TO FIT SNUG AROUND 6 X 6 COLUMN.
- [J] DIMENSION H1 INCREASES WHEN AIRPLANE IS ON PRIMARY JACKS.
- [K] SEE DETAIL II FOR KEEL CHORD EXTENSION CUTOUTS IF REQUIRED.
- [L] ADDITIONAL CLEARANCE REQUIRED FOR TOILET DRAIN FITTING ON FOUR-DOOR MODELS ONLY.
- [M] TO MAKE A STABILIZER CRADLE, USE 164.0 INCHES FOR THIS DIMENSION. TO USE A WING CRADLE AS A STABILIZER CRADLE, ADD 20 INCHES OF LUMBER BELOW THE BASE.

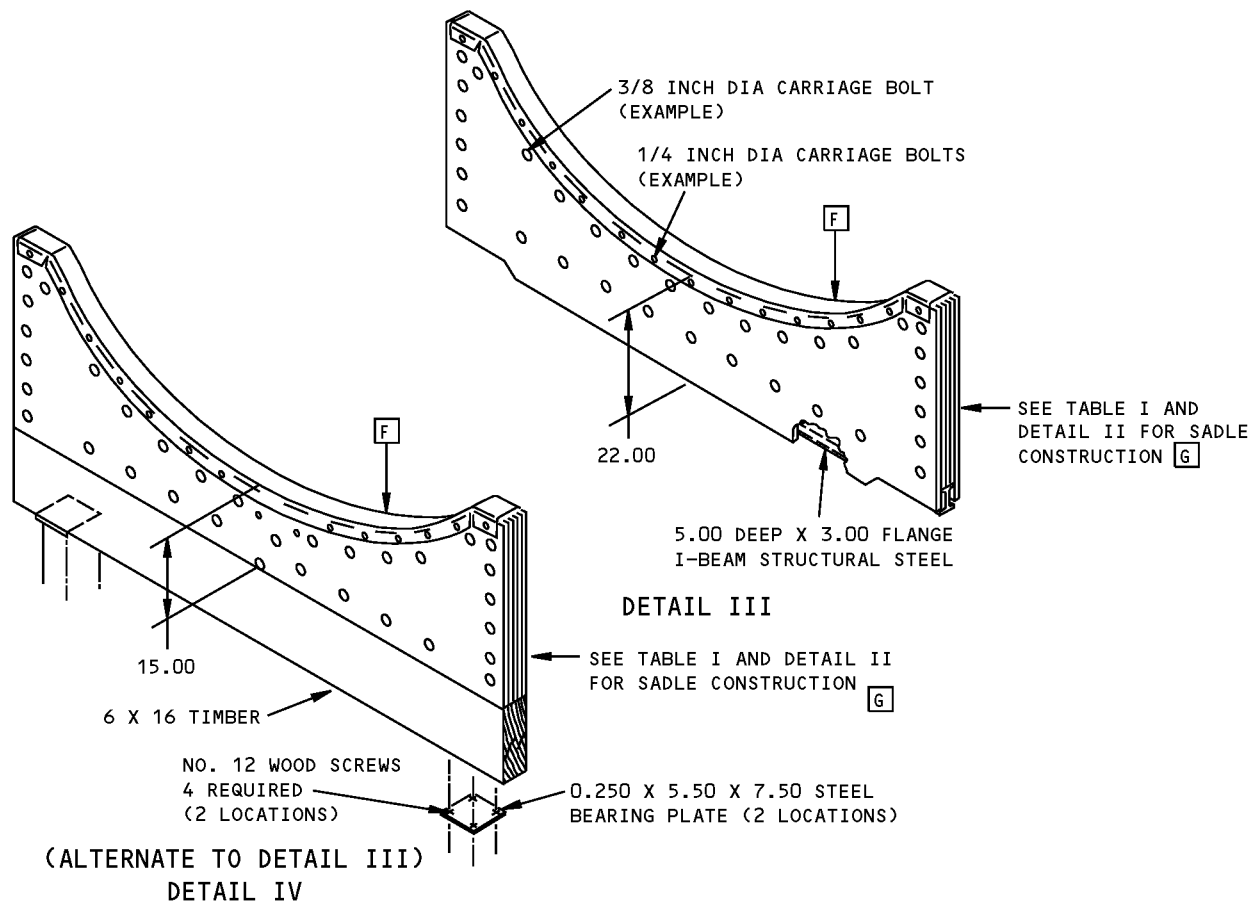
**Construction of Cradle Support Equipment
Figure 3 (Sheet 2 of 8)**

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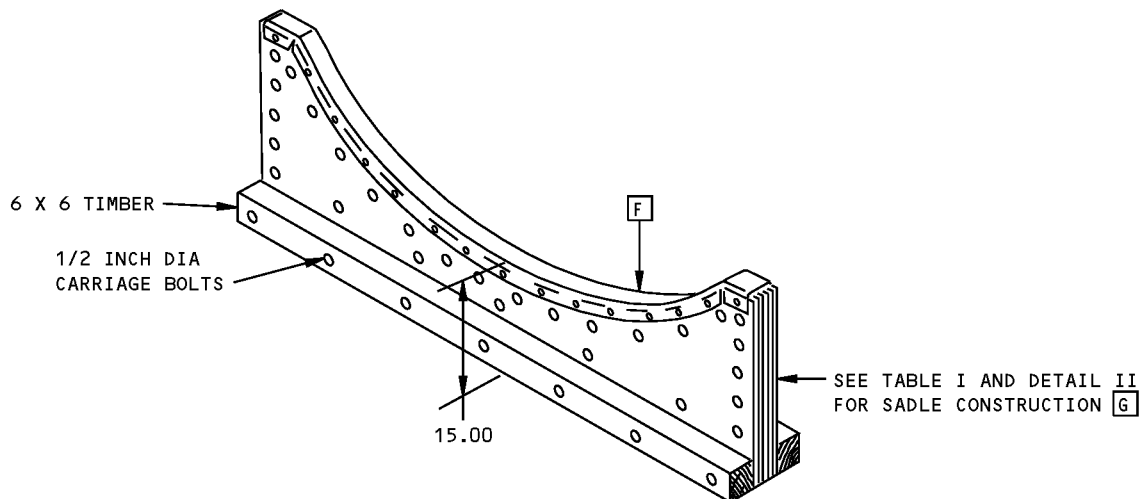


**Construction of Cradle Support Equipment
Figure 3 (Sheet 3 of 8)**

757-200 STRUCTURAL REPAIR MANUAL



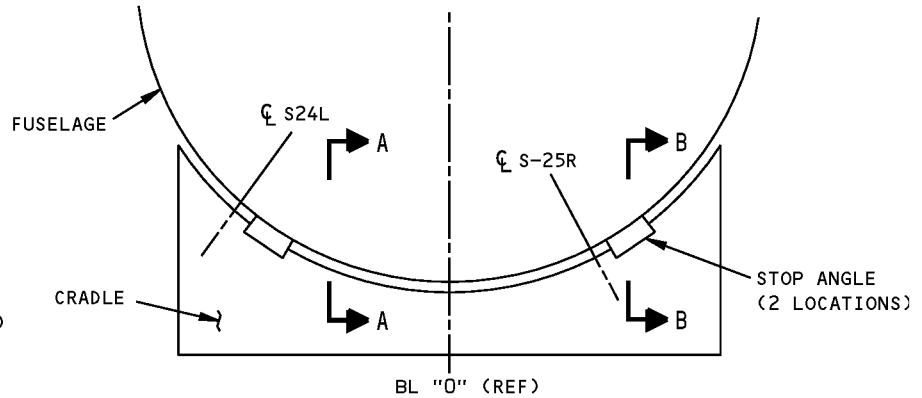
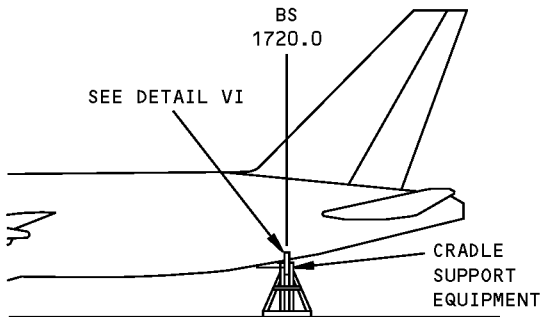
CRADLES FOR USE WITH A-FRAME TYPE STRUCTURE



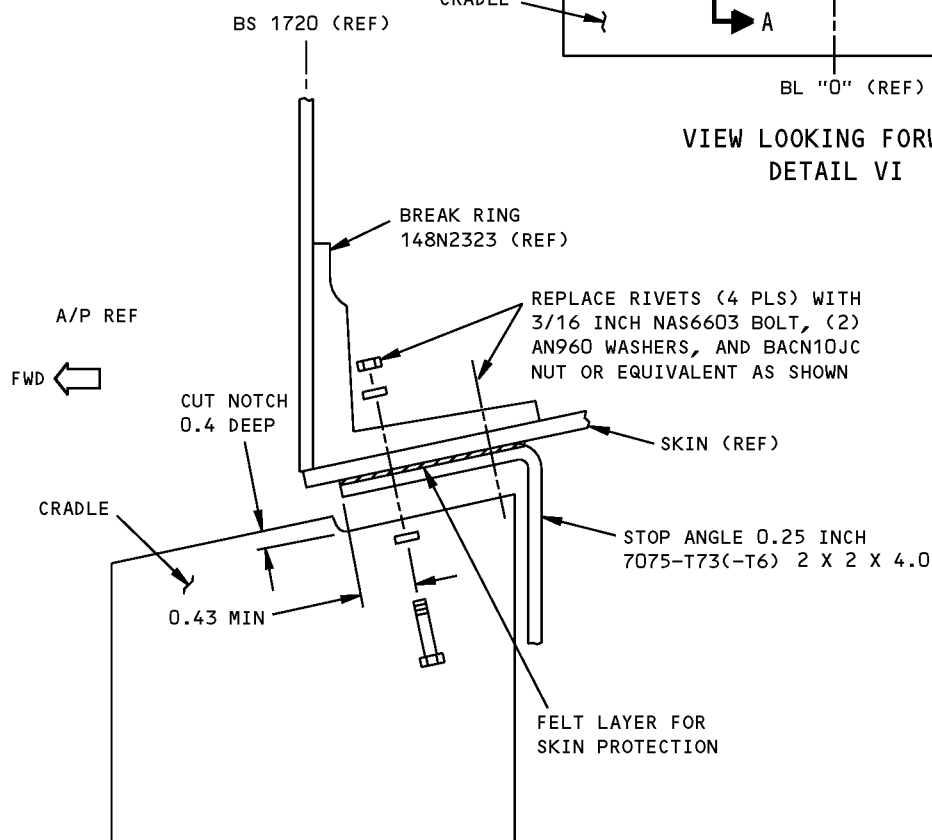
CRADLE FOR USE WITH CRIBBING DETAIL V

Construction of Cradle Support Equipment Figure 3 (Sheet 4 of 8)

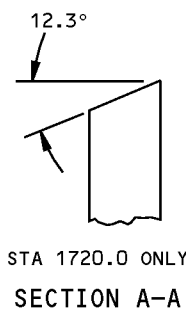
757-200 STRUCTURAL REPAIR MANUAL



VIEW LOOKING FORWARD
DETAIL VI

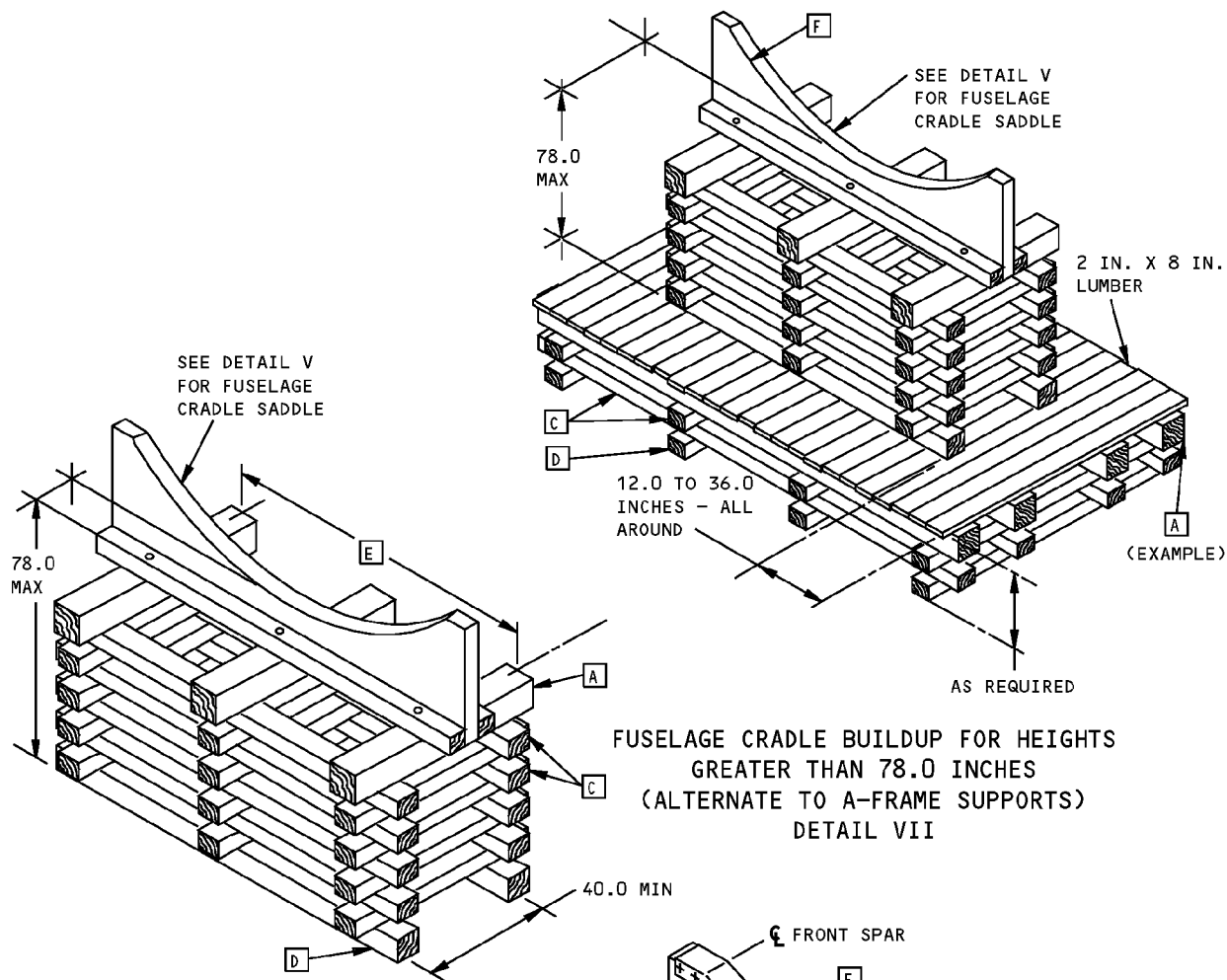


SECTION B-B

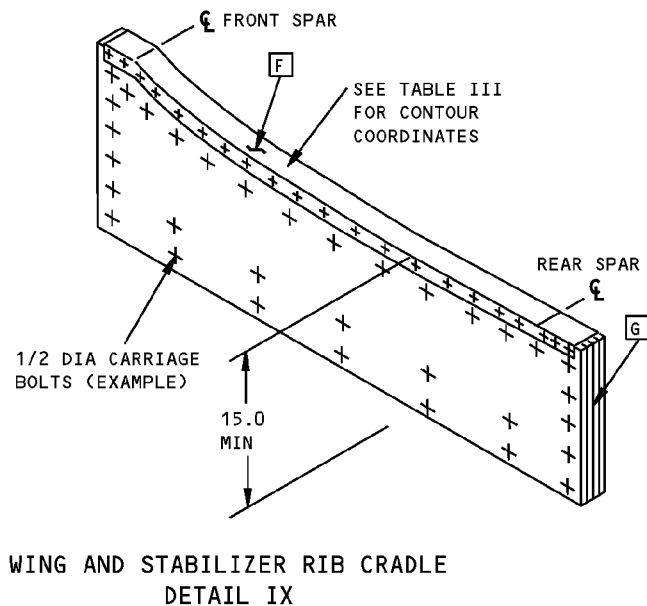


Construction of Cradle Support Equipment
Figure 3 (Sheet 5 of 8)

757-200 STRUCTURAL REPAIR MANUAL

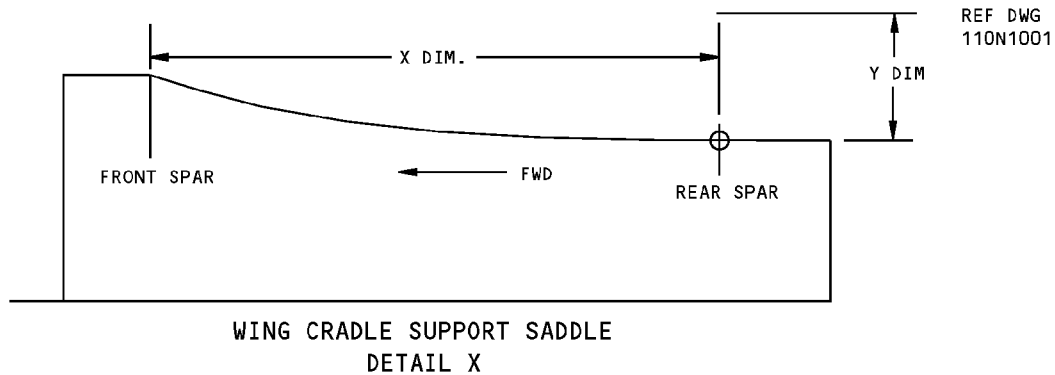


FUSELAGE CRADLE BUILDUP FOR HEIGHTS UP TO 78.0 INCHES (ALTERNATE TO A-FRAME SUPPORT) DETAIL VIII



Construction of Cradle Support Equipment
Figure 3 (Sheet 6 of 8)

757-200 STRUCTURAL REPAIR MANUAL



WING STATION 397.50	
X DIM	Y DIM
0	0
0.4	-0.04
2.1	-0.25
3.8	-0.45
5.7	-0.65
8.6	-0.95
11.5	-1.23
14.4	-1.47
17.4	-1.70
20.4	-1.89
25.0	-2.14
29.7	-2.32
34.5	-2.44
39.4	-2.50
44.5	-2.49
49.6	-2.42
54.9	-2.28
60.3	-2.08
64.2	-1.89
69.9	-1.56
75.4	-1.18
79.2	-0.88
83.5	-0.52
88.3	-0.09
91.0	0.17
95.1	0.56

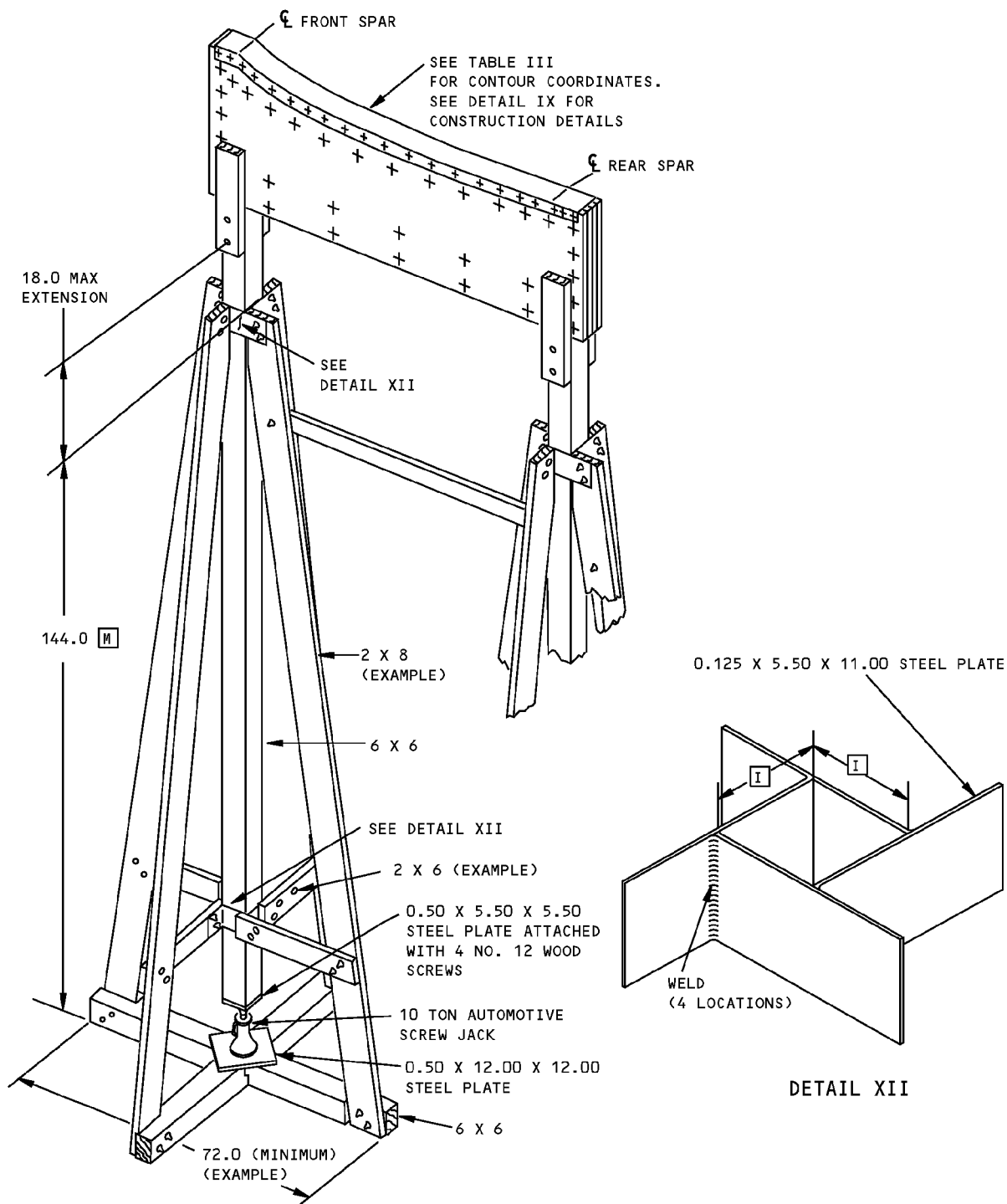
WING STATION 623.50	
X DIM	Y DIM
0.0	0.0
1.8	0.2
5.0	0.5
8.1	0.8
11.2	1.0
14.2	1.2
17.0	1.3
18.6	1.4
21.6	1.5
24.5	1.6
27.3	1.7
30.1	1.7
32.7	1.7
35.3	1.7
37.9	1.6
40.4	1.5
42.9	1.4
45.4	1.3
47.9	1.1
50.4	0.9
52.5	0.7

HORIZONTAL STAB. STATION 176..5	
X DIM	Y DIM
0.0	0.0
3.0	0.2
6.5	0.5
8.2	0.6
9.9	0.7
10.7	0.7
12.2	0.8
13.6	0.8
14.9	0.9
17.2	1.0
19.7	1.0
21.3	1.0
22.9	1.1
26.1	1.1
27.8	1.1
30.9	1.1
32.4	1.1
35.4	1.0
36.9	1.0
37.8	1.0

COORDINATES FOR WING AND STABILIZER CRADLE SUPPORTS [B]
TABLE III

Construction of Cradle Support Equipment
Figure 3 (Sheet 7 of 8)

757-200 STRUCTURAL REPAIR MANUAL

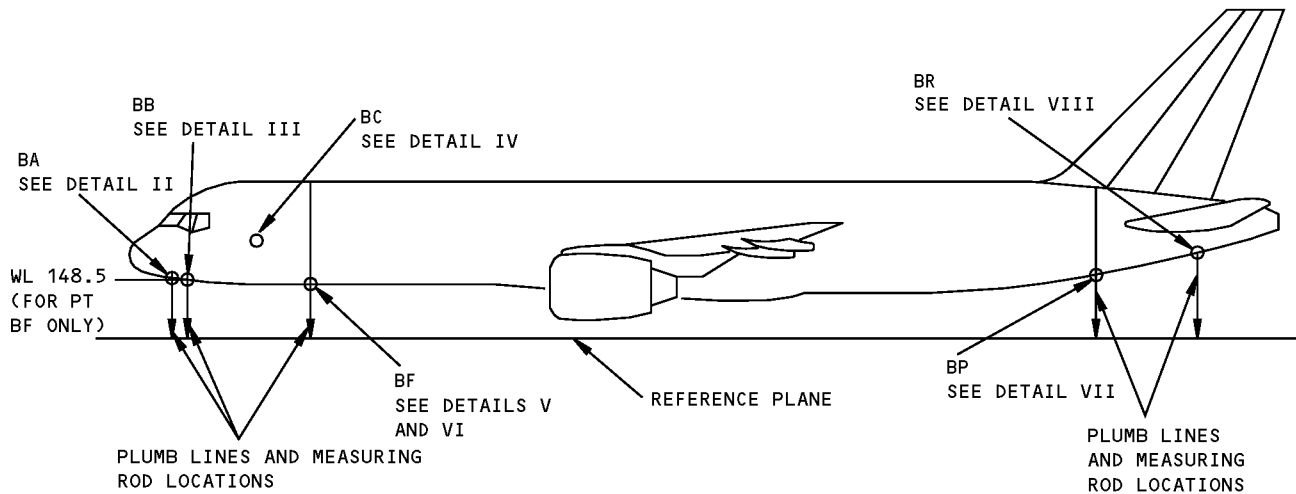


STRUCTURE FOR USE WITH WING AND STABILIZER CRADLES
DETAIL XI

Construction of Cradle Support Equipment
Figure 3 (Sheet 8 of 8)

757-200 STRUCTURAL REPAIR MANUAL

REFERENCE DRAWING
012N2201



DETAIL I

AIRPLANE EFFECTIVITY	ALIGNMENT CHECK POINT	BODY STATION	BODY WATER LINE	BODY BUTTOCK LINE	HEIGHT ABOVE ALIGNMENT POINT BF ± 0.05	
WITHOUT "TCAS STRUCTURAL PROVISION" [A]	BA	215.80	157.45	RBL 2.82	9.03	
	BB	254.06	152.44	RBL 3.02	4.02	
	BF	440.37	148.42	0.00	0.00	DATUM
	BP	1721.10	169.01	LBL 0.44	20.59	
	BR	1863.32	199.34	0.00	50.92	
	BC	288.50	218.35	66.40	69.93	
WITH "TCAS STRUCTURAL PROVISION" [A]	BA	215.80	157.45	RBL 2.82	9.12	
	BB	254.06	152.44	RBL 3.02	4.11	
	BF	440.37	148.33	0.00	0.00	DATUM
	BP	1721.10	169.01	LBL 0.44	20.68	
	BR	1863.32	199.34	0.00	51.01	
	BC	288.50	218.35	66.40	70.02	

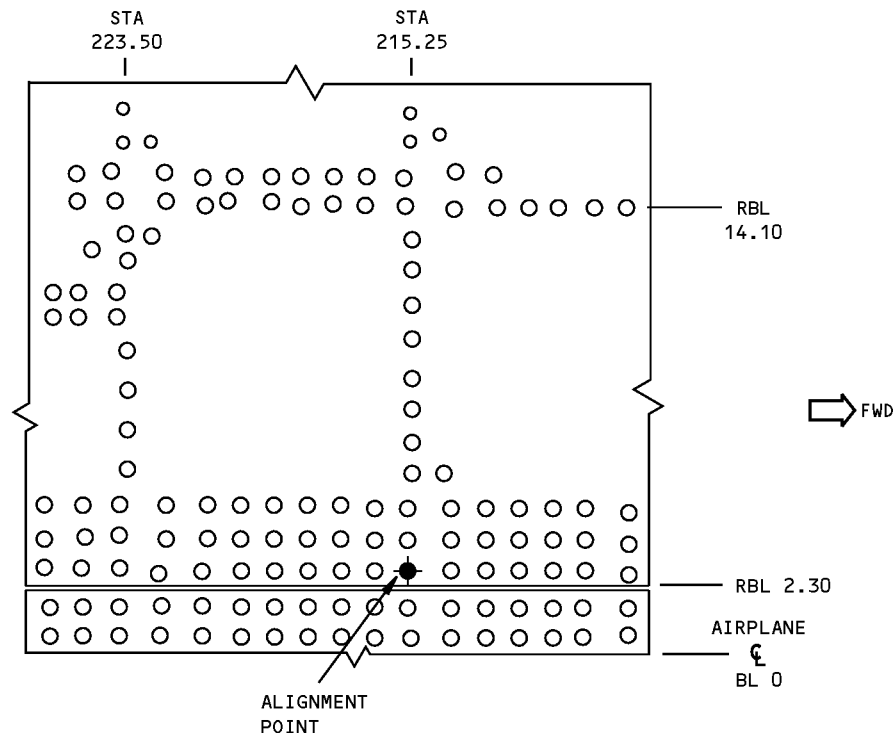
FUSELAGE ALIGNMENT POINT LOCATIONS
TABLE I

NOTE

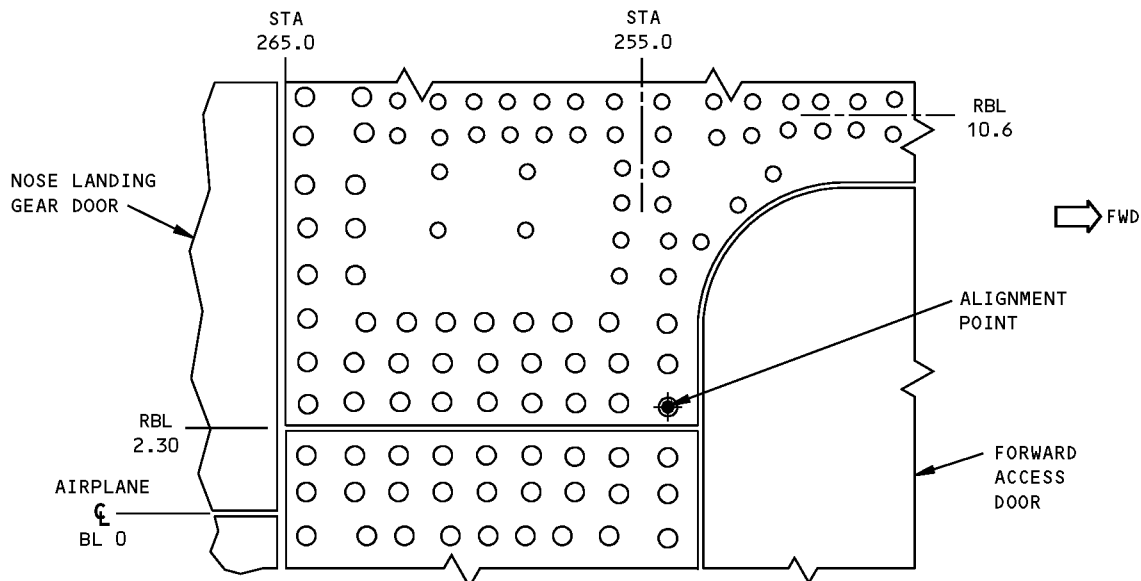
- [A] "TCAS STRUCTURAL PROVISION" INCLUDES AN ADAPTOR PLATE MOUNTED ON OUTSIDE SKIN SURFACE AT STA 440.37 AND BL 0.00 AS GIVEN IN DRAWING 143N3400

Airplane Alignment Points in Jig Position
Figure 4 (Sheet 1 of 12)

757-200 STRUCTURAL REPAIR MANUAL



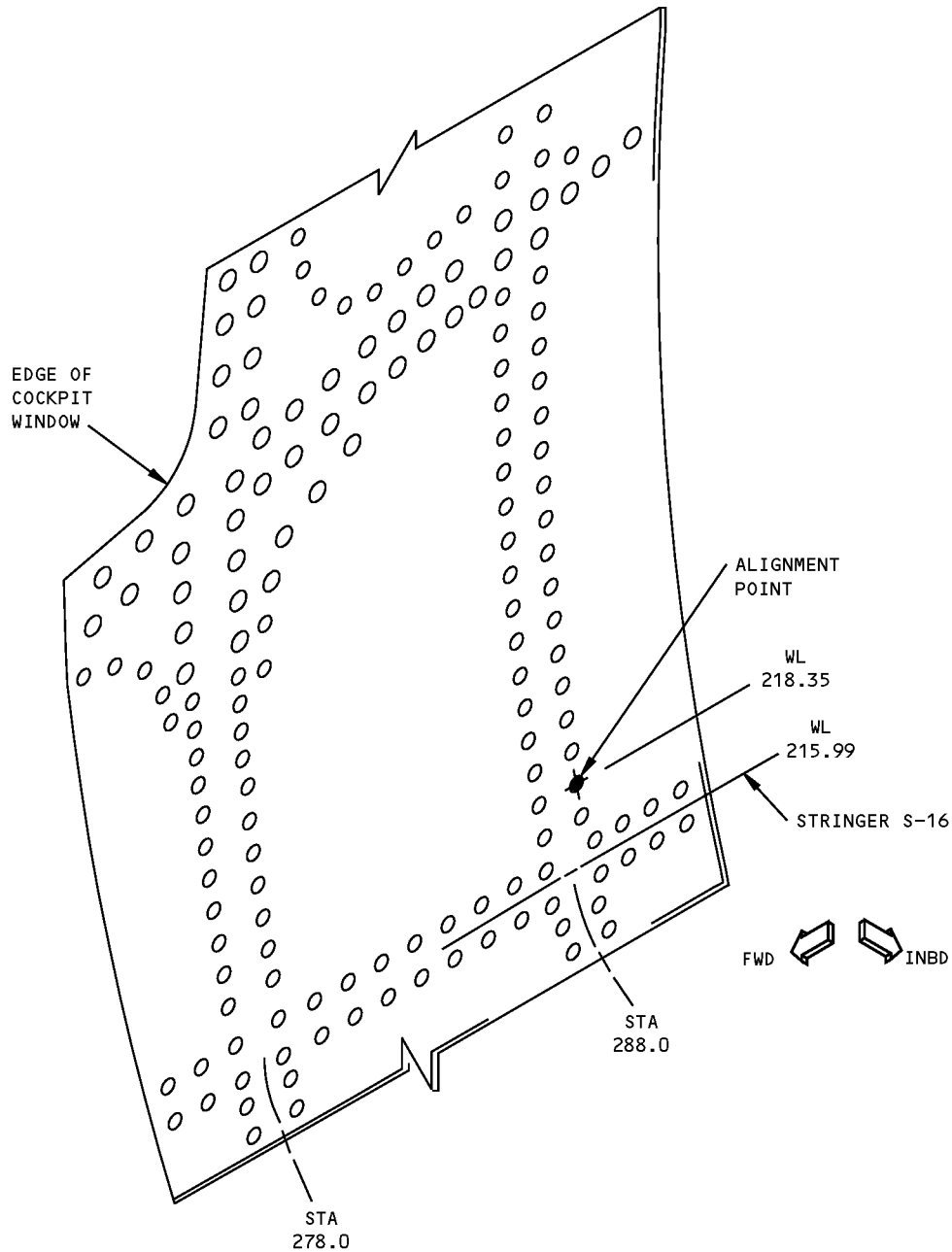
**BOTTOM VIEW OF FUSELAGE
POINT BA
DETAIL II**



**BOTTOM VIEW OF FUSELAGE
POINT BB
DETAIL III**

**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 2 of 12)**

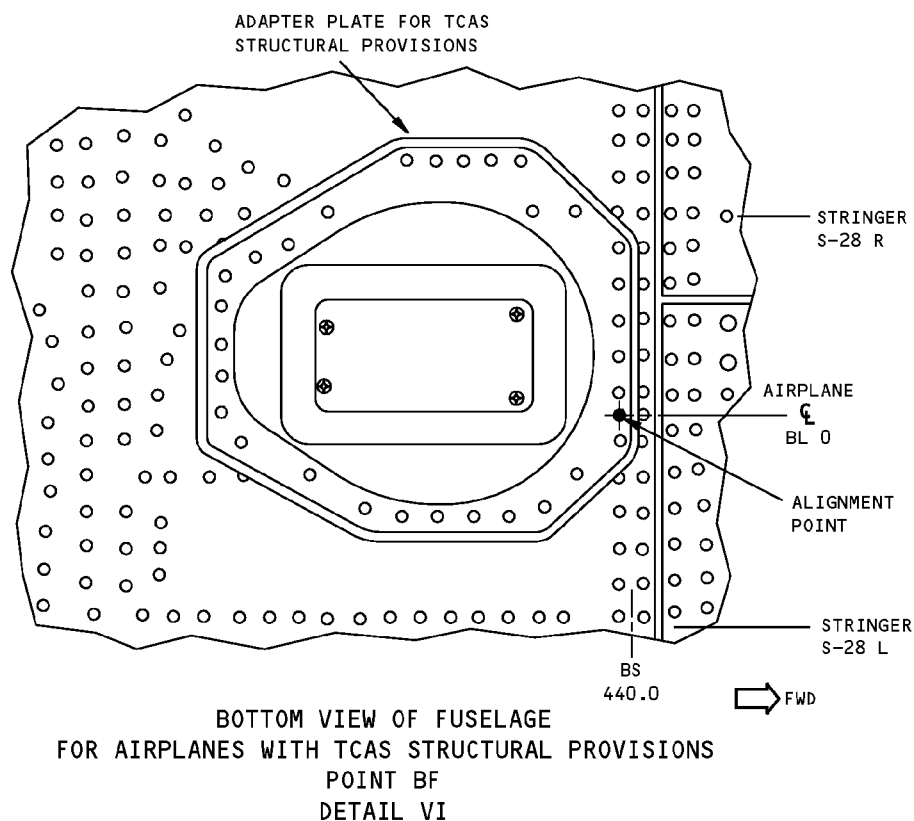
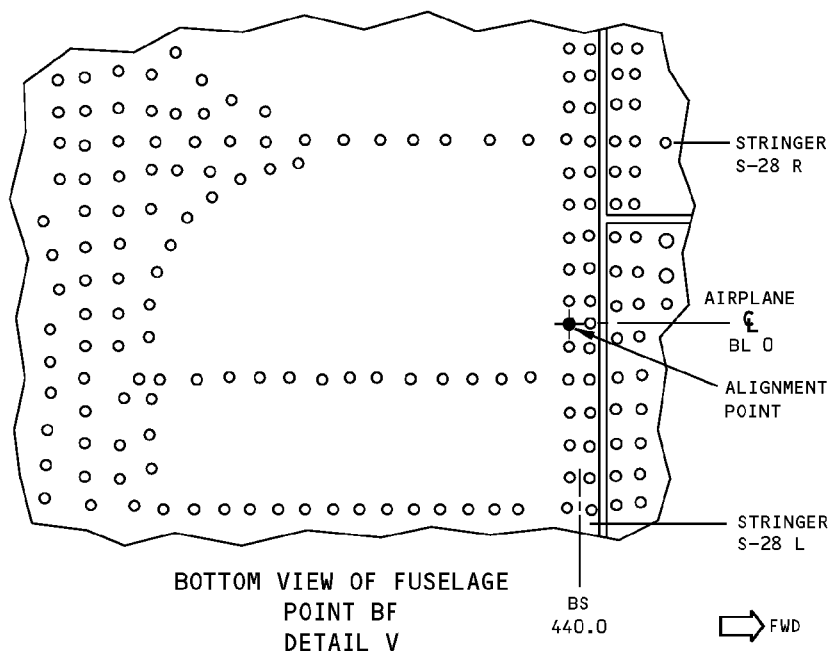
757-200
STRUCTURAL REPAIR MANUAL



LEFT SIDE VIEW OF FUSELAGE BELOW PILOTS AFT WINDOW
RIGHT SIDE OPPOSITE
POINT BC
DETAIL IV

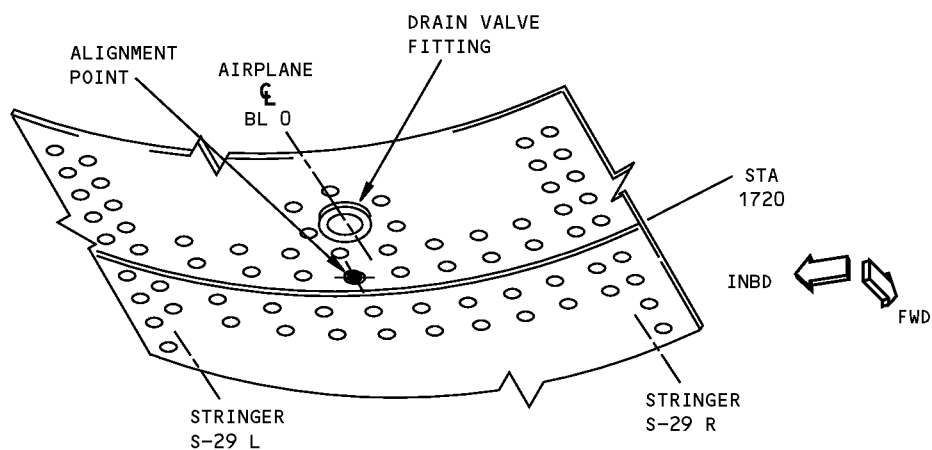
Airplane Alignment Points in Jig Position
Figure 4 (Sheet 3 of 12)

757-200 STRUCTURAL REPAIR MANUAL

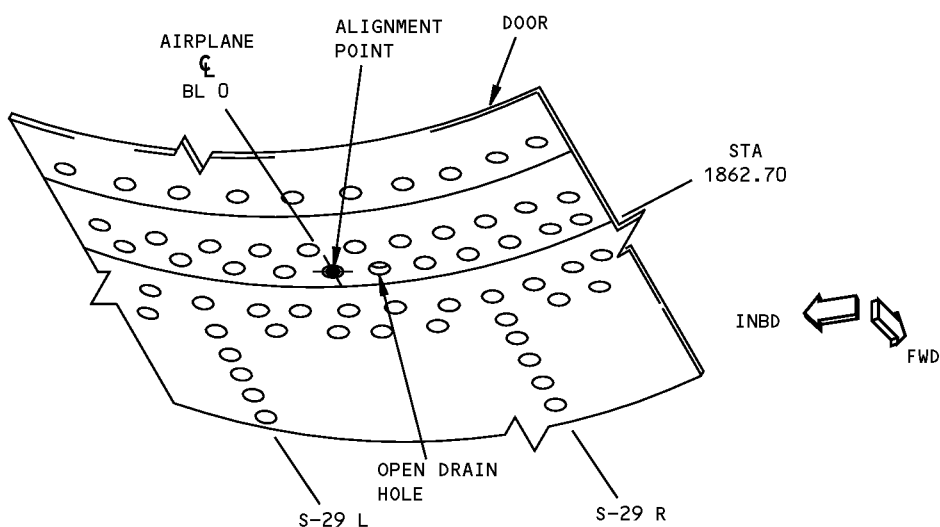


**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 4 of 12)**

**757-200
STRUCTURAL REPAIR MANUAL**



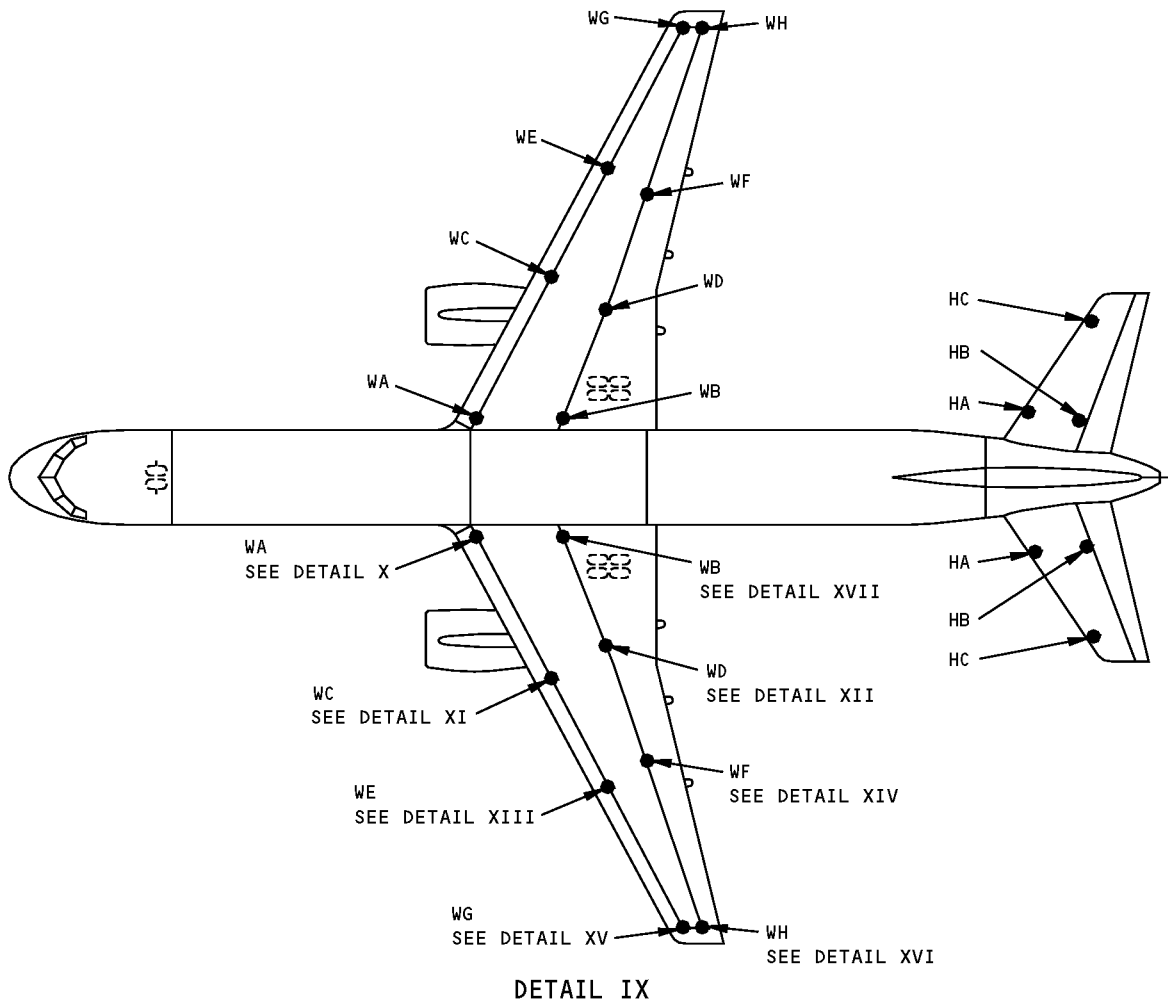
**BOTTOM VIEW OF FUSELAGE
POINT BP
DETAIL VII**



**BOTTOM VIEW OF FUSELAGE
POINT BR
DETAIL VIII**

**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 5 of 12)**

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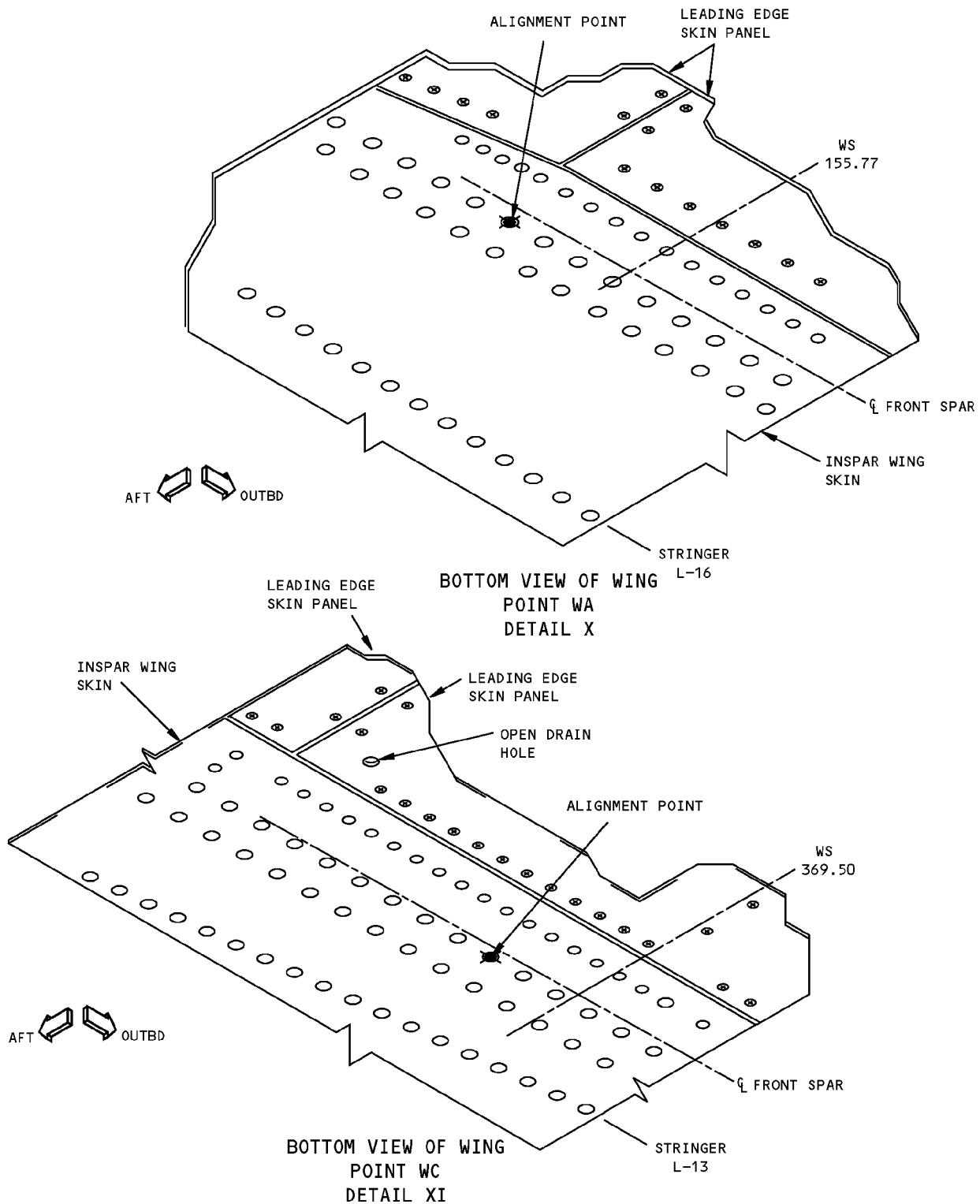
DETAIL IX

ALIGNMENT CHECK POINT	BODY STATION	BODY WATER LINE	BODY BUTTOCK LINE	HEIGHT ABOVE ALIGNMENT POINT WB ± 0.05	
WA	911.57	170.76	92.40	5.55	
WB	1046.70	165.10	93.19	0.0	DATUM
WC	1033.12	202.12	318.65	37.02	
WD	1127.79	199.77	289.79	34.67	
WE	1126.97	217.97	494.17	52.87	
WF	1195.24	219.61	504.19	54.51	
WG	1242.76	237.73	711.57	72.63	
WH	1258.77	238.11	706.41	73.01	

WING ALIGNMENT POINT LOCATIONS
TABLE II

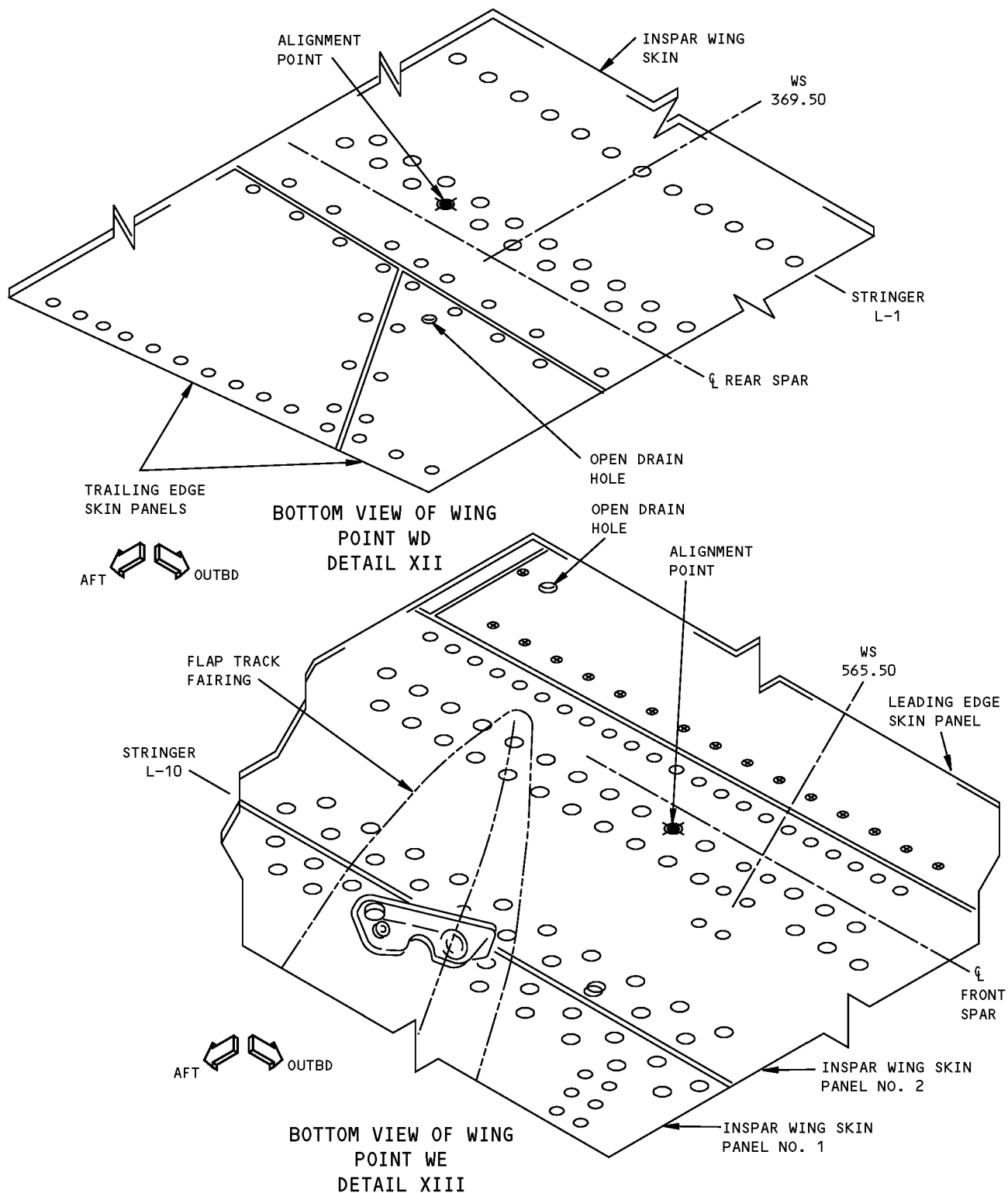
Airplane Alignment Points in Jig Position
Figure 4 (Sheet 6 of 12)

757-200 STRUCTURAL REPAIR MANUAL



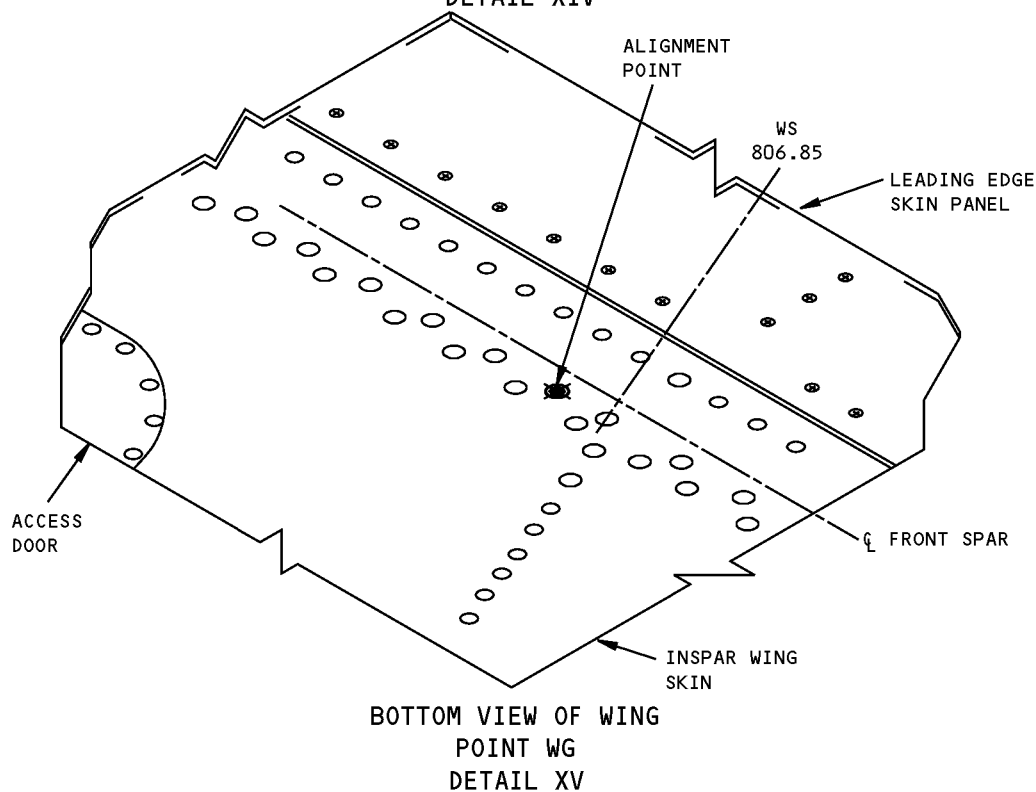
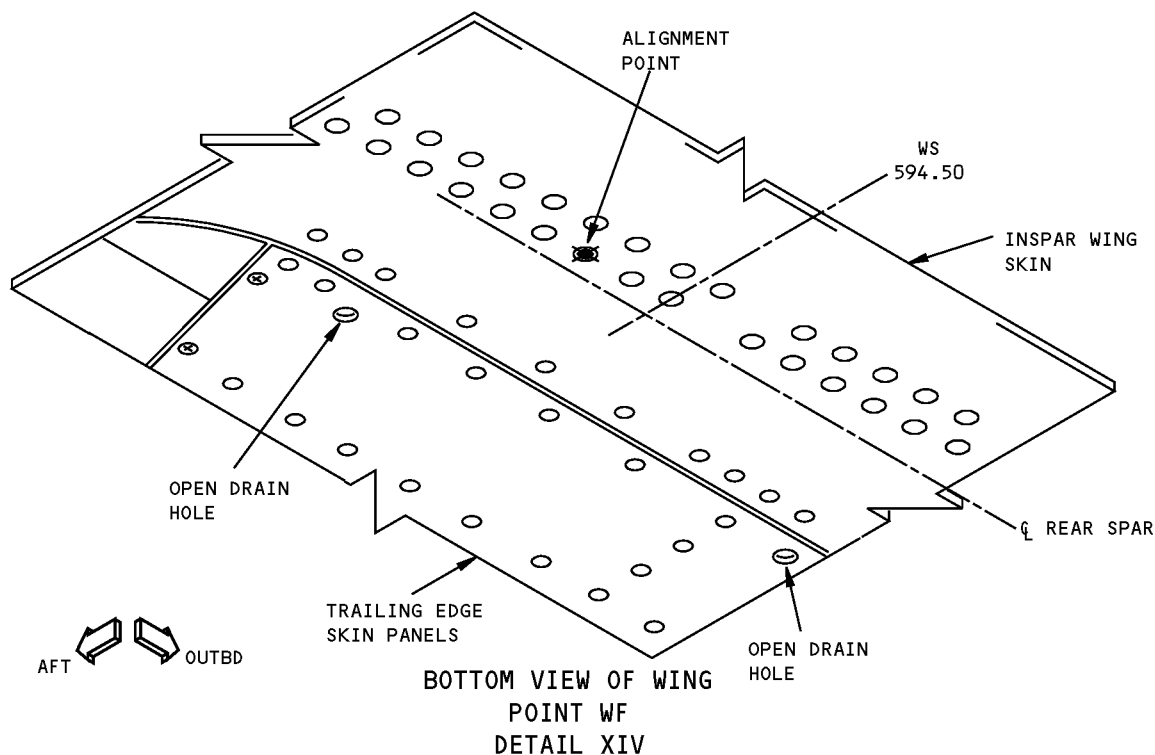
**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 7 of 12)**

757-200 STRUCTURAL REPAIR MANUAL



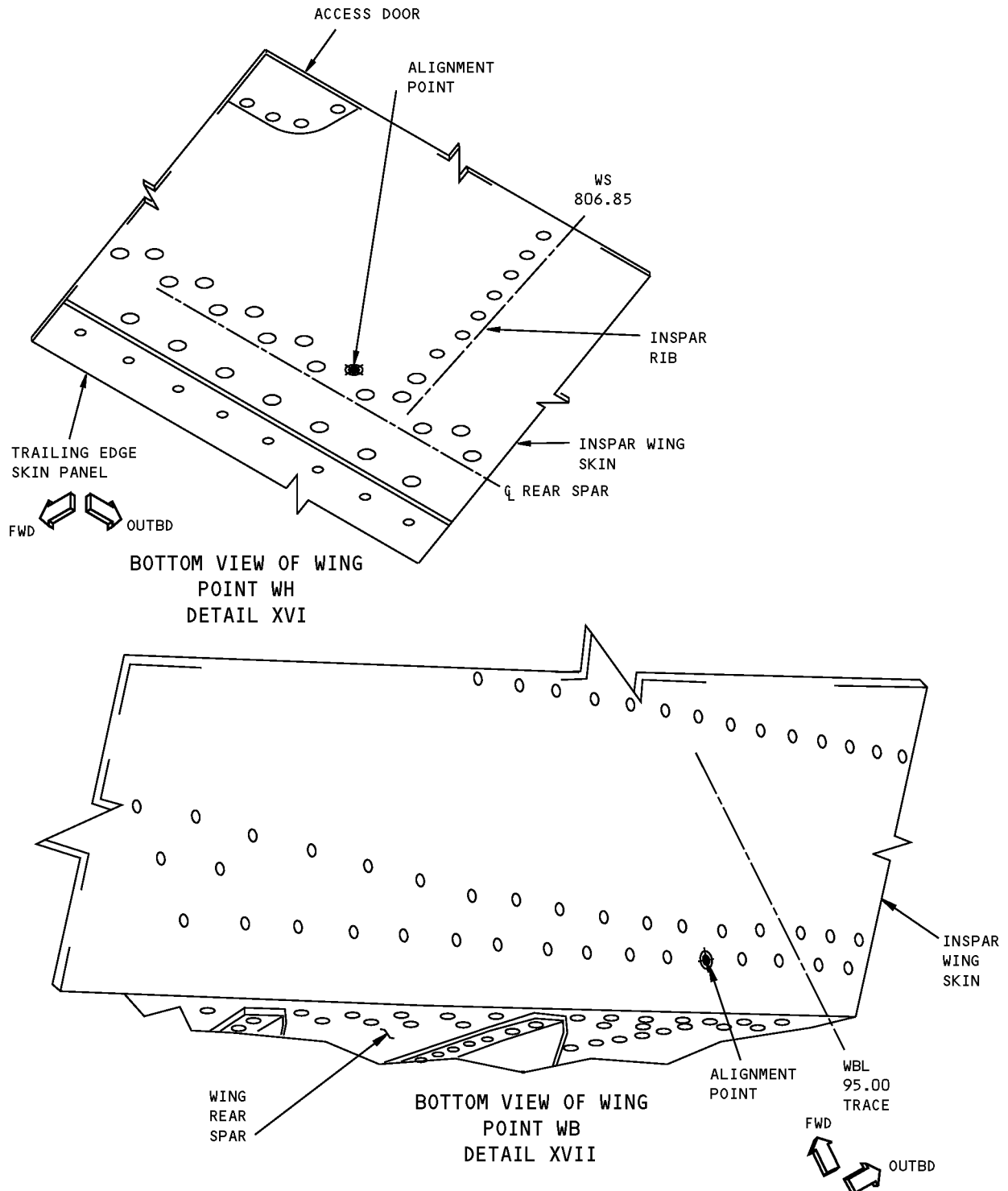
**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 8 of 12)**

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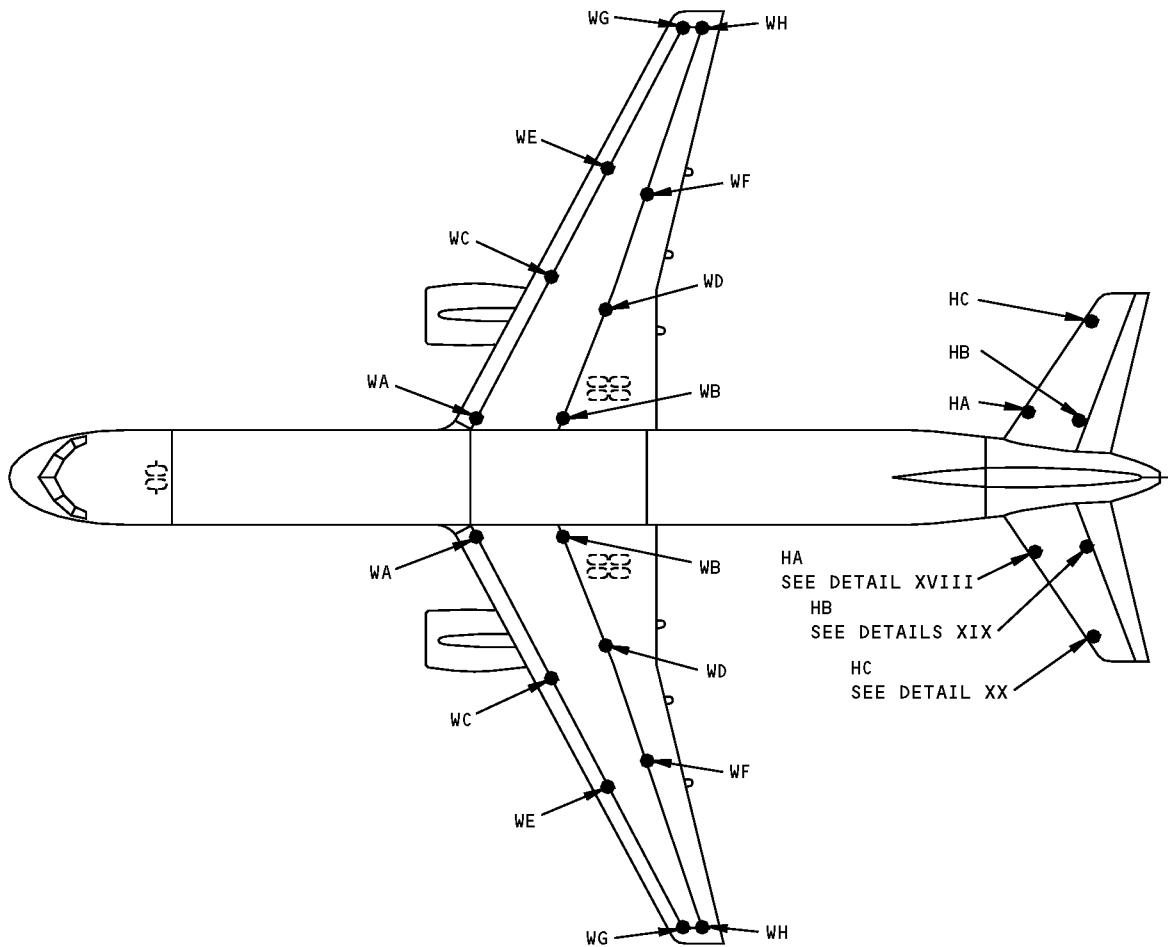
**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 9 of 12)**

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**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 10 of 12)**

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DETAIL XVII

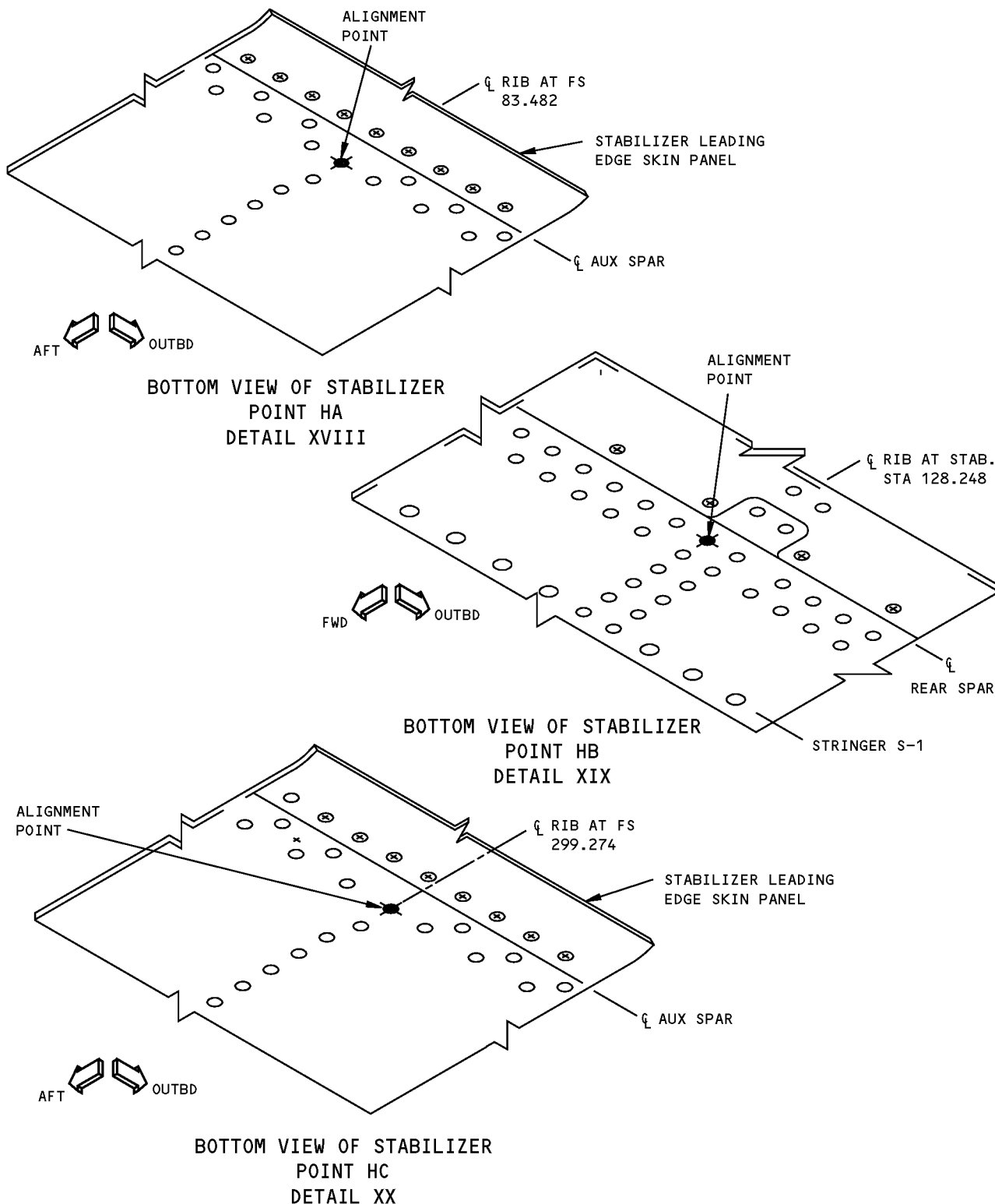
ALIGNMENT CHECK POINT	BODY STATION	BODY WATER LINE	BODY BUTTOCK LINE	HEIGHT ABOVE ALIGNMENT POINT HB ± 0.05	
HA	1792.04	241.25	87.63	0.22	
HB	1867.16	241.03	79.60	0.00	DATUM
HC	1911.26	268.74	266.61	25.58	

HORIZONTAL STABILIZER ALIGNMENT POINT LOCATIONS

TABLE III

Airplane Alignment Points in Jig Position Figure 4 (Sheet 11 of 12)

757-200 STRUCTURAL REPAIR MANUAL



**Airplane Alignment Points in Jig Position
Figure 4 (Sheet 12 of 12)**



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - AILERON REBALANCE PROCEDURES

1. General

- A. This subject gives the balance requirements and rebalance procedures, after a Rework, for the aileron.
- B. There are three categories of balance requirements for Control Surfaces.
 - (1) Category I: Surfaces that can be adjusted to meet the necessary Operational Static Balance Limits. The aileron is a Category I Control Surface.
 - (2) Category II: Surfaces that cannot be adjusted to meet the necessary Operational Static Balance Limits but have a built-in rework allowance for a moderate amount of Rework. There are no Category II Control Surfaces on the 757 Airplane.
 - (3) Category III: Surfaces with no balance requirements. The elevator and rudder are Category III Control Surfaces.
- C. The aileron can be adjusted to meet the necessary Operational Static Balance Limits. Refer to Table 1/GENERAL for the static balance limits.

Table 1: Aileron Static Balance Limits

CONTROL SURFACE	CATEGORY	STATIC BALANCE LIMITS (POUND-INCHES)		
		MANUFACTURE	CALCULATED	OPERATIONAL
AILERON	I	(-)30.00 TO (-)20.00	(-)10.00	(-)50.00 TO 0.00

WARNING: IF THE BALANCE MOMENT OF THE AILERON IS MORE THAN 0.00 POUND-INCHES, A CONDITION DANGEROUS TO FLIGHT SAFETY CAN OCCUR.

- (1) Boeing recommends that the aileron be removed from the airplane when all of the Balance Adjust Weights have been installed and the Balance Moment is more than the Calculated Limit of (-) 10.00 pound-inches. Boeing also recommends that the aileron be removed if you are not sure of the Balance Moment. After finding the Balance Moment in a balance fixture, subsequent Balance Moment calculations can be made up to the Operational Limit.

NOTE: It is recommended that the aileron be removed at (-) 10.00 pound-inches to protect against possible calculation errors.

- D. When the aileron is rebalanced in a balance fixture, Balance Adjust Weights can be added to increase the Rework Capability sufficiently to reduce the need for more weight on the next Rework.
- E. Refer to 57-60-01, REPAIR 1 for the repair procedures.

2. References

Reference	Title
51-70-03, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-04, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 350°F (177°C) Cure
51-70-05, GENERAL	Graphite/Aramid/Hybrid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 250°F (121°C) Cure
57-60-01, REPAIR 1	Aileron Skin Repairs

3. Definition of Terms

- A. The definitions of terms that are applicable to the aileron rebalance procedures are as follows:



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- (1) Balance Adjust Weights: Small weight increments which can be added or subtracted to put the aileron into fine balance. In manufacturing, these weights are used to adjust for small variations at the initial balance (Static Balance Moment). In service, Balance Adjust Weights are used to balance a Reworked aileron as necessary.
- (2) Balance Moment (M): The product of the weight or Weight Reaction times the Moment Arm.
- (3) Calculated (Static Balance) Limit: The limit for on the airplane calculation of the Balance Moment (of the Control Surface). Once all of the Balance Adjust Weights have been installed and this limit is reached, Boeing recommends that the Control Surface be removed from the airplane to have the Balance Moment found in a balance fixture.
- (4) Control Surface: The movable portion of a wing or tail which controls movement about one of the airplane's axes.
- (5) Fixed Balance Weights: Specially designed weights installed on a Control Surface forward of the hinge centerline at manufacture.
- (6) Manufacture (Static Balance) Limit: The range that the initial Static Balance Moment (of the Control Surface) must be at before the Control Surface is delivered to the customer.
- (7) Moment Arm (Y): The horizontal distance from the hinge centerline to the point where the weight is put to the surface, or the point where the Weight Reaction is measured.
- (8) Operational (Static Balance) Limit: The range that the Static Balance Moment (of the Control Surface) must be at to permit the necessary dynamic stability and safety of flight.
- (9) Repaint: A procedure that adds exterior primer and/or paint to a Control Surface.
- (10) Repair: A procedure that adds a concentrated quantity of repair material (weight) to a Control Surface.
- (11) Rework: Any procedure that changes the Static Balance Moment or Rework Capability of the Control Surface. This is applicable when you do Repairs, Repaints, or add or subtract Balance Adjust Weights.
- (12) Rework Moment (MR): The change in the Static Balance Moment of a Control Surface because of a Rework to the surface. It is the difference between the material removed and the material added, multiplied by the Moment Arm. Also, for a Category I Control Surface, it is the moment change between the Rework to the surface and the moment from adding or subtracting any Balance Adjust Weights.
- (13) Rework Record: A record of all the Rework done to a Control Surface. The record must contain (as a minimum):
 - (a) The Rework Moment
 - (b) The Rework weight and its center of gravity location
 - (c) The revised Balance Moment
 - (d) The date of rework
 - (e) All Rework Procedures done
- (14) Static Balance Moment (as used in the SRM): The initial moment of of the total Control Surface weight about its hinge centerline.
- (15) Weight Reaction (WR): The force (in pounds) of a Control Surface acting on a support point at a given distance from its hinge centerline. You determine the Weight Reaction by using a weight scale under the reaction points.

4. Sign Convention

A. Distances:

GENERAL
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- (1) Make the distances aft of the hinge centerline to be positive (+).
- (2) Make the distances forward of the hinge centerline to be negative (-).

B. Weight Reactions:

- (1) Weight Reactions are considered to be positive (+) if the aileron makes a downward load on the support.
- (2) Weight Reactions are considered to be negative (-) if the aileron makes an upward load on the support.

C. Balance Moment:

- (1) Positive (+) Balance Moments identify Control Surfaces that are underbalanced. This means that the total center of gravity is aft of the hinge centerline which makes the Control Surface tail heavy.
- (2) Negative (-) Balance Moments identify Control Surfaces that are overbalanced. This means that the total center of gravity is forward of the hinge centerline which makes the Control Surface nose heavy.

5. Measuring Accuracy

- A. When the Balance Moment is calculated on the airplane from measured quantities, it is important that the distance and the weight measurements be as accurate as possible. To make sure that the Balance Moment tolerances are satisfactory (and keep errors to a minimum), use equipment that is calibrated to make measurements as follows:
 - (1) Measure the Moment Arm (Y) to an accuracy of ± 0.1 inch.
 - (2) Measure the angle that the aileron is leveled at to an accuracy of ± 1 degree.
 - (3) Measure the weight to ± 0.1 percent of the measured weight.

6. Special Tools and Equipment

- A. Refer to Figure 1/GENERAL for details of special tools and equipment for Control Surface balancing.

7. Estimation of Material Weight for Repairs made on the Airplane

- A. Repairs to honeycomb structure are described in 51-70-03, GENERAL for a room temperature repair cure, 51-70-04, GENERAL for a 350°F (177°C) repair cure, and 51-70-05, GENERAL for a 250°F (121°C) repair cure.
- B. Refer to Figure 2/GENERAL to determine component weights for calculating approximate Rework Moments.

8. Tracking

- A. Boeing recommends that you keep a Rework Record of how much weight and Rework Moment is added by each Rework operation.
- B. The Rework Moments, the collected total of all the Rework Moments, Balance Adjust Weights, locations, dates, total surface Repaints, and Repaint moments should be recorded in the Rework Record for each aileron. If an aileron is replaced by a spare or installed on a different airplane, the Rework Record must go with that aileron.

9. Rework Moment and Serviceability

- A. The aileron is no longer serviceable when it has a Balance Moment more than 0.00 pound-inches and there is no more balance adjust weight space remaining.

STRUCTURAL REPAIR MANUAL

- B. The serviceability of the aileron can be determined by adding all of the Rework Moments (from the Rework Record) to the Static Balance Moment or the Manufacture Limit of (-) 20.00 pound-inches (if the Static Balance Moment is not known).
- C. Serviceability can possibly be regained by removing the paint buildup from Repaints and Repairs that were performed without paint removal, and refinishing the aileron.

10. Balance of the Aileron on the Airplane

- A. Calculate the Rework Moment caused by the Repair. Refer to Paragraph 7./GENERAL for the material weights.
- B. Check to determine that the Balance Moment is less than (-) 10.00 pound-inches and that the required weight space is available to add more Balance Adjust Weights. Refer to Figure 3/GENERAL for adjustable weight part numbers and locations. If space is available, an aileron can be rebalanced without removal from the airplane. In addition, the criteria that follows must be met:
 - (1) The Repair, with good workmanship, can be completed with the required accuracy and tolerances of Paragraph 5./GENERAL. The weight tolerances must include equipment tolerances and error of material estimation (both removed damage and the repair material). The distance tolerance must include the possible error in estimating the perpendicular distance from the hinge centerline to the center of gravity of the Repair.
- C. Adjust the aileron balance as follows:
 - (1) Check to determine that the required adjust weight space is available.
 - (2) Determine the weight of the Repair by subtracting the weight of the removed damaged material from the weight of repair material as determined from Paragraph 7./GENERAL.
 - (3) Locate hinge centerline as shown in Figure 4/GENERAL.
 - (4) Measure perpendicular distance, "Y" from center of gravity (CG) of Repair area to hinge centerline within ± 0.125 inches. Refer to Figure 4/GENERAL, Detail II.
 - (5) Calculate the Rework Moment (MR)
$$MR = \text{Repair weight (in pounds)} \times \text{"Y" (in inches)}$$
 - (6) Collect the total moments for the aileron by adding this Rework Moment to the Rework Moments as recorded in the Rework Record and the Static Balance Moment.
 - (7) If the Balance Moment is less than (-) 10.00 pound-inches, then no balance compensation is required. Record the Rework Moment on the foil moment marker. Record the Repair information in the Rework Record with the location and date of Repair, and that this Rework moment was determined on the airplane.
 - (8) If the Balance Moment is more than (-) 10.00 pound-inches, Refer to Figure 3/GENERAL to determine the number of Balance Adjust Weights to be added. Additional Balance Adjust Weights can be added so sufficient overbalance capability will be available for subsequent Reworks.
 - (a) Remove the wing trailing edge panels as required to gain access to the adjust weight location and install the Balance Adjust Weights as required.
 - (b) Record the Repair information in the Rework Record, and note the location and date of Repair, the number and location of Balance Adjust Weights that were added, the Rework Moment (the difference between the Repair moment and the moment from the added adjust weights), and that this Rework Moment was determined on the airplane.

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11. Sample Calculations - Repairs which may be balanced on the Airplane

- A. The examples that follow demonstrate the type of procedures to use when calculating the Rework Moment to determine the Balance Moment. Two examples are given, one which does not require rebalance and one which requires rebalance with Balance Adjust Weights.
- B. Example 1 - No adjust weights will be required. Assume that the aileron has been gouged and dented over a 14-inch diameter area, with damage to a 3-ply graphite skin and core with an average thickness of 2 inches. The center of gravity (CG) of the Repair has a distance of 13 inches aft of the hinge centerline shown in Figure 4/GENERAL. Assume the aileron has a recorded Static Balance Moment of (-) 29.00 pound-inches and two previous Rework operations (a Repaint of (+) 11.00 pound-inches and a previous Repair of (+) 2.0 pound-inches). The calculated Balance Moment for this aileron is (-) 16.00 pound-inches.

- (1) The estimated Rework Moment for the new Repair is (+) 5.00 pound-inches. The estimated Balance Moment after Repair is not more than (-) 10.00 pound-inches; therefore, no Balance Adjust Weights are required.

$$\text{Estimated Balance Moment} = (-) 16.00 + 5.00 = (-) 11.00 \text{ pound-inches}$$

- (2) A determination is made that the Repair can be completed, with good workmanship to the required accuracy and tolerance on the airplane.
- (3) The Repair is made in accordance with 51-70-04, GENERAL or 51-70-05, GENERAL. The damaged skin and core was removed to a 14-inch diameter.
- (a) Make sure that the linear accuracy of Paragraph 5./GENERAL is met.
- (b) Make sure to weigh the repair materials in a balance scale with the accuracy requirements of Paragraph 5./GENERAL.
- (4) Determine the increased weight from the added repair material. The weight of replaced core would be equivalent to the removed core.

The material weight would be from one extra repair ply and the required repair adhesive. The weight of the added repair finish would be equivalent to the removed original finish (primer and paint). The weight of removed Repaints in the Repair area can be calculated and subtracted from the added Repair weight. Use the repair material weight estimation requirements of Paragraph 7./GENERAL for calculations.

- (a) The added weight for a 350°F (177°C) Repair is calculated:

NOTE: Area of a circular repair ply = $\pi(D^2)/4$;

$$\text{Area of core splice foam adhesive} = \pi(\text{Core Diameter})(\text{Depth of Core});$$

$$\pi = \text{Pi} = 3.14159$$

Table 2:

Weight from outer graphite repair ply (17-inch diameter)	=	$\pi (17)^2(0.0005)/4 = 0.1135 \text{ pound}$
1-ply adhesive bonding core to opposite face (BMS 8-245)	=	$\pi (14)^2(0.00035)/4 = 0.0539 \text{ pound}$
Core splice foam adhesive (BMS 5-90, Type III, Grade 50)	=	$\pi (14)(2)(0.0027) = 0.2375 \text{ pound}$
TOTAL ADDED WEIGHT	=	0.4049 pound

- (b) The weight from subsequent Repaints (if applicable) is calculated:



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Table 3:

Weight from repaint (17-inch diameter)	=	$\pi(17)^2(0.000122) / 4$	=	0.0277 pound (per Repaint)
TOTAL SUBTRACTED WEIGHT	=	0.0277 (1 Repaint)	=	0.0277 pound

- (c) TOTAL REPAIR WEIGHT = $0.4049 - 0.0277 = 0.3772$ pound
- (d) Measured distance from CG to hinge centerline (Y)
"Y" as given = 13 inches
- (e) The calculated Rework Moment = $(0.3772 \text{ pounds})(13 \text{ inches}) = (+) 4.90$ pound-inches
- (5) Find the calculated Balance Moment after Rework:

Table 4:

Calculated Balance moment	=	$(-) 16.00 + (+) 4.90$
	=	$(-) 11.10$ pound-inches

- (6) The aileron's Balance moment is less than the Operational Limit
- (7) Record the Repair information in the Rework Record with the location and date of the Repair, and that this Rework Moment had been determined on the airplane.
- C. Example 2 - Balance Adjust Weights will be required. Assume that the aileron has a recorded Static Balance Moment of $(-) 25.00$ pound-inches and a Repair Moment for a new Repair that is $(+) 26.00$ pound-inches.

Estimated Balance Moment = $(-) 25.00 + 26.00 = 1.00$ pound-inch.

- (1) The estimated Balance Moment is more than $(-) 10.00$ pound-inches indicating insufficient overbalance. Sufficient Balance Adjust Weights can be added to increase the overbalance capability to be less than $(-) 10.00$ pound-inches.
- (a) From Figure 5/GENERAL, adding seven Balance Adjust Weights between Wing Stations (WS) 676.6 and 686.5 will have a moment change of $(-) 20.69$ pound-inches.
- (b) Calculate the Rework Moment after adding adjust weights:
Rework Moment = $(+) 26.00 + (-) 20.69 = (+) 5.31$ pound-inches
- (c) Find the calculated Balance moment after Rework:

Table 5:

Calculated Balance Moment	=	$(-) 25.00 + (+) 5.31$
	=	$(-) 19.69$ pound-inches

- (d) Install the seven Balance Adjust Weights.
- (e) Record the Repair information in the Rework Record with the location and date of Repair, the number and location of Balance Adjust Weights that were added, that this Rework moment was determined on the airplane, and the new Balance moment of $(-) 19.69$ pound-inches.

NOTE: This aileron would have been remove from the airplane and the Balance Moment found in a balance fixture if there was no remaining adjustable weight space.

12. Balance of the Aileron Off of the Airplane

- A. Static balancing requires the removal of the aileron from the airplane.



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- (1) The aileron must be complete, including exterior and decorative finishes, with four trailing dischargers installed. For balance purposes, the equivalent weight of the four trailing dischargers can be simulated and contribute approximately (+) 2.30 pound-inches of moment. Bonding jumpers are not required for static balancing.
- (2) Mount the aileron (top surface up) on the balance jig (Figure 1/GENERAL) locating the hinge supports at WS 705.266 and 775.450 as shown in Figure 4/GENERAL.
- (3) Record the tare weight of the tool stand and weight reaction tip fixture (Figure 2/GENERAL). Locate reaction tip at point "A" which is 0.5 inch from aileron trailing edge on WS 726.266 (Figure 4/GENERAL). At this location, the moment arm is 21 inches from the hinge centerline.
- (4) With the aileron free to turn about the hinge line, position the aileron's upper surface 8 degrees from the horizontal position by placing a level on the surface and adjusting the weight reaction adjusting screws.
- (5) With the top surface 8 degrees from the horizontal, remove the level and record the scale reading.
- (6) Calculate the surface Balance moment by multiplying the Weight Reaction (WR) in pounds by the 21-inch moment arm.

Surface Moment = WR x 21 inches

Where WR = scale reading - tare weight

NOTE: Take care to observe proper sign convention as stated in Paragraph 4./GENERAL. If WR adds to the tare weight, this would be a downward force and is positive (+). IF WR decreases, the tare weight, this would be an upward force and is negative (-).

Example: Tare weight of tool stand and reaction tip is 30 pounds
and scale reading is 32 pounds:

WR = 32 - 30 = (+)2 pounds

- (7) If the moment is less than 0.00 pound-inch, record in the Rework Record that a static balance has been done with the aileron removed from the airplane, the new Balance Moment, location and type of Rework with the date.
- (8) If the moment is more than 0.00 pound-inch, add sufficient Balance Adjust Weights to make the moment less. Recheck the moment by repeating steps (4) through (6). Record in the Rework Record that a static balance has been done with the aileron removed from the airplane, the new Balance Moment, the number of balance weights added, and location and type of Rework with the date.

NOTE: Add sufficient Balance Adjust Weights so that the Balance Moment is less than the Calculated Limit for the next Rework.

- (9) If the moment is more than 0.00 pound-inch and all of the adjustable weight space has been used, the aileron must be:
 - (a) Refinished and have the paint buildup removed, or
 - (b) Removed and replaced, or
 - (c) Ask The Boeing Company to analyze the Rework Record to determine its serviceability.

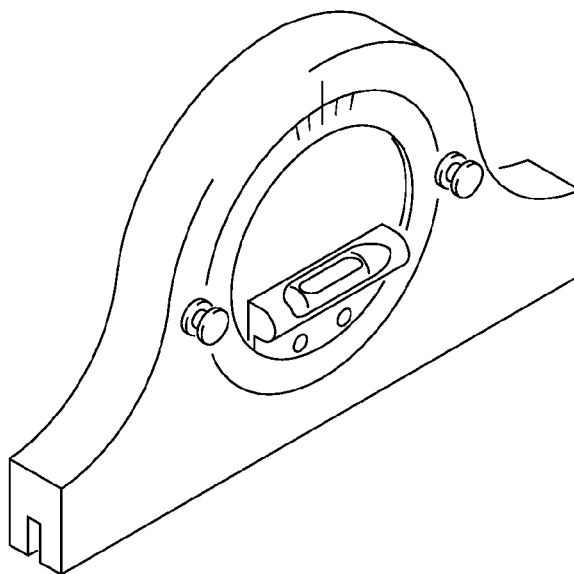
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SPECIAL TOOLS AND EQUIPMENT				
ITEM	QUANTITY REQUIRED	PART NUMBER	DETAIL NO.	SOURCE
BALANCE JIG STAND	1	BOEING F70330	II	THE BOEING CO.
OPTIONAL JIG STANDS		BOEING FME5-71799	III	THE BOEING CO.
		BOEING 2FME113N7100	NOT SHOWN	
TOOL STAND	1	BOEING F70330	IV	THE BOEING CO.
WEIGHT REACTION TIP	1	BOEING F70330	V	THE BOEING CO.
HINGE SUPPORTS	2	---	VI	ANY SOURCE
PLATFORM SCALE - 300 LB CAPACITY	1	---	IV	ANY SOURCE A
PROTRACTOR LEVEL	1	---	I	ANY SOURCE
C-CLAMPS	3	---		ANY SOURCE

NOTES

A ANY SUITABLE CERTIFIED SCALE OR EQUIVALENT CAPACITY AND ACCURACY THAT HAS 0.1 POUND GRADUATIONS

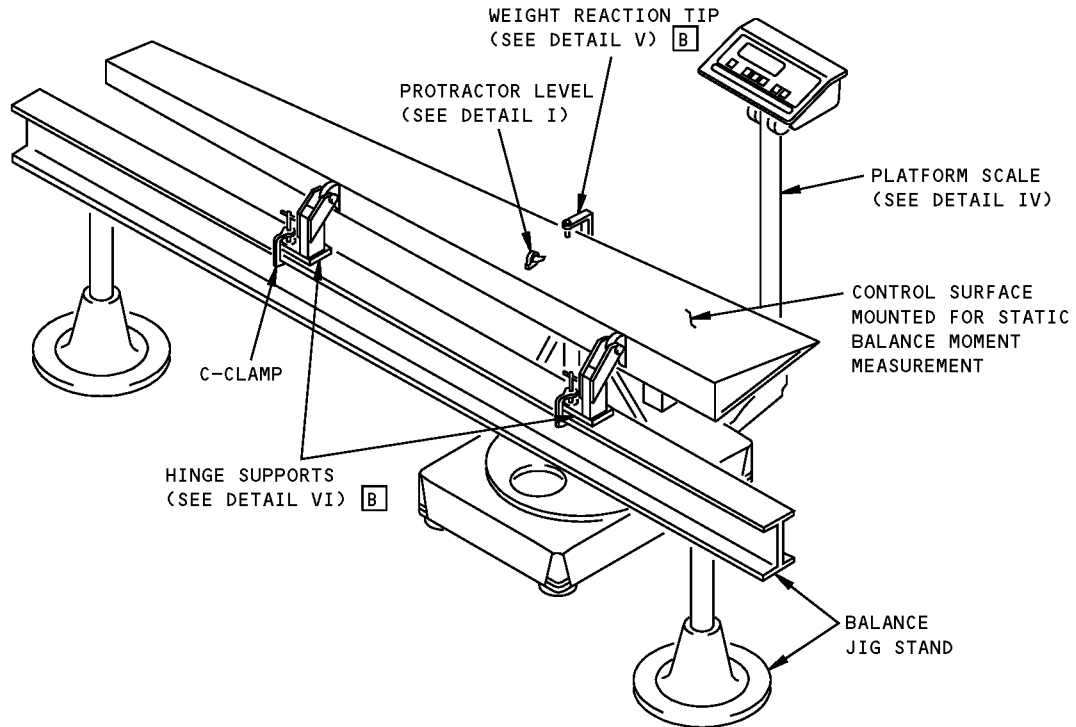
B SEE FIGURE 5 FOR LOCATION OF WEIGHT REACTION TIP AND HINGE SUPPORTS



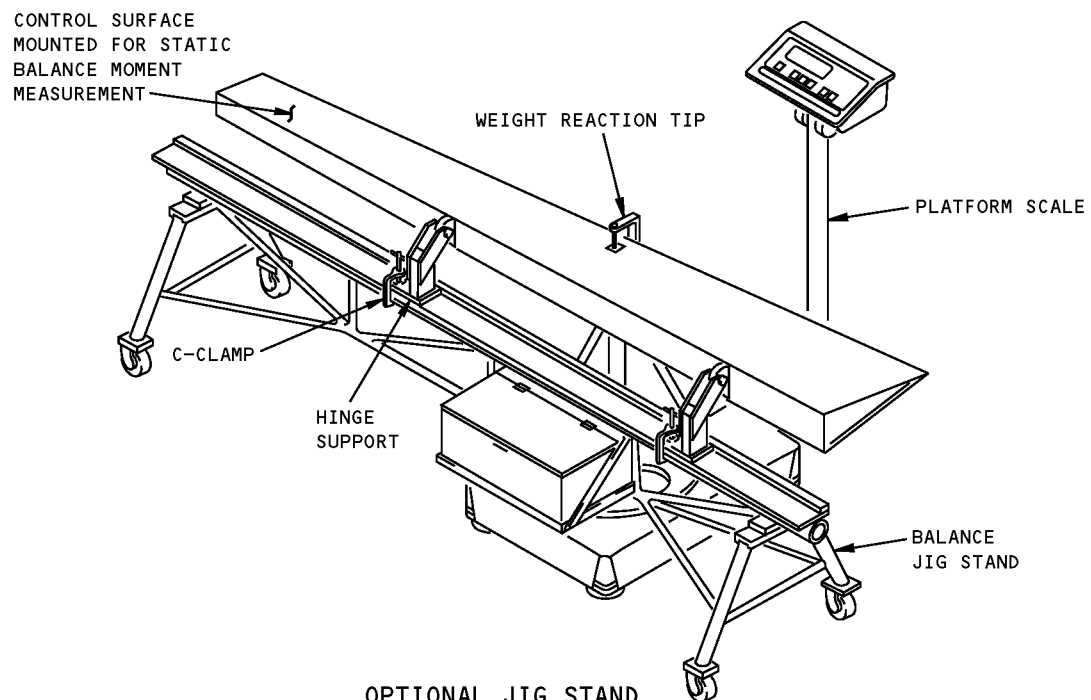
PROTRACTOR LEVEL
DETAIL I

Tools and Equipment
Figure 1 (Sheet 1 of 3)

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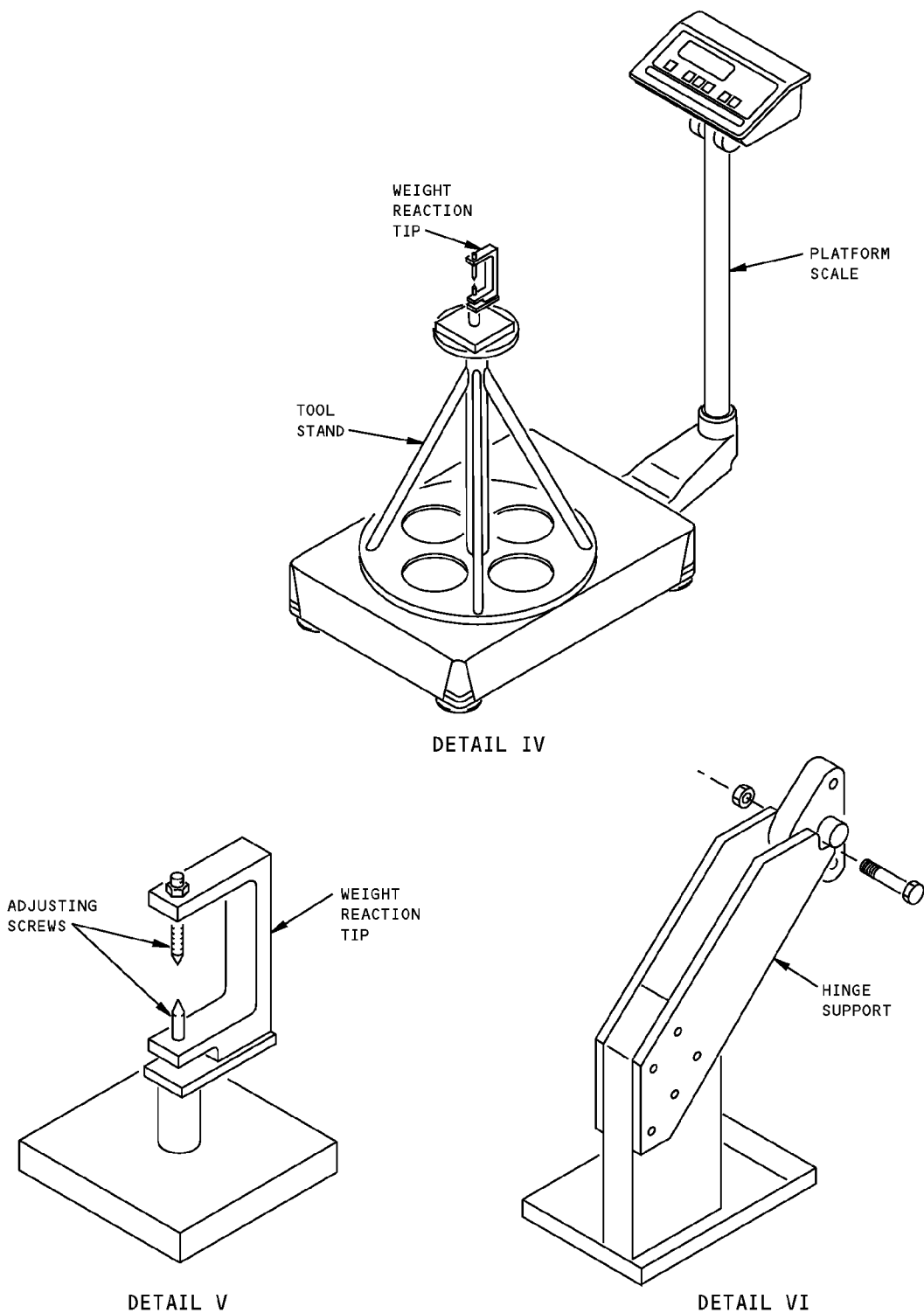
**FLOOR MOUNTED JIG STAND
DETAIL II**



**OPTIONAL JIG STAND
DETAIL III**

**Tools and Equipment
Figure 1 (Sheet 2 of 3)**

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Tools and Equipment
Figure 1 (Sheet 3 of 3)



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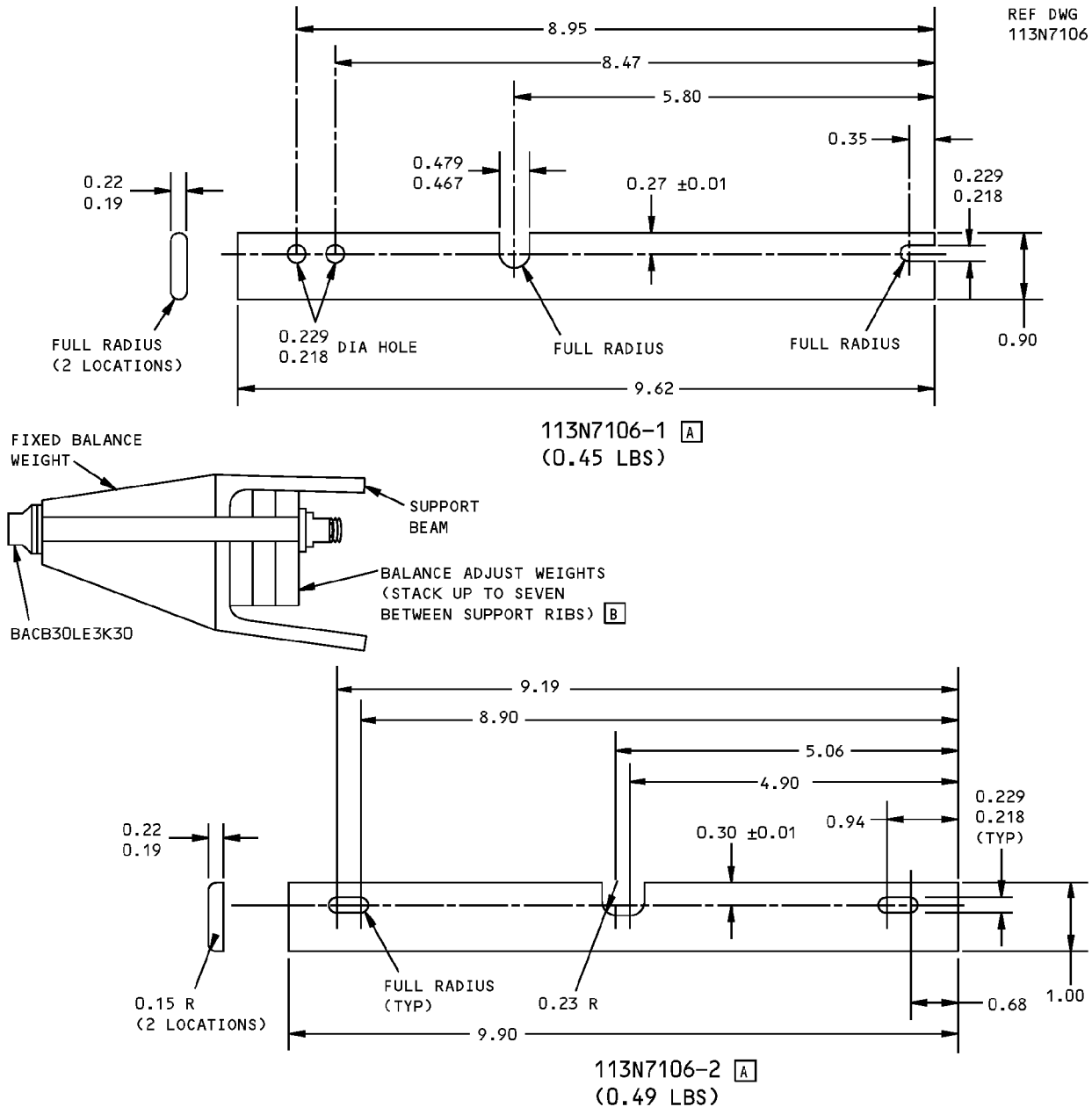
CONTROL SURFACE MATERIAL	
PREPREG SKIN TYPE	WEIGHT
FIBERGLASS PREPREG BMS 8-139, TYPE 120 BMS 8-79, TYPE 120 BMS 8-79, TYPE 1581 BMS 8-79, TYPE 7781 GRAPHITE PREPREG (TAPE) BMS 8-168, TYPE II, CLASS I, GRADE 145 BMS 8-212, TYPE III, CLASS I, GRADE 95 BMS 8-212, TYPE III, CLASS I, GRADE 145 BMS 8-212, TYPE III, CLASS I, GRADE 190 BMS 8-256, TYPE I, CLASS I, GRADE 145 GRAPHITE PREPREG (FABRIC) BMS 8-168, TYPE II, CLASS II, GRADE 3K-70-PW BMS 8-212, TYPE III, CLASS II, GRADE 3K-135-8H BMS 8-212, TYPE IV, CLASS II, GRADE 3K-70-PW BMS 8-256, TYPE I, CLASS II, GRADE 3K-70-PW BMS 8-258, TYPE I, CLASS II, GRADE 3K-70-PW	0.00027 LBS/IN ² /PLY 0.00028 LBS/IN ² /PLY 0.00070 LBS/IN ² /PLY 0.00070 LBS/IN ² /PLY 0.00035 LBS/IN ² /PLY 0.00021 LBS/IN ² /PLY 0.00033 LBS/IN ² /PLY 0.00043 LBS/IN ² /PLY 0.00033 LBS/IN ² /PLY 0.00047 LBS/IN ² /PLY 0.00085 LBS/IN ² /PLY 0.00046 LBS/IN ² /PLY 0.00049 LBS/IN ² /PLY 0.00049 LBS/IN ² /PLY
WET LAYUP SKIN TYPE	
FIBERGLASS WITH RESIN BMS 9-3, TYPE D, STYLE 120 BMS 9-3 TYPE H-2, STYLE 181-150 GRAPHITE FABRIC WITH RESIN BMS 9-8 TYPE I, CLASS II, GRADE 3, STYLE 3K-70-P	0.00030 LBS/IN ² /PLY 0.00083 LBS/IN ² /PLY 0.00055 LBS/IN ² /PLY
END COVER	
3/64 PHENOLIC SHEET AS GIVEN IN MIL-P-15035, TYPE FBE OR FBG	0.00225 LBS/IN ²
CORE	
NOMEX BMS 8-124, CLASS IV, TYPE V, GRADE 3	0.0017 LBS/IN ³
ADHESIVE	
SKIN TO CORE BONDING (350° CURE) BMS 8-245, TYPE II, CLASS I, GRADE 05 SKIN TO CORE BONDING (250°F CURE) BMS 5-129, TYPE 2 OR 4, GRADE 10 CORE SPLICE BONDING (350-250°F CURE) BMS 5-90, TYPE III, GRADE 50	0.00035 LBS/IN ² 0.00042 LBS/IN ² 0.00274 LBS/IN ²
POTTING COMPOUND	
FOR SURFACE DENTS BMS 5-28, TYPE 7	0.032 LBS/IN ³
PAINT/DECAL	
PAINT (NOMINAL 2.5 MILS THICK) BMS 10-60, TYPE II PRIMER (NOMINAL 0.5 MILS THICK) BMS 10-103, TYPE I DECAL	0.000122 LBS/IN ² 0.000042 LBS/IN ² 0.000139 LBS/IN ²

NOTES

- A** ONE COMPLETE COAT (BOTH SIDES, 3 MILS THICK) WILL WEIGH 1.1 POUNDS AND WILL INCREASE THE MOMENT BY +11 POUND-INCHES.

**Weights of Repair Materials
Figure 2**

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AILERON BALANCE ADJUST WEIGHTS DETAIL I

NOTES:

[A] MATERIAL: 4130 STEEL PLATE, CAD PLATE PER QQ-P-416 TYPE 2, CLASS 2. APPLY PRIMER BMS 10-11 TYPE 1.

[B] IT IS RECOMMENDED THAT WHEN BALANCE ADJUST WEIGHTS ARE ADDED, THAT THEY BE INSTALLED BETWEEN THE MOST INBOARD SUPPORT RIBS UNTIL MAXIMUM CAPACITY IS REACHED, AND THEN PROCEED OUTBOARD AS EACH SUPPORT BEAM IS FILLED TO CAPACITY.

Balance Adjust Weights and Moments
Figure 3 (Sheet 1 of 2)



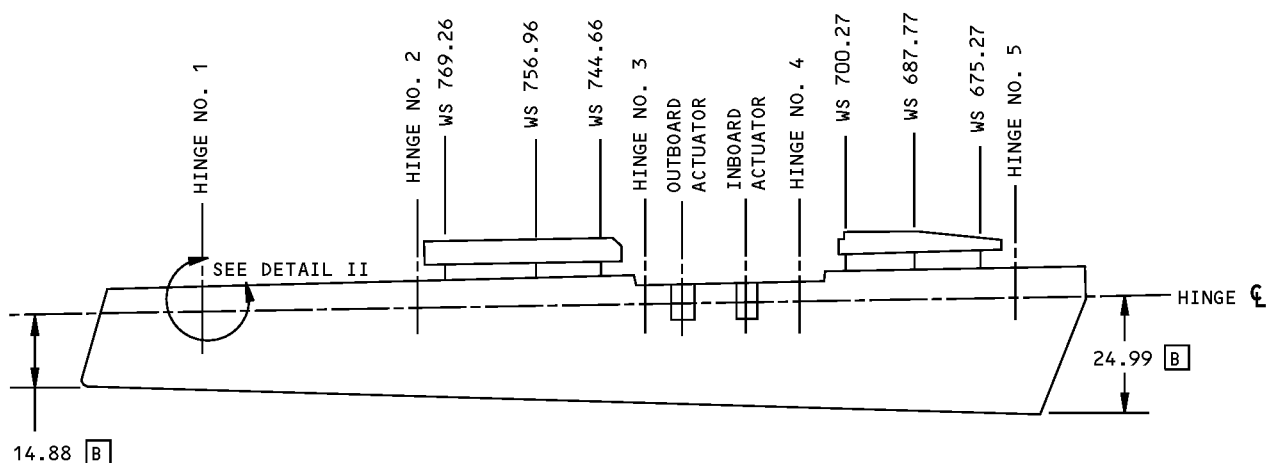
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ADJUST WT. PART NO.	WING STA.	NO. OF WTS.	ARM IN.	INCREMENTAL MOMENT CHANGE (Lb-In.)	TOTAL ACCUMULATED MOMENT CHANGE (Lb-In.)
113N7106-2	676.6	1	-6.60	-3.23	-3.23
		2	-6.41	-3.14	-6.37
		3	-6.22	-3.05	-9.42
		4	-6.03	-2.96	-12.38
		5	-5.84	-2.86	-15.24
		6	-5.65	-2.77	-18.01
	686.5	7	-5.46	-2.68	-20.69
113N7106-2	689.1	1	-6.35	-3.11	-23.80
		2	-6.16	-3.02	-26.82
		3	-5.97	-2.93	-29.75
		4	-5.78	-2.83	-32.58
		5	-5.59	-2.74	-35.32
		6	-5.40	-2.65	-37.97
	699.0	7	-5.21	-2.55	-40.52
113N7106-1	746.0	1	-5.00	-2.25	-42.77
		2	-4.81	-2.16	-44.93
		3	-4.62	-2.08	-47.01
		4	-4.43	-1.99	-49.00
		5	-4.24	-1.91	-50.91
		6	-4.05	-1.82	-52.73
	755.7	7	-3.86	-1.74	-54.47
113N7106-1	758.3	1	-4.78	-2.15	-56.62
		2	-4.59	-2.07	-58.69
		3	-4.40	-1.98	-60.67
		4	-4.21	-1.89	-62.56
		5	-4.02	-1.81	-64.37
		6	-3.83	-1.72	-66.09
	768.0	7	-3.64	-1.64	-67.73

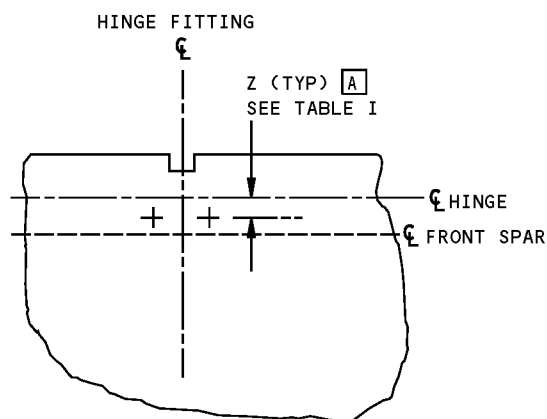
TABLE I

Balance Adjust Weights and Moments
Figure 3 (Sheet 2 of 2)

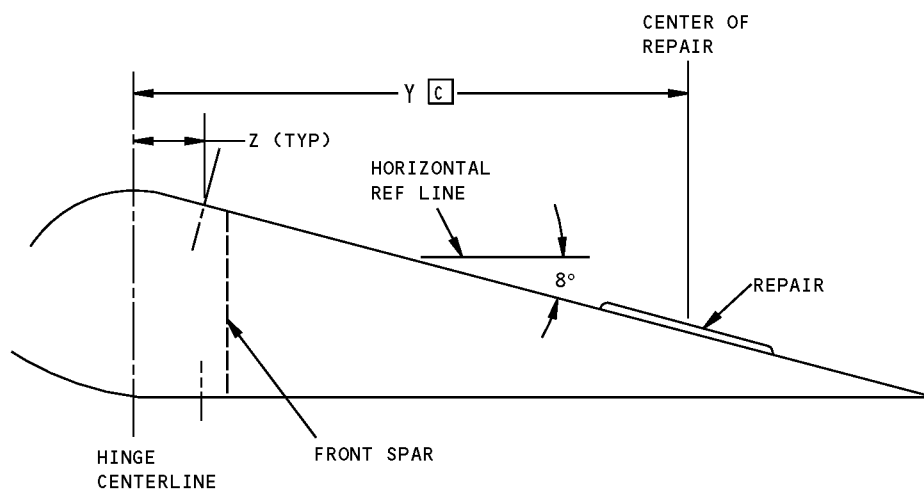
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DETAIL I



DETAIL II (TYP)



DETAIL III

Locating Hinge Centerline and Moment Arm
Figure 4 (Sheet 1 of 2)



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LOCATION	WS	Z ^A INCHES
HINGE NO. 1	817.266	1.91
HINGE NO. 2	775.450	1.91
BALANCE ARM	756.960	1.75
HINGE NO. 3	735.266	1.99
ACT. OUTBD	726.266	1.93
ACT. INBD	714.266	1.93
HINGE NO. 4	705.266	1.96
BALANCE ARM	687.770	1.75
HINGE NO. 5	670.266	1.77

TABLE I

NOTES

- ALL DISTANCES ARE MEASURED NORMAL (PERPENDICULAR) TO THE HINGE CENTERLINE

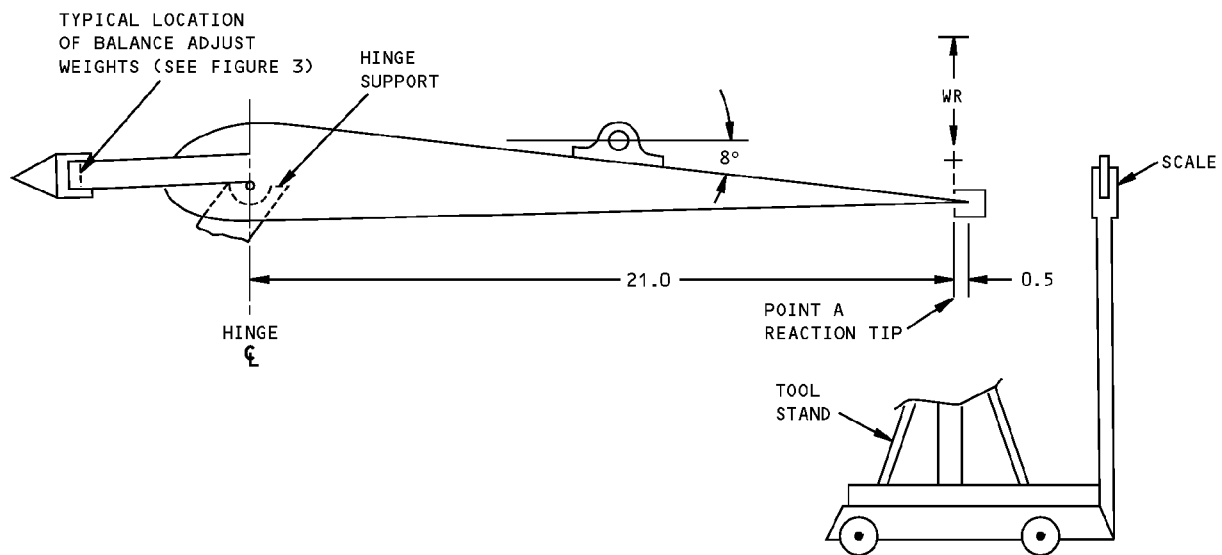
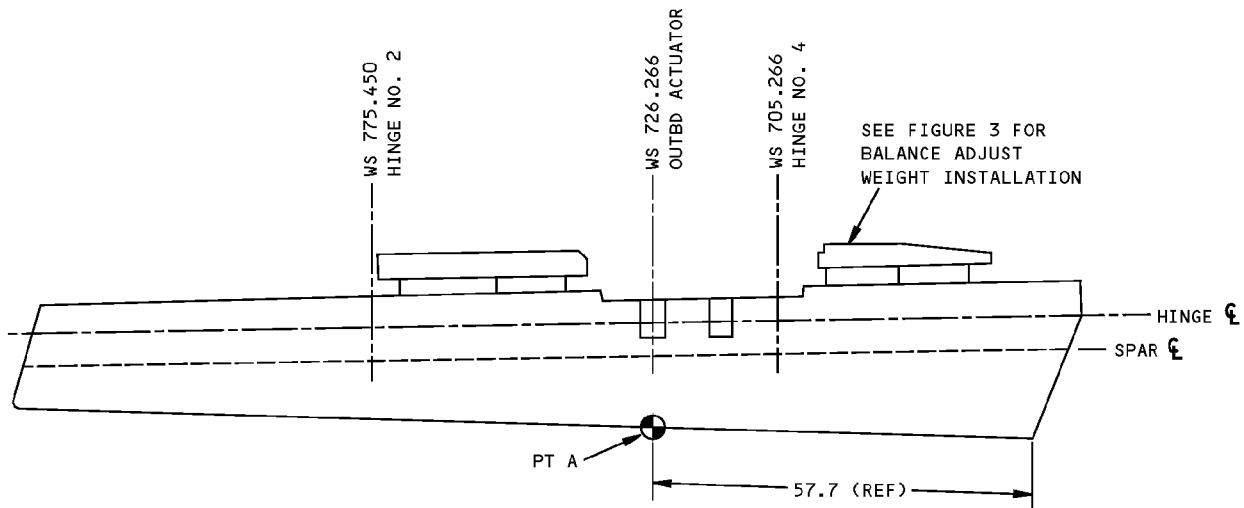
^A Z IS UPPER AND LOWER SURFACE DISTANCE FROM CENTER OF HINGE FITTING FASTENERS TO HINGE CENTERLINE. LOCATE HINGE CENTERLINE BY MEASURING Z DISTANCES FROM CENTER OF FASTENERS AT GIVEN WS AND SNAP CHALKLINE ACROSS LENGTH OF AILERON. DO NOT USE SHARP PENCIL THAT COULD SCRATCH THROUGH PAINT AND SCORE GRAPHITE FIBERS

^B ALTERNATIVE METHOD FOR LOCATING HINGE CENTERLINE. MEASURE DISTANCES FROM EDGE OF AILERON TO HINGE CENTERLINE, SHOWN IN DETAIL I AND SNAP CHALKLINE ACROSS THESE POINTS

^C MOMENT ARM Y IS THE DISTANCE FROM HINGE CENTERLINE TO CENTER OF REPAIR (CENTER OF GRAVITY)

Locating Hinge Centerline and Moment Arm
Figure 4 (Sheet 2 of 2)

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TRAILING EDGE REACTION - W.S. 726.266 (PT A)

NOTES

- THE REACTION TIP IS PLACED AT WING STATION 726.266 (A LINE, NORMAL TO THE HINGE LINE, PASSING THROUGH THE CENTER OF THE OUTBOARD ACTUATION PICK-UP FITTING)

Static Balance Setup
Figure 5



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GENERAL - TYPICAL REPAIRS

1. General

- A. This section contains typical repairs. These repairs are for general application and will be found referenced in other chapters of this manual. Because of the unspecific nature of the repairs, illustrations usually only depict the actual component which has been damaged. Attaching parts may preclude the use of the typical repair and necessitate the use of a specially designed repair or replacement of the part.
- B. Before using the typical repairs in this section, it should be ascertained that no specific repairs are available in the chapter applicable to the component. Repairs contained in other chapters are designed specifically for those components and are preferred to the typical repairs of this section.

2. References

Reference	Title
51-40-03, GENERAL	Fastener Substitution
51-40-05, GENERAL	Fastener Hole Sizes

3. Partial Repairs

- A. In some cases it may be more practical to use an existing production splice where one is adjacent to the damaged area. In this case, the typical repair data may be used to provide an additional splice to permit partial replacement of a damaged member.
- B. In some cases, damage to a component may be confined to a small portion of the member, such as one flange of an extruded section. In this instance, it is often more practical to clean up the damage to the flange and install the repair rather than completely remove a section of the damaged member.

4. Multiple Repairs

- A. Where damage is not confined to one structural element, typical repairs may be combined. For example, a web repair and an extrusion repair may both be used to restore a damaged member to a serviceable condition.

5. Fasteners

- A. Adhere to the quantities, type of fasteners, and hole sizes specified for the typical repair. Fasteners, fastener patterns, hole sizes, and quantities have been chosen to provide adequate strength and fatigue life.
- B. Where a choice of fasteners is permitted, use similar types and spacing as those existing in the vicinity of the repair.
- C. When fasteners specified in a repair are not available, refer to 51-40-03, GENERAL for fastener substitution data. The use of substitute fasteners which result in an increase in quantity or diameter may affect the size of repair parts, therefore, fastener availability should be checked before commencing the repair.
- D. Refer to 51-40-05, GENERAL for hole sizes for the various types of fasteners. Where repairs utilize existing holes in the structure it is frequently necessary to use oversize fasteners. This is particularly true where close tolerance fasteners, such as hi-loks, are used to replace rivets.



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STRUCTURAL REPAIR MANUAL

REPAIR 1 - PROCEDURES TO REWORK ALLOWABLE DENTS ON THE EXTERNAL AERODYNAMIC SURFACES OF METALLIC PARTS

1. Applicability

A. This subject gives the procedures to:

(1) Rework a dent that:

- (a) Is on the external aerodynamic surface of the airplane
- (b) Is in a 2000 series (which includes C188) or 7000 series aluminum sheet or aluminum facesheet/aluminum honeycomb sandwich panel
- (c) Is in sheet material that is 0.063 or less in thickness.
- (d) Does not have other damage (such as creases, nicks, gouges, scratches, or punctures) that is more than what is permitted by the allowable damage limits given in the Chapter-Section-Subject for the specified part
- (e) Is permitted by the applicable allowable damage limits given in the Chapter-Section-Subject for the specified part.

(2) Fill a dent that:

- (a) Is on the external aerodynamic surface of the airplane
- (b) Is in a metallic part
- (c) Is permitted by the applicable allowable damage limits given in the Chapter-Section-Subject for the specified part. The allowable damage data will also tell you if you are not permitted to fill the dent.

B. The instructions in this subject are not applicable to:

NOTE: Refer to the Chapter-Section-Subject of these parts for the applicable dent information.

- (1) Non-metallic parts
- (2) Parts that have an aluminum sheet bonded to a non-metallic honeycomb core
- (3) Parts that have non-metallic plies bonded to an aluminum honeycomb core.

C. Do not put dents back to their initial contour in the areas that follow:

NOTE: Refer to the applicable repair section in this manual to repair the damage in these areas.

- (1) Damaged bonded structures that have delaminations
- (2) Damaged areas where the skin is attached to a frame, a stringer, an intercostal, or a doubler
- (3) Damaged area across a fastener hole.

D. A dented skin area that is in a stringer and frame bay can be put back to its initial contour. For repairs across a stringer, a frame, or more than one frame bay, tell the Boeing Company.

E. This subject does not give approval for the condition of the dent, before or after you rework or fill the dent. Refer to the applicable allowable damage data in the Chapter-Section-Subject of the specified part to find the limits that are permitted for the dent.

2. General

A. Dents can cause:

- (1) A decrease in the flight performance
- (2) An effect on the flight qualities of the airplane that is not satisfactory,

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- (3) An increase in stall speed of the airplane
- (4) Buffeting.
- B. For the data that is not given in this subject but is necessary before you fill a dent, refer to:
 - (1) The allowable damage data in the Chapter-Section-Subject for the specified part to find if there are locations where you are not permitted to fill a dent,
 - (2) The allowable damage data in the Chapter-Section-Subject for the specified part to find the limits on the types of structural adhesives or fairing compounds that can be used.
- C. Make sure the aerodynamic smoothness is satisfactory as given in 51-10-01, GENERAL or the performance of the airplane will decrease.

NOTE: Dents are permitted to the dimensions given in the applicable Chapter-Section-Subject for the specified part. It is possible that these dimensions can be larger than the smoothness limits given in 51-10-01, GENERAL.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-10-02, GENERAL	Inspection and Removal of Damage
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
AMM 51-21-01	Paint Stripping - Cleaning and Painting
AMM 51-21-10/701	Decorative Exterior Finishes - Cleaning/Painting
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
NDT Part 4, 51-00-05	Bondline Delamination Inspection in Honeycomb Structure
NDT Part 6, 51-00-01	Aluminum Part Surface Inspection (Meter Display)
SOPM 20-20-02	Penetrant Methods of Inspection
SOPM 20-44-04	Application of Urethane Compatible Primers

4. Procedures to Rework and Fill Dents

- A. Do an inspection of the dent damage.
 - (1) Before and after you rework an aluminum sheet, or before you fill a dent, do the step that follows:
 - (a) Do a High Frequency Eddy Current (HFEC) inspection of the damaged area as given in NDT Part 6, 51-00-01. Make sure there are no cracks in the dent or in the adjacent area. If there are cracks, they must be repaired.

NOTE: The penetrant inspection is permitted as an alternative to the HFEC inspection. Refer to SOPM 20-20-02 for the penetrant inspection procedure.
 - (2) Before and after you rework an aluminum facesheet/aluminum honeycomb sandwich panel, or before you fill a dent, do the steps that follow:
 - (a) Do a HFEC inspection of the damaged area as given in NDT Part 6, 51-00-01. Make sure there are no cracks in the dent or in the adjacent area. If there are cracks, they must be repaired.

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- (b) Do an inspection of the damaged area to find if there is delamination between the facesheets and the core caused by the dent. It is recommended that you use an instrumented Non-Destructive Test (NDT) procedure as given in NDT Part 4, 51-00-05. The tap test procedure as given in NDT Part 1, 51-05-01 is optional. If there is delamination, make sure it is not more than the allowable limits specified in the applicable Chapter-Section-Subject.

WARNING: MAKE SURE THE OPERATOR OF THE ELECTROMAGNETIC DENT PULLER FOLLOWS THE MANUFACTURER'S INSTRUCTIONS. IF THE INSTRUCTIONS ARE NOT OBEYED, THE OPERATOR CAN GET AN ELECTRIC SHOCK OR DAMAGE TO THE PARTS CAN OCCUR.

- (3) Rework the dent as follows:

NOTE: The Boeing Company uses an electromagnetic dent remover that is sold by: Electroimpact, Inc. 4606 107th Street Southwest Mukilteo, WA, 98275, USA Phone: 425-348-8090 Internet: <http://www.electroimpact.com> If you use this dent remover, ask The Boeing Company for the instructions as given in document D6-38394, Electromagnetic Dent Remover.

- (a) For an aluminum sheet that has dent conditions that agree with the limits given in Paragraph 1.A.(1)/REPAIR 1, use the applicable metal forming procedures (which includes the procedure that uses the electromagnetic dent remover) to rework the dent.

CAUTION: DO NOT USE METAL FORMING PROCEDURES OTHER THAN THE PROCEDURE WHICH USES THE ELECTROMAGNETIC DENT PULLER TO REWORK DENTS IN ALUMINUM FACESHEET/ALUMINUM HONEYCOMB SANDWICH PANELS. IF YOU DO, DAMAGE TO THE STRUCTURAL BOND BETWEEN THE FACESHEET AND THE CORE (THAT IS MORE THAN THE ALLOWABLE DAMAGE LIMITS) CAN OCCUR.

- (b) For an aluminum facesheet/aluminum honeycomb sandwich panel that has dent conditions that agree with the limits given in Paragraph 1.A.(1)/REPAIR 1, only use an electromagnetic dent remover to rework the dent.
- (c) Remove all of the allowable damage (nicks, gouges, scratches, corrosion, and sharp creases) from the area of the dent. Refer to 51-10-02, GENERAL
- (4) Make sure the reworked dent is satisfactory.
 - (a) Do an inspection of the dent as given in Paragraph 4.A.(1)/REPAIR 1. If honeycomb sandwich was reworked, then inspect as given in Paragraph 4.A.(2)/REPAIR 1 also.
 - (b) Make sure the reworked condition of the dent agrees with the allowable damage limits given in the Chapter-Section-Subject of the damaged part.
- (5) Apply a chemical conversion coating to all the bare surfaces of the rework area. Refer to 51-20-01, GENERAL.
- (6) If applicable, apply one layer of BMS 10-79, Type II or III primer to the rework area. Refer to SOPM 20-44-04.
- (7) If applicable, apply a decorative external finish to the reworked area. Refer to AMM 51-21-10/701.

B. Dent fill procedures

- (1) Do an inspection of the dent as given in Paragraph 4.A./REPAIR 1.

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- (2) Remove the external finish in the area of the dent plus a minimum of 0.50 inch of the external finish around the dent. Refer to AMM 51-21-01.
 - (3) Put masking tape around the rework area.
 - (4) Remove all the allowable damage (nicks, gouges, scratches, corrosion, and sharp creases) from the area of the dent. Refer to 51-10-02, GENERAL.
 - (5) Apply a chemical conversion coating to all the bare surfaces of the rework area. Refer to 51-20-01, GENERAL.
 - (6) Apply one layer of BMS 10-79, Type II or III primer or the applicable decorative external finish to the rework area. Refer to SOPM 20-44-04 for the procedures to apply BMS 10-79, Type II or III primer.
 - (a) Refer to the applicable AMM subject for other decorative finishes.
 - (7) Fill the dent with one of the two types of materials that follow:
 - (a) BMS 5-92, Type I or Type V structural adhesive as given in Paragraph 4.C./REPAIR 1, or
 - (b) EC-3587-1/4 or EC-3587-1 fairing compound as given in Paragraph 4.D./REPAIR 1.
- C. Fill the dent with BMS 5-92, Type I or Type V structural adhesive.
- (1) Apply BMS 5-92, Type I or Type V structural adhesive.
 - (a) Mix the Part A, and the Part B, components together as given in Table 201/REPAIR 1. If you mix a lesser or larger quantity of Part A or B together, or the temperature does not agree with those in Table 201/REPAIR 1, the pot life will be different. Refer to the manufacturer's recommendations when you use different quantities of Part A and Part B than those given in Table 201/REPAIR 1.

NOTE: The pot life is the length of time in which you can apply the structural adhesive.
 - (b) Apply the structural adhesive to the dent until it is slightly higher than the necessary contour.

NOTE: If necessary, you can put a plastic sheet (polyethylene or equivalent) on the filled area to help hold the necessary contour. Hold the plastic sheet down with masking tape.
 - (c) Smooth the structural adhesive out on the area around the dent that has a chemical conversion coating.

Table 201: BMS 5-92 Structural Adhesive

TYPE	PART A QUANTITY	PART B QUANTITY	POT LIFE
I	58 grams	42 grams	120 minutes at 65°F (18°C) to 80°F (27°C) from the time Parts A and B are mixed together
V Class 1	Refer to the manufacturer's instructions	Refer to the manufacturer's instructions	20 minutes at 60°F (16°C) to 80°F (27°C) from the time Parts A and B are mixed together
V Class 2	Refer to the manufacturer's instructions	Refer to the manufacturer's instructions	60 minutes at 60°F (16°C) to 80°F (27°C) from the time Parts A and B are mixed together

- (2) Cure the BMS 5-92, Type I or Type V structural adhesive.
 - (a) Refer to Figure 201/REPAIR 1 for the cure time and cure temperature of BMS 5-92, Type I structural adhesive.
 - (b) Cure BMS 5-92, Type V, Class 1 structural adhesive at:

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- 1) 70°F (21°C) to 100°F (38°C) for a minimum of 3 hours, or
 - 2) 120°F (49°C) to 130°F (54°C) for a minimum of 2 hours.
- (3) Cure the BMS 5-92, Type IV, Class 2 structural adhesive at
- (a) 70°F (21°C) to 100°F (38°C) for a minimum of 7 hours.

WARNING: MAKE SURE THAT YOU WEAR GLOVES, PROTECTIVE CLOTHING AND EYE PROTECTION WHEN YOU WORK WITH THE UNCURED RESINS OF BMS 5-92, TYPE I AND TYPE V STRUCTURAL ADHESIVES. MAKE SURE THAT THERE IS A GOOD FLOW OF CLEAN AIR. UNCURED RESINS ARE DANGEROUS. IF THE UNCURED RESINS TOUCH YOUR SKIN, WASH YOUR SKIN WITH WARM WATER AND SOAP. THE RESULT CAN BE PERSONAL INJURY.

- (4) Sand the cured structural adhesive to the necessary contour of the aerodynamic surface. Use care so that you do not cause damage to the surfaces external to the rework area.
 - (5) Apply one layer of BMS 10-79, Type II or III primer to the structural adhesive. Refer to SOPM 20-44-04.
 - (6) Apply BMS 10-60, type II enamel or other decorative external finish to the reworked area. Refer to AMM 51-21-00/701 or AMM 51-21-10/701 as applicable.
- D. Fill the dent with EC-3587-1/4 or EC-3587-1 fairing compound.

WARNING: MAKE SURE THAT YOU WEAR GLOVES, PROTECTIVE CLOTHING AND EYE PROTECTION WHEN YOU WORK WITH THE UNCURED RESINS OF EC-3587-1/4 OR EC-3587-1 FAIRING COMPOUND. MAKE SURE THAT THERE IS A GOOD FLOW OF CLEAN AIR. UNCURED RESINS ARE DANGEROUS. IF THE UNCURED RESINS TOUCH YOUR SKIN, WASH YOUR SKIN WITH WARM WATER AND SOAP. IF YOU DO NOT, INJURY TO PERSONS CAN OCCUR.

- (1) Apply EC-3587-1/4 or EC-3587-1 fairing compound.
 - (a) Refer to Table 202/REPAIR 1 for the application times and the cure temperatures of the fairing compound.

Table 202: Cure Times, Cure Temperature. and Application Time for EC-3587-1/4 AND EC-3587-1 Fairing Compounds

MATERIAL	CURE TIME	CURE TEMPERATURE	APPLICATION TIME
EC-3587-1/4	48 hours	70°F (21°C) to 80°F (27°C)	15 minutes at 70°F (21°C) to 80°F (27°C)
EC-3587-1/4	20 hours	115°F (46°C) to 125°F (52°C)	15 minutes at 70°F (21°C) to 80°F (27°C)
EC-3587-1	96 hours	70°F (21°C) to 80°F (27°C)	60 minutes at 70°F (21°C) to 80°F (27°C)
EC-3587-1	30 hours	115°F (46°C) to 125°F (52°C)	60 minutes at 70°F (21°C) to 80°F (27°C)

- (b) Apply the fairing compound to the dent until it is slightly higher than the necessary contour.

NOTE: If necessary, you can put a plastic sheet (polyethylene or equivalent) on the filled area to help hold the necessary contour. Hold the plastic sheet down with masking tape.
 - (c) Smooth the fairing compound out on the area around the dent that has a chemical conversion coating.
- (2) Cure the fairing compound. Refer to Table 202/REPAIR 1 for the cure time and cure temperature of the fairing compound.



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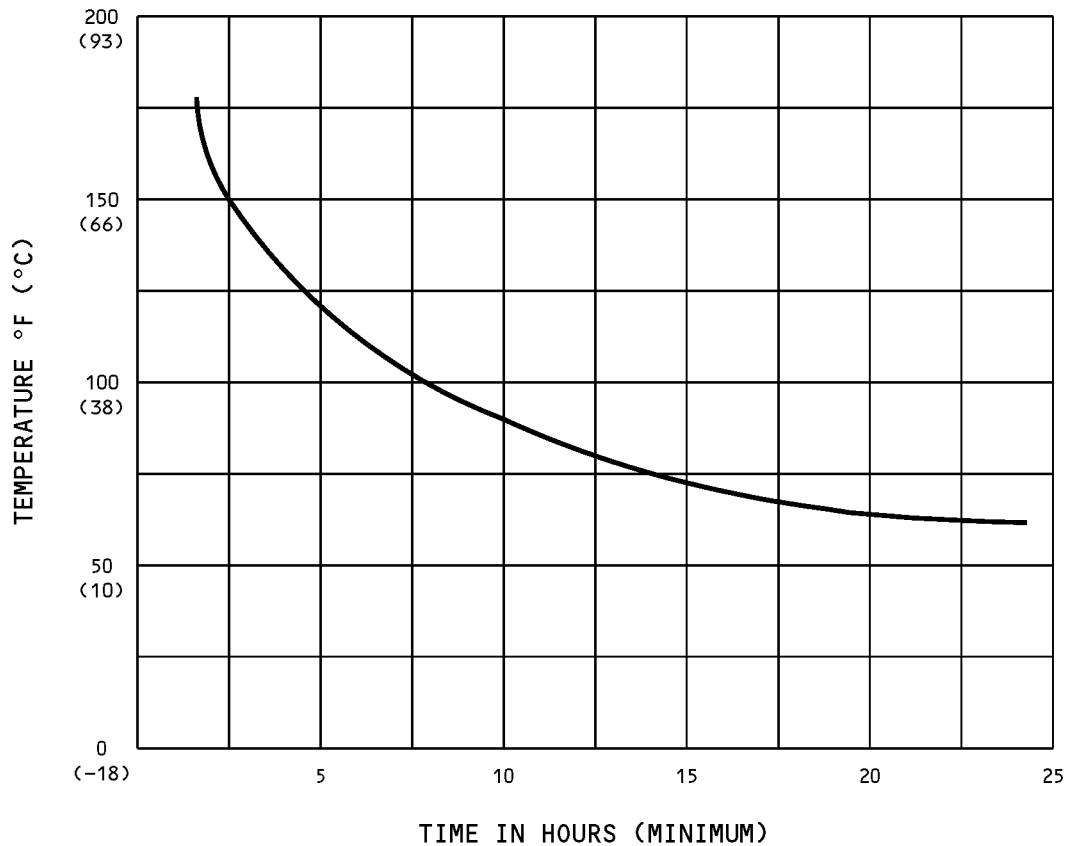
STRUCTURAL REPAIR MANUAL

WARNING: MAKE SURE THAT YOU WEAR GLOVES, PROTECTIVE CLOTHING, EYE PROTECTION AND AN APPROVED MASK WHEN YOU SAND THE FAIRING COMPOUND. MAKE SURE THAT THERE IS A GOOD FLOW OF CLEAN AIR. IF YOU DO NOT, THE FINE DUST THAT IS THE RESULT CAN CAUSE DAMAGE TO YOUR RESPIRATORY SYSTEM.

- (3) Sand the cured fairing compound to the necessary contour of the aerodynamic surface. Use care not to cause damage to the surfaces external to the rework area.
- (4) Apply one layer of BMS 10-79, Type II or III primer to the fairing compound. Refer to SOPM 20-44-04.
- (5) Apply a decorative external finish to the reworked area. Refer to AMM 51-21-10/701.



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BMS 5-92, Type I Structural Adhesive Cure Cycle
Figure 201



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GENERAL - LOCATIONS OF THE PRINCIPAL COMPOSITE COMPONENTS

1. General

- A. This subject contains information pertaining to the locations of principal fiberglass, graphite, aramid, and graphite/aramid/glass hybrid composite components. Reference is made to specific component repair, allowable damage, and identification subjects.
- B. Refer to Figure 1/GENERAL, Table I for principal fiberglass components manufactured at 250°F (121°C) cure temperature.
- C. Refer to Figure 1/GENERAL, Table II for principal fiberglass components manufactured at 350°F (177°C) cure temperature.
- D. Refer to Figure 1/GENERAL, Table III for principal graphite, aramid, and graphite/aramid/glass hybrid fiberglass components manufactured at 250°F (121°C) cure temperature.
- E. Refer to Figure 1/GENERAL, Table IV for principal graphite, aramid, and graphite/aramid/glass hybrid components manufactured at 350°F (177°C) cure temperature.



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NOTES

- REFER TO SPECIFIC IDENTIFICATION SUBJECT FOR PICTORIAL REPRESENTATION.
- REFER TO SPECIFIC COMPONENT REPAIR SUBJECT FOR AUTHORIZED REPAIRS AND REPAIR LIMITS.
- REFER TO SPECIFIC ALLOWABLE DAMAGE SUBJECT FOR ALLOWABLE DAMAGE DATA.

A COMPONENT HAVING MORE THAN ONE COMPOSITE ARRANGEMENT.

COMPONENT DESCRIPTION	REFERENCE DRAWING(S)	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
APU INTAKE PORT DOOR	353N1001 353N1010	52-40-02
CREW DOOR	417N1076	52-50-02
FLOOR PANELS		53-00-50
NOSE RADOME	141N0070	53-10-72
SECTION 43 CARGO COMPARTMENT DECK PLATE PAN	453N1170	53-30-53
HORIZONTAL STABILIZER TRAILING EDGE PANEL	183N1102	55-10-01
HORIZONTAL STABILIZER TIP	189N0001 A	55-10-30
HORIZONTAL STABILIZER FAIRING SKIN	184N1006	55-10-70
VERTICAL STABILIZER SKIN PANEL	175N2002	55-30-01
VERTICAL STABILIZER RIB	174N1104	55-30-09
VERTICAL STABILIZER FIXED TRAILING EDGE BEAM HINGE ASSEMBLY	173N1104	55-30-13
VERTICAL STABILIZER TIP	179N1008 A	55-30-30
RUDDER TIP	173N2603 A	55-40-30
WING FIXED LEADING EDGE SKIN PANELS	114N2202 114N2201 114N2103 THRU 114N2107	57-41-01
WING LEADING EDGE SLAT SKIN CLOSURE PANEL	114N4058 A 114N3012 A	57-43-01
WING FIXED TRAILING EDGE SKIN PANEL	113N1984	57-51-01
TRUNNION FAIRING SKIN PANELS	113N1800	57-51-70
TRAILING EDGE FLAP SKIN PANEL	113N2003 113N3600	57-53-01
FLAP TRACK FAIRING SKIN PANELS	113N1719 A 113N1739 A	57-53-70

LOCATION OF PRINCIPAL FIBERGLASS COMPONENTS MANUFACTURED AT
250°F (121°C) CURE TEMPERATURE
TABLE I

Locations of Composite Fabric Components
Figure 1 (Sheet 1 of 6)



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STRUCTURAL REPAIR MANUAL

COMPONENT DESCRIPTION	DRAWING	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
WING FIXED LEADING EDGE SKIN PANELS	114N1601 114N1501 114N2108	57-41-01
FLAP TRACK FAIRING SKIN PANELS	113N1761 A	57-53-70

LOCATION OF PRINCIPAL FIBERGLASS COMPONENTS MANUFACTURED AT
350°F (177°C) CURE TEMPERATURE
TABLE II

Locations of Composite Fabric Components
Figure 1 (Sheet 2 of 6)



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






COMPONENT DESCRIPTION	REFERENCE DRAWING	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
HYDRAULIC ACCESS DOOR	149N7610	52-40-02
AIR CONDITIONING ACCESS DOOR	149N7314	52-40-02
RAM AIR TURBINE DOOR	149N7720	52-40-02
TOILET DRAIN ACCESS DOOR	147N7702	52-40-02
WING TO BODY FAIRING ACCESS DOORS	149N7111	52-40-02
LANDING GEAR GROUND ACCESS DOOR	149N7640	52-40-02
APU INTAKE PORT FRAME	353N1001 353N1035	52-40-02
NOSE LANDING GEAR DOOR PANELS	141N6910	52-80-02
MAIN LANDING GEAR STRUT DOOR PANELS	113N8100 113N8107	52-80-02
TRUNNION FAIRING DOOR PANEL	113N1800	52-80-02
SECTION 43 CARGO COMPARTMENT STANCHION	453N1151	53-30-53
SECTION 43 WING TO BODY FAIRING	149N7110 149N7111	53-30-70
SECTION 44 WING TO BODY FAIRING	149N7501	53-40-70
SECTION 46 CARGO COMPARTMENT STANCHION	453N1701 453N1601	53-60-53
SECTION 46 WING TO BODY FAIRING	149N7601	53-60-70

LOCATION OF PRINCIPAL GRAPHITE, ARAMID, AND GRAPHITE/ARAMID/GLASS HYBRID
REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH COMPOSITES
MANUFACTURED AT 250°F (121°C) CURE TEMPERATURE
TABLE III

Locations of Composite Fabric Components
Figure 1 (Sheet 3 of 6)



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STRUCTURAL REPAIR MANUAL

COMPONENT DESCRIPTION	DRAWING(S)	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
HORIZONTAL STABILIZER TRAILING EDGE UPPER PANELS	183N1102  183N1101 	55-10-01
HORIZONTAL STABILIZER TRAILING EDGE LOWER PANELS	183N1201 THRU 183N1206	55-10-01
HORIZONTAL STABILIZER TIP	189T0001 	55-10-30
ELEVATOR FAIRING TIP	183N2903	55-20-30
VERTICAL STABILIZER SKIN PANELS	173N1105 THRU 173N1108	55-30-01
VERTICAL STABILIZER TIP	179N1008 	55-30-30
RUDDER TIP	173N2603 	55-40-30
WING FIXED LEADING EDGE SKIN PANELS	114N2101 114N2109 THRU 114N2115 114N2119	55-41-01
WING LEADING EDGE SLAT SKIN CLOSURE PANELS	114N4058  114N3012 	57-43-01
WING FIXED TRAILING EDGE SKIN PANELS	113N1610 113N1620 113N1640 113N1650	57-51-01
TRUNNION FAIRING SKIN PANELS	113N1800	57-51-70
FLAP TRACK FAIRING SKIN PANELS	113N1714 113N1734 112N1753	57-53-70

LOCATION OF PRINCIPAL GRAPHITE, ARAMID, AND GRAPHITE/ARAMID/GLASS HYBRID
REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH COMPOSITES
MANUFACTURED AT 250°F (121°C) CURE TEMPERATURE
TABLE III (CONT)

Locations of Composite Fabric Components
Figure 1 (Sheet 4 of 6)



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








COMPONENT DESCRIPTION	REFERENCE DRAWING(S)	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
MAIN LANDING GEAR DOOR	149N6002	52-80-02
MAIN LANDING GEAR DOOR HEAT SHIELD	149N6018 149N6023	52-80-02
SECTION 44 WING TO BODY FAIRING SKIN PANELS	149N7501	53-40-70
INLET COWL OUTER SKIN PANEL PW2000	314N3012	54-11-01
FAN COWL SKIN PANELS RB211-535C	LJ71465	54-20-01
FAN COWL SKIN PANELS RB211-535E4	LJ75503	54-20-01
FAN COWL SKIN PANELS	314N3111	54-21-01
REVERSER COWL SKIN PANEL RB211-535C	LJ70087	54-30-01
REVERSER COWL SKIN PANEL RB211-535E4	LJ75087	54-30-01
FAN DUCT COWL AND THRUST REVERSER SKIN PANELS PW2000	315N3564 315N3230	54-31-01
STRUT FAIRING SKIN RB211 ENGINES	313N5036 313N5037 313N5003 313N5004 313N5006	54-50-70
STRUT SKIN FLUID BARRIER	313N3030	54-51-01
STRUT FAIRING SKIN PANEL PW2000	313N3100 313N3004 313N3006	54-51-70

LOCATION OF PRINCIPAL GRAPHITE, ARAMID, AND GRAPHITE/ARAMID/GLASS HYBRID
REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH COMPOSITES
MANUFACTURED AT 350°F (177°C) CURE TEMPERATURE
TABLE IV

Locations of Composite Fabric Components
Figure 1 (Sheet 5 of 6)



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STRUCTURAL REPAIR MANUAL

COMPONENT DESCRIPTION	DRAWING	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
ELEVATOR SKIN	183N2003	55-20-01
ELEVATOR SPAR	183N2202	55-20-02
ELEVATOR RIBS	183N2501 THRU 183N2504	55-20-02
ELEVATOR LEADING EDGE RIB	183N2003	55-20-02
RUDDER SKIN PANELS	173N2101	55-40-01
RUDDER RIBS & SPARS	173N2101	55-40-02
WING FIXED LEADING EDGE SKIN PANELS	114N1501	57-41-01
WING TRAILING EDGE MAIN FLAP TRAILING EDGE WEDGE	113N2803	57-53-01
WING TRAILING EDGE MAIN FLAP SKIN PANELS	113N2003	57-53-01
WING TRAILING EDGE AFT FLAP LEADING EDGE SKIN PANELS	113N3804	57-53-01
WING TRAILING EDGE AFT FLAP NOSE CAP SKIN	113N3801	57-53-01
WING TRAILING EDGE AFT FLAP TRAILING EDGE WEDGE	113N3820	57-53-01
FLAP TRACK FAIRING SKIN PANEL	113N1761 	57-53-70
AILERON SKIN PANELS	113N7100	57-60-01
AILERON SPAR ASSEMBLY	113N7105	57-60-02
SPOILER 1,2,3 SKIN PANELS	113N5101  113N5502 	57-70-01
SPOILER 4 SKIN PANELS	113N5401  113N5602 	57-70-01
SPOILER 5 SKIN PANELS	113N4101  113N4502 	57-70-01
SPOILER 6 SKIN PANELS	113N4201  113N4602 	57-70-01
SPOILER 1,2,3 SPAR	113N5105  113N5503 	57-70-02
SPOILER 4 SPAR	113N5402  113N5603 	57-70-02
SPOILER 5 SPAR	113N4105  113N4503 	57-70-02
SPOILER 6 SPAR	113N4205  113N4603 	57-70-02

LOCATION OF PRINCIPAL GRAPHITE, ARAMID, AND GRAPHITE/ARAMID/GLASS HYBRID
REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH COMPOSITES
MANUFACTURED AT 350°F (177°C) CURE TEMPERATURE
TABLE IV (CONT)

Locations of Composite Fabric Components
Figure 1 (Sheet 6 of 6)



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STRUCTURAL REPAIR MANUAL

GENERAL - GRAPHITE AND/OR ARAMID REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH REPAIRS - ROOM TEMPERATURE/150°F (66°C) CURE (WET LAYUP)

1. Applicability

WARNING: DO NOT BREATHE CARBON FIBER DUST. MAKE SURE THAT THERE IS A GOOD FLOW OF AIR WHERE YOU DO THE WORK. USE EQUIPMENT TO HELP YOU BREATHE WHEN YOU WORK IN A CONFINED SPACE. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY.

CAUTION: TO GET AN ACCEPTABLE QUALITY REPAIR, DO AS FOLLOWS:



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(CAUTION PRECEDES)

- REFER TO THE APPLICABLE COMPONENT WHICH YOU ARE GOING TO REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE YOU USE THESE REPAIR INSTRUCTIONS.
- USE THE CORRECT MATERIALS FOR THE TYPE OF COMPONENT AND REPAIR THAT IS MADE.
- USE THE MATERIALS THAT AGREE WITH THE SPECIFICATIONS IN THE SRM.
- ACCURATELY FOLLOW THE SRM PROCEDURES AT EACH STEP OF THE REPAIR. IF YOU DO NOT DO THIS, IT CAN CAUSE A REPAIR THAT IS NOT SATISFACTORY AND IS NOT APPROVED.

ROOM TEMPERATURE/150°F (66°C) CURE REPAIRS WILL NOT RESTORE EITHER THE STRENGTH OR THE DURABILITY OF THE ORIGINAL 250°F (121°C) OR 350°F (177°C) CURE COMPONENTS. FOR SIZE AND LIMITS OF SUCH REPAIRS, SEE APPLICABLE REPAIR SECTION.

ROOM TEMPERATURE/150°F (66°C) REPAIRS MUST NOT BE USED IN STRESS CRITICAL AREAS OF PRIMARY STRUCTURE COMPONENTS. FAILURE TO COMPLY WOULD RESULT IN AN INADEQUATE REPAIR.

CAUTION: DO NOT LET CARBON FIBER DUST GO INTO ELECTRICAL EQUIPMENT. CARBON FIBER DUST IS ELECTRICALLY CONDUCTIVE AND IT CAN CAUSE SHORT CIRCUITS IF IT GOES INTO ELECTRICAL EQUIPMENT. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE ELECTRICAL EQUIPMENT.

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of graphite tape or fabric, aramid fabric or a combination of graphite, aramid or fiberglass. A hybrid is the combined use of graphite, aramid or fiberglass. The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands and at fitting locations. Glass fabric is also known as fiberglass cloth. This section describes repairs made using room temperature/150°F (66°C) cure materials (wet layup).

NOTE: The repairs called for in this section are wet layup repairs. These repairs require rapid use of catalyzed resin materials. Room temperature wet layup repairs will not return the structure to its original strength or durability. A periodic inspection plan for the repaired area may be required. For size and limits of such repairs, see applicable repair section.

The repairs in this section are room temperature/150°F (66°C) repairs, the cure of which may be accelerated by the application of heat as specified herein. To obtain maximum properties, cure repair at 150°F (66°C).

- B. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.



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Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage
Paragraph 4.B./GENERAL	Remove Water and Dry Out Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedures
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 5.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.H./GENERAL	Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Punctures, 0.50 in. (12.7 mm) Diameter or Less, in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Laminated Panels
Paragraph 5.L./GENERAL	Repair of Surface Dents
Paragraph 5.M./GENERAL	Repair of Lightning Strike Damage
Paragraph 5.N./GENERAL	Repair of Small Damage to One Skin
Paragraph 5.O./GENERAL	Repair of Erosion Damage to Panel Edges
Paragraph 5.P./GENERAL	Repair of Cracked Graphite Stanchion in Cargo Compartment

2. General

WARNING: HEAT FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.



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(WARNING PRECEDES)

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR NEOPRENE GLOVES WITH COTTON LINERS, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE BARE OR ALUMINUM COATED TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY ALSO BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.

WHEN REINSTALLING ALUMINUM FITTINGS ON GRAPHITE COMPOSITE STRUCTURE, ENSURE THAT THE ORIGINAL CORROSION PROTECTIVE TREATMENT IS MAINTAINED. INSTALL FITTINGS WITH FAYING SURFACE SEAL USING BMS 5-26 IN FUEL TANK AREAS OR BMS 5-95 IN ALL OTHER AREAS.

- A. Specific allowable damage, repair limitations, and repair data, can be found in the chapter/section/ subject associated with each structural component.
- B. Use suitable holding fixtures for large repairs to prevent distortion of the structure.
- C. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- D. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- E. Store resin, and/or adhesive material at 40° to 80°F (4° to 27°C) in sealed containers. An identification label must accompany the material inside the container, with the following information: BMS Type, Class, grade, supplier name, batch number, and date of preparation.
- F. Refer to 51-70-02, GENERAL for locations of principal composite components.
- G. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- H. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
 - I. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- J. Refer to 51-70-16, GENERAL for drilling and machining of composite parts.
- K. Refer to 51-70-14, GENERAL for repair of flame spray.
- L. Refer to 51-30-06, GENERAL for composite repair material ordering data.
- M. Repair damage to aluminum foil per 51-70-14, GENERAL if damage does not extend into underlying plies. Repair aluminum foil per 51-70-04, GENERAL or 51-70-05, GENERAL if damage does extend into the underlying plies.

3. **References**

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-05, GENERAL	Repair Sealing

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STRUCTURAL REPAIR MANUAL

(Continued)

Reference	Title
51-30	REPAIR MATERIALS
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-60	CONTROL SURFACE BALANCING
51-70-02, GENERAL	Locations of the Principal Composite Components
51-70-04, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 350°F (177°C) Cure
51-70-05, GENERAL	Graphite/Aramid/Hybrid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 250°F (121°C) Cure
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Repair Procedures Common to Various Repairs

A. Determine Damage

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- (1) Examine visually for extent of damage.
- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic or thermography methods. Remove contaminants. Refer to Paragraph 4.B./GENERAL for water removal instructions.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental nondestructive inspection (NDI) methods or by tap test. For tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will give a dull sound. Solid bonded areas will give a sharp ring. Refer to NDT Part 1, 51-05-01.

B. Remove Water and Dry Out Damaged Area.

- (1) Remove water from honeycomb sandwich (Figure 11/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb in the damaged area. Remove standing water using vacuum or oil-free compressed air.
 - (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
 - (c) Apply a fiberglass or metal fine mesh screen over exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.

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- (g) If the far side is accessible, apply thermocouple and heating blanket to the far side of the honeycomb sandwich panel.

NOTE: If the far side is accessible, it is acceptable to heat the area using a heating blanket only on the far side. An additional heating blanket may be used on the near side at the location shown in Figure 11/GENERAL to accelerate water removal.

If the far side is inaccessible, use of a heating blanket on the near side is required.

- (h) When the far side is inaccessible or when using an additional heating blanket, place the heating blanket over the bleeder cloth on the near side.
- (i) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
- (j) Evacuate the layup to a minimum 22 in/Hg (75 kPa) vacuum.
- (k) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
- (l) Remove layup materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
- (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
- (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

C. Remove Damage and Prepare Damaged Area.

(1) Damage removal.

- (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.

- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. For crush splice repairs (Paragraph 4.D./GENERAL) leave two to four core cells visible between core cavity and skin (Figure 19/GENERAL). The core area removed should extend at least 0.5 in. (12.7 mm) further than the visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side. In cores greater than 1.0 in. (25.4 mm) thick, partially remove core (at least 0.5 in. (12.7 mm) deep) sufficient to clean up damage.

NOTE: When a potted core repair is to be made, removal of damaged core is not required.

- (c) In areas where contamination cannot be removed by cleaning or drying as given in Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 4.C.(1)(a)/GENERAL.
- (e) When core is removed from the inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.



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CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 9/GENERAL AND FIGURE 14/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(2) Preparation of damaged area (Figure 14/GENERAL).

- (a) Determine the number and orientation of plies that have been cut. Mask off the area around the cleaned up damage allowing 1.0 in. (25.4 mm) overlap for each ply replacement, plus 1.0 in. (25.4 mm) extra for each extra ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the applicable structure identification or engineering drawing.

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
 - 1) Remove the paint finish or Tedlar film using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper in the masked off area.
 - 2) Taper sand each ply or simply abrade the surface around the cleaned up damage a minimum of 1.0 in. (25.4 mm) per ply. Refer to Figure 14/GENERAL.
 - 3) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
 - 4) Abrade surfaces around repair using No. 150 or finer Scotch-Brite abrasive.
- (c) External surface of panel (critical aerodynamic surfaces).
 - 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over an approximate distance of 1.0 in. (25.4 mm) for each existing ply of the laminate. Step sanding is optional to taper sanding on honeycomb sandwich structure in areas of noncritical aerodynamic smoothness. Refer to 51-10-01, GENERAL for locations of areas of critical aerodynamic smoothness. Always taper sand on solid laminate structures.

NOTE: For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.

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- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 1.0 in. (25.4 mm) border using No. 150 or finer sandpaper.
- (d) Edgeband of panel.
 - 1) Taper sand panel edgeband according to Paragraph 4.C.(2)(c)/GENERAL.

NOTE: Edgeband is the solid laminate around the outer periphery of the honeycomb panel.

- (e) Cleaning of repair area.
 - 1) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PART WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99 or SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

- (1) Fabricate core plug.
 - (a) Fabricate core plug. Refer to specific component structural identification section to determine type, class, and grade of the original core.
 - (b) For butt splicing, the honeycomb core, plug should fit flush with original core and with ribbon direction the same as in original core. The replacement core must overlap enough to make contact with the cell walls of surrounding core material.
 - (c) For crush splicing, the honeycomb core plug should be made two to four cells larger than the repair cavity and be made from core material which is a maximum of two grades denser than the original core (Figure 19/GENERAL).

NOTE: Crush splicing applies to fiberglass core (BMS 8-124, Class I) only.

- (d) Trim core plug to full or partial depth of original core as given in Paragraph 4.C.(1)(b)/GENERAL and Figure 2/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive between core plug and undamaged core or skin (Figure 2/GENERAL, Figure 3/GENERAL, Figure 8/GENERAL, Figure 14/GENERAL).

- (2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

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STRUCTURAL REPAIR MANUAL

(WARNING PRECEDES)

CAUTION: DO NOT EXCEED IMMERSION CRITERIA GIVEN IN PARAGRAPH 4.D.(2)(A)/GENERAL. DAMAGE TO CORE MATERIAL WILL OCCUR. DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (AMM 20-30-99 or SOPM 20-30-99) bath for 60 seconds.
- (b) Locally contaminated areas can be washed with solvent, Series 99 (AMM 20-30-99 or SOPM 20-30-99).
- (c) The core must be completely dry, clean and free of evidence of solvents before installation.
- (3) Install core plug (Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, and Figure 8/GENERAL).
 - (a) If one skin is undamaged, cut two plies of BMS 9-3, Type H-2 or H-3 fiberglass fabric or four plies of BMS 9-3, Type D fiberglass fabric that will fit on the inside surface of the undamaged skin (Figure 2/GENERAL and Figure 14/GENERAL). Saturate the plies with Resin Mix 1, prepared as shown in Figure 1/GENERAL, then position in core cavity.
 - (b) If both skins are damaged, tape a caul plate against the exterior surface of far side skin and repair as for damage to one skin only. Repair the other surface in a subsequent repair cycle.
 - (c) For butt splicing, spread Resin Mix 2 with microballoons, on the sides of the replacement core and the undamaged core that will mate when the plug is installed. Orientate ribbon in the direction of original core ribbon.
 - (d) For crush splicing, prepare and install the core plug per Figure 19/GENERAL. Orient ribbon in the direction of original core ribbon.
 - (e) Put the layup materials and equipment in place as shown in Figure 3 (Sheet 2).
 - (f) Evacuate the repair area to a minimum of 22 in/Hg (75 kPa) vacuum.
 - (g) Cure per component repair chart and Figure 1/GENERAL.
 - (h) Sand repair core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
 - (i) Vacuum to remove sanding residue from core cells.

NOTE: The above procedure is based on the core plug installation being cured separately from the repair plies. As an option, core plug installation and repair plies may be cured at the same time.

E. Prepare and Apply Repair Plies.

NOTE: Refer to applicable paragraphs for preparation of glass and graphite fabrics. For hybrid components, refer to relevant material paragraphs for each individual ply. Aramid fabric damage will be repaired using glass fabric plies. Refer to Figure 13/GENERAL for substitution of glass fabric for aramid fabric.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

- (1) Prepare glass fabric repair plies (BMS 9-3).

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- (a) Refer to the component structure identification to determine number, style, and orientation of glass fabric used in original structure. Repair existing Type 120 plies with Type D plies. Repair existing Type 1581 or 181 plies with Type H-2 plies. Repair existing Type 7781 plies with Type H-3 plies. Refer to specific structural component repair section for extra repair ply requirements (Figure 18/GENERAL). Refer to Figure 13/GENERAL for substitution of repair ply fabrics.

- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. Each repair ply must be of equivalent thickness and the same orientation as the original plies. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 18/GENERAL for extra repair ply material and orientation.

- (c) When replacing ply over core, a filler ply the size of the cutout is required to minimize surface depressions.

- (d) Impregnate repair plies with resin per Paragraph 4.E.(3)/GENERAL.

(2) Prepare graphite fabric repair plies (BMS 9-8).

- (a) Refer to the specific structural component identification to determine number, style, and orientation of graphite fabric used in original structure. Refer to the structural component repair section for extra repair ply requirements. Refer to Figure 13/GENERAL for substitution of repair ply fabrics.

- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. Each repair ply must be of equivalent thickness and the same orientation as the original plies. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 18/GENERAL for extra repair ply material and orientation.

- (c) When replacing ply over core a filler ply the size of the cutout is required to minimize surface depression.

- (d) Impregnate repair plies with resin per Paragraph 4.E.(3)/GENERAL.

(3) Impregnate repair plies with resin.

- (a) Cut two pieces of parting film approximately 3.0 in. (7.6 cm) larger all around than the fabric and tape down one piece to a smooth surface.

NOTE: Use Teflon film or other parting films.

- (b) Lay fabric onto parting film.

- (c) Spread Resin Mix 1, prepared as shown in Figure 1/GENERAL, to adequately cover fabric evenly.

- (d) Cover the fabric on the parting film with the second piece of parting film.

- (e) Press the resin through the fabric by working over the parting film with a squeegee or roller, in order to impregnate the fabric and to remove entrapped air.

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- (f) Work excess resin to edges of fabric such that fabric weave is barely visible.

NOTE: Resin content of the impregnated fabric should be 55 ± 5 percent by weight.

- (g) Cut the impregnated fabric to the required sizes for each individual ply of the patch. The parting film on both sides of the fabric decreases fraying of the edges while cutting the fabric.

NOTE: The total number of repair plies is to be in accordance with Paragraph 4.E.(2)/GENERAL. Refer to Figure 14/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired. The filler ply over an exposed honeycomb core must be installed with the same orientation as the original surface ply. Other extra repair plies must be installed as specified in individual structural component repair sections.

- (4) Apply repair plies (Figure 2/GENERAL and Figure 14/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with filler plies before application of the repair plies.

CAUTION: ENSURE THAT PARTING FILM IS REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Apply a coat of Resin Mix 1, prepared as shown in Figure 1/GENERAL, over the repair area, both the sanded laminate and the exposed core.
- (b) Remove parting film from one side of the smallest ply of the patch and place the exposed face against the repair area with orientation as in original structure.
- (c) Use a squeegee over the parting film that covers the patch to remove wrinkles and entrapped air. Do not apply excessive pressure. Excessive pressure will produce a patch deficient in resin.
- (d) After removing parting film from the contact faces, place the next larger size ply of the impregnated patch over the ply on the repair area with proper orientation and with overlap all around per Figure 14/GENERAL.
- (e) Place succeeding plies of the patch as described in Paragraph 4.E.(4)(c)/GENERAL and Paragraph 4.E.(4)(d)/GENERAL.
- (f) Proceed to layup/bagging procedure.

F. Layup/Bagging Procedure (Figure 3/GENERAL).

- (1) Place a layer of perforated FEP parting film (1 mil (0.025 mm) thick) over the repair. Cut the FEP so that the edges extend 3 in. (7.6 cm) beyond the edge of the repair patch.
- (2) Secure three thermocouples (spaced evenly around repair) to the panel at the edge of the repair and secure them to the appropriate recorders.
- (3) Place a layer of dry peel ply or Style 120 glass fabric (or equivalent thickness glass fabric) over the perforated FEP as a surface bleeder. Cut the surface bleeder so that the edges extend 2 in. (5 cm) beyond the edge of the perforated FEP.
- (4) Place a layer of solid FEP parting film (2 mils (0.051 mm) thick) over the surface bleeder. Cut the solid FEP so that the edges are even with the edge of the perforated FEP.

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- (5) Place a layer of Airweave SS or Style 120 glass fabric over the solid FEP as a surface breather. Cut the surface breather so that the edges extend to the edge of the surface bleeder. Make certain the surface breather makes contact with the surface bleeder along the edges.
- (6) Secure a vacuum line on the edge of the surface breather.

WARNING: FOR ACCELERATED CURE, USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- (7) If a heat blanket is used as a heat source, perform the following steps:

NOTE: A heat blanket, infrared heat lamp, or equivalent heat source may be used to accelerate the cure.

If the repair is made on a structure too small to allow the heat blanket to be vacuum bagged, proceed to Paragraph 4.F.(8)/GENERAL and place heat blanket over the vacuum bag. A second vacuum bag may then be placed over the part to hold the heat blanket in place.

- (a) Place a heat blanket over the surface breather. The heat blanket must extend a minimum of 2 in. (5 cm) beyond the repair patch edges.

NOTE: When using a heat blanket larger than 12 in. (30 cm) on one side, an aluminum caul plate (0.016 in. (0.41 mm) thick) can be used under the heat blanket to minimize localized heating. Make the caul plate slightly smaller than the surface breather.

- (b) Place controlling thermocouple over the center of the heat blanket.
- (c) Place 4 to 6 layers of glass fabric over the heat blanket. The glass fabric will insulate the heat blanket and prevent damage to the bagging film.
- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.

CAUTION: HOLLOW COMPOSITE COMPONENTS SUCH AS RUDDERS, ELEVATORS, AND AILERONS MUST NOT BE COMPLETELY BAGGED BECAUSE THEY MAY COLLAPSE UNDER 22 IN/HG (75 KPA) VACUUM. ATTACH VACUUM BAG TO ONE SIDE OF COMPONENT ONLY OR ATTACH SEPARATE VACUUM BAGS TO EACH SIDE TO ENSURE THAT ATMOSPHERIC PRESSURE IS MAINTAINED INSIDE OF COMPONENT DURING REPAIR. COMPONENTS CONSISTING OF A SINGLE PANEL MADE OF FULL DEPTH HONEYCOMB CORE WITH LAMINATE FACE SHEETS AND EDGE BANDS MAY BE COMPLETELY BAGGED. REFER TO FIGURE 24/GENERAL.

- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. In some cases, it is optional to vacuum bag the entire part.

NOTE: The entire surface must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts where sagging and distortion could occur due to the weight of the part.

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- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum.

NOTE: Maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.

- (11) Check the vacuum bag for leak paths.
(12) Cure the repair per Paragraph 4.G./GENERAL.

G. Cure the Repair

NOTE: Determination of the temperature must be made by using thermocouples placed at edge of patch.

The gel and cure times of the potting and laminating resins are based on ambient temperature (70 to 80°F; 21 to 27°C); elevated temperatures will advance the reactions and lower temperatures will retard the reactions.

An infrared heat lamp (250 watt), heating blankets or equivalent source may be used to accelerate the cure. The graph shown in Figure 4/GENERAL indicates the temperature obtained on the patch surface when the heat lamp is a certain height. Monitor temperature by thermocouples.

WARNING: USE EXPLOSIONPROOF HEAT LAMP OR HEAT BLANKETS FOR ACCELERATED CURE. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

CAUTION: SURFACE TEMPERATURE MUST NOT EXCEED 170°F (77°C). DAMAGE OR DISTORTION OF STRUCTURE MAY OCCUR IF TEMPERATURE EXCEEDS 170°F (77°C).

(1) Cure of wet layup

- (a) Cure of the repair may be accomplished at room temperature (70 to 80°F; 21 to 27°C) or can be accelerated by the use of heat blanket or heat lamp. See Figure 1/GENERAL and graph in Figure 4/GENERAL for time at temperature requirements. Heat at a maximum of 7°F (4°C) per minute. Refer to component repair chart for cure requirements.

NOTE: Cure time does not include the time required for the mold and part to heat up to temperature. Cure time is the period after the part has reached that temperature.

- (b) Maintain vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
(c) Remove bagging and parting film after curing.
(d) The patch should be free from pits, blisters, starved areas, and excess resin deposits.

H. Refinish After Repair

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of topmost repair ply as necessary to fair the edge. Sand surface of repair to produce a smooth finish without damaging fibers.
(2) Refinish repair area per 51-70-14, GENERAL.

NOTE: The procedures for restoring finishes in 51-70-14, GENERAL include repairs of Tedlar films, conductive finishes, Teflon finishes, paint systems, and aluminum foil tape applications. Sealant applications using BMS 5-95 are restored.

I. Perform Post Repair Requirements

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- (1) Make an inspection of the repair that was done to make sure that the repair is satisfactory. The inspection must include these areas:

- The area that was hot.
- A minimum width of 2 in. (5 cm) all around the area that was hot.

If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: Post repair inspection is recommended. Examples of inspection procedures are given in NDT Part 1, 51-01-01. Other inspection methods that have been examined and found satisfactory by the airlines can be used.

WARNING: FLIGHT SAFETY DEMANDS THAT CERTAIN CONTROL SURFACES BE PROPERLY BALANCED AT ALL TIMES.

- (2) Following repair of control surface, balance must be checked to determine whether or not rebalancing is required. Rebalance as necessary per CONTROL SURFACE BALANCING, SECTION/51-60.

CAUTION: REPAIRS MADE TO CONTROL SURFACES AND/OR ADJACENT STRUCTURE MUST NOT INTERFERE WITH THE DESIGNED OPERATION OF THE CONTROL SURFACES. DAMAGE TO AIRPLANE STRUCTURE MAY OCCUR.

- (3) Check all repairs for noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

CAUTION: REPAIRS MUST NOT COVER EXISTING DRAIN HOLES IN PANELS. WATER WILL ACCUMULATE IF DRAIN HOLES ARE COVERED.

- (4) If the repair covers a drain hole, drill through the repair at existing location.

NOTE: Drain holes are usually 0.375 in. (9.52 mm) diameter. Refer to AMM 51-41-01.

5. Typical Repairs

NOTE: These repairs apply to all graphite/aramid/glass fabric reinforced honeycomb and laminate components except radomes and floor panels.

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR THE REPAIR LIMITS, INSPECTION REQUIREMENTS, AND MATERIAL FOR THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

A. Repair of Delaminations Between Plies.

- (1) Delamination of plies over core area of panel (Figure 5/GENERAL).
- (a) Determine damage per Paragraph 4.A./GENERAL. Ensure that water and other contaminations are removed per Paragraph 4.B./GENERAL.
 - (b) Cut away delaminated plies per Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area per Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband (Figure 12/GENERAL).

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CAUTION: DELAMINATION MUST NOT REACH DEEPER THAN 0.5 IN. (12.7 MM) INTO THE PANEL EDGE BAND OR EXTEND TO WITHIN 0.5 IN. (12.7 MM) OF THE HONEYCOMB CORE (FIGURE 12/GENERAL). IF SO, REPAIR PER DAMAGED PLY METHOD.

- (a) Determine damage per Paragraph 4.A./GENERAL.
 - (b) Remove all contaminants and water from damaged area. Area must be completely dried out.
 - (c) Force Resin Mix 1 (Figure 1/GENERAL), BMS 5-25, or BMS 5-92, Type 1, Grade 1 into delaminated area.
 - (d) Clamp plies together and remove excess resin.
 - (e) Cure according to Paragraph 4.G./GENERAL, maintaining pressure until cured. Vacuum pressure is not required for this repair.
 - (f) Refinish surface as required.
 - (g) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.
- B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel (Figure 15/GENERAL).
- (1) Remove clear or colored Tedlar film surface, as applicable, from repair area per Paragraph 4.C.(2)/GENERAL.
 - (2) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper.
 - (3) Dry out structure around puncture per Paragraph 4.B./GENERAL.
 - (4) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape per Paragraph 4.C./GENERAL.
 - (5) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Prepare Resin Mix 4, or Resin Mix 5, according to Figure 1/GENERAL.
 - (7) Work resin into the hole filling as much as possible.
 - (8) Cure according to Paragraph 4.G./GENERAL.
 - (9) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.25 mm).
- NOTE:** A 0.010 in. (0.25 mm) thick aluminum template may be used to protect surrounding surface while sanding.
- (10) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
 - (11) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
 - (12) Prepare and apply two fabric cover plies same material and orientation as original surface ply, except replace aramid ply with glass fabric plies according to Paragraph 4.E./GENERAL.
 - (13) Complete repair per Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Figure 2/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.

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- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
 - (5) Clean surface according to Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Figure 6/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL, except it is not necessary to vacuum bag the core plug installation at this time.
 - (5) Prepare and apply repair plies to one surface of the panel according to Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
 - (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
 - (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
 - (8) Prepare and apply repair plies to the other surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- NOTE:** The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.
- E. Replacement of Honeycomb Core on Damaged Edge of Panel (Figure 7/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
 - (5) Clean surfaces according to Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side Only (Figure 8/GENERAL).
- NOTE:** This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side. Refer to Figure 8/GENERAL when making this repair.

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CAUTION: THIS REPAIR IS NOT ALLOWED IF INSPECTIONS DESCRIBED IN THE SPECIFIC COMPONENT REPAIR SECTION CANNOT BE MADE OF THE FAR SIDE SKIN.

- (1) Determine extent of damage per Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
- (3) Remove damage and prepare area per Paragraph 4.C./GENERAL and the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + \{N \times [1.0 \text{ in. (25.4 mm) for each ply}]\} + (1.0 \text{ in. (25.4 mm)})$

d = diameter of cleaned up damage (1.5 in. (38.1 mm) maximum)

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole.
 - (c) Taper sand the outer skin plies per Paragraph 4.C.(2)/GENERAL.
 - (4) Fabricate an airtight patch, (Figure 8/GENERAL, Details II thru V) to cover the oval hole from the inaccessible side as follows:
 - (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
 - (b) Cover the mold with parting film or release agent.
 - (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 4.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D diameter.
 - (d) Bag and cure the patch per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Place thermocouples at the edge of the patch before cure.
 - (e) Remove the patch from the mold.
 - (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
 - (g) Drill a 0.125 in. (3.175 mm) diameter hole in the center of the patch for a Cleco fastener.
 - (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
 - (i) Fabricate a strip of spring steel 1.0 in. (25 mm) X 10.0 in. (254 mm) and drill a 0.125 in. (3.175 mm) diameter hole in the center for the Cleco fastener.

NOTE: This repair illustrates the use of a spring steel clamp. However, any suitable retaining method may be used.

- (j) Assemble the patch and spring steel together with a 0.125 in. (3.175 mm) diameter Cleco fastener.
 - (5) Remove Tedlar, if required and abrade the underside of the inner skin to a distance of 0.4 in. (10 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

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CAUTION: DO NOT IMMERSE PARTS IN TRICHLOROETHANE SOLVENT OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
- (7) Bend up both ends of the spring steel and apply BMS 5-109, Type II adhesive paste to the precured patch.
- (8) Holding the spring steel up, insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
- (9) Cure the adhesive per Figure 1/GENERAL. When cure is complete, remove the Cleco fastener and spring. Fill hole for Cleco fastener with BMS 5-109, Type II adhesive paste or BMS 5-95, Class B 1/2 sealant and let it cure.

NOTE: Cure BMS 5-109 adhesive as given in Figure 1/GENERAL. Cure BMS 5-95 sealant as given in 51-20-05, GENERAL.

- (10) Clean out the repair area per Paragraph 4.C.(2)(e)/GENERAL.
 - (11) Apply Resin Mix 1 to the surface of the inner skin which fays with the inner skin repair plies.
 - (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin.
 - (13) Fabricate, clean, and install core plug per Paragraph 4.D./GENERAL.
 - (14) Prepare and apply repair plies to the outer skin surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Figure 9/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.

CAUTION: DO NOT SAND INTO BOND PLY OR CORE (FIGURE 9/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THIS CAUTION IS NOT OBSERVED. BOND PLY IS PLY ADJACENT TO CORE.

- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.

CAUTION: ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN THE METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY CAUSE CORROSION IN THE ALUMINUM STRUCTURE.

- (4) Prepare and apply repair plies according to Paragraph 4.E./GENERAL.
 - (5) Bag repair and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
 - (6) Refinish the repair according to Paragraph 4.H./GENERAL.
 - (7) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.
- H. Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels (Figure 21/GENERAL).

NOTE: This repair applies to components made from laminated fabric plies and epoxy resin without a honeycomb core.

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.

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- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.

CAUTION: DO NOT PENETRATE THE UNDAMAGED PLIES. LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR.

- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL except taper or step sand minimum of 0.5 in. (12.7 mm) per repair ply instead of 1.0 in. (25.4 mm) when cleaning up damage.

NOTE: Taper sand edges of plies around repair on damaged side of panel.

- (4) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

I. Repair of Punctures, 0.50 in. (12.7 mm) Diameter or Less, in Solid Laminate Panels (Figure 22/GENERAL).

- (1) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
- (3) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape per Paragraph 4.C./GENERAL.
- (4) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
- (5) Prepare Resin Mix 1, including 42% $\pm 3\%$ milled glass fiber, according to Figure 1/GENERAL.
- (6) Work resin into the hole filling as much as possible.
- (7) Cure according to Paragraph 4.G./GENERAL.
- (8) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.25 mm).

NOTE: A 0.010 in. (0.25 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (9) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
- (10) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
- (11) Prepare and apply two fabric cover plies according to Paragraph 4.E./GENERAL.

NOTE: Refer to specific component structure identification for laminate material and orientation.

For graphite laminates, use graphite repair plies of the same material and orientation as the original surface plies.

For aramid, fiberglass or hybrid laminates, use fiberglass repair plies with the same orientation as the original surface plies.

Refer to Figure 13/GENERAL for repair ply substitutions.

- (12) Complete repair per Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

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J. Repair of Delaminations Between Plies in Solid Laminate Panels.

NOTE: This repair applies to components made from laminated tape or fabric plies and epoxy resin without a honeycomb core.

- (1) Repair delaminations using methods described in Paragraph 5.H./GENERAL.

K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Laminated Panels (Figure 10/GENERAL).

- (1) Determine the extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage according to Figure 10/GENERAL.
- (4) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.

CAUTION: ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURE.

- (5) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

L. Repair of Surface Dents (Figure 16/GENERAL).

- (1) Check for delamination and broken fibers per Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair per Paragraph 5.A./GENERAL.
- (3) If broken fibers are found, repair per Paragraph 5.B./GENERAL or Paragraph 5.C./GENERAL.
- (4) If no delamination or broken fibers are found, mark off damaged area allowing 1.0 in. (25.4 mm) of overlap for the repair ply.
- (5) Clean damaged area according to Paragraph 4.C.(2)(e)/GENERAL.
- (6) Mask area for repair with masking tape.
- (7) Remove Tedlar or decorative finish using methods described in Paragraph 4.C.(2)(b)/GENERAL and Paragraph 4.C.(2)(c)/GENERAL.
- (8) Pot dent flush or slightly higher than surrounding surface with Resin Mix 2 potting compound.
- (9) Cure per Paragraph 4.G./GENERAL.

CAUTION: DO NOT SAND INTO FIBERS IN THE AREA SURROUNDING DENT.

- (10) Sand flush using 150 grit or finer sandpaper.
- (11) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.
- (12) Prepare and apply one ply of the same material and orientation as the original surface ply, except replace aramid with a glass fabric ply according to Paragraph 4.E./GENERAL. The ply layer is to be 2.0 in. (50.8 mm) larger than the potted area (Figure 16/GENERAL).

NOTE: On graphite panels, Type H-2 or H-3 glass fabric may be substituted for graphite fabric in this repair only if graphite fabric is not available.

- (13) Bag repair and cure per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (14) Refinish per Paragraph 4.H./GENERAL.

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M. Repair of Lightning Strike Damage (Figure 17/GENERAL).

CAUTION: THIS REPAIR IS LIMITED TO LIGHTNING DAMAGE NOT PENETRATING FIBERS. IF FIBERS OR CORE HAVE BEEN DAMAGED, REMOVE AND REPLACE PER PARAGRAPH 4.A./GENERAL, PARAGRAPH 4.B./GENERAL, PARAGRAPH 4.C./GENERAL, PARAGRAPH 4.D./GENERAL, PARAGRAPH 4.E./GENERAL, PARAGRAPH 4.F./GENERAL, PARAGRAPH 4.G./GENERAL, PARAGRAPH 4.H./GENERAL, AND PARAGRAPH 4.I./GENERAL.

- (1) Check for delamination per Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair per Paragraph 5.A./GENERAL or Paragraph 5.G./GENERAL.
- (3) If delamination is not found, mask off damaged area allowing 1.0 in. (25.4 mm) of overlap for the repair ply.
- (4) Clean damaged area according to Paragraph 4.C.(2)(e)/GENERAL.
- (5) Mask area for repair with masking tape.
- (6) Remove Tedlar or decorative finish using methods described in Paragraph 4.C.(2)(b)/GENERAL and Paragraph 4.C.(2)(c)/GENERAL.
- (7) Seal surface with Resin Mix 6, prepared as shown in Figure 1/GENERAL. Excess resin must be scraped off before it gels.
- (8) Cure per Paragraph 4.G./GENERAL.
- (9) Prepare and apply one ply layer of Type H-2 or H-3 glass fabric according to Paragraph 4.E.(1)/GENERAL. The ply layer is to overlap the lightning damage by 1.0 in. (25.4 mm) all around (Figure 17/GENERAL).
- (10) Complete repair per Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

N. Repair of Small Damage to One Skin (Figure 20/GENERAL).

CAUTION: THIS REPAIR HAS INSPECTION REQUIREMENTS AND TIME LIMITS. SEE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR REPAIR LIMITATIONS.

- (1) Determine damaged area per Paragraph 4.A./GENERAL.
- (2) Mask area for repair with masking tape.
- (3) Remove Tedlar or decorative finish using method described in Paragraph 4.C./GENERAL.
- (4) Remove any moisture and contamination using vacuum or oil-free compressed air.
- (5) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 7°F (4°C) per minute.
- (6) Lightly abrade masked area with 150 grit or finer sandpaper.
- (7) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.
- (8) Make a wet layup of two plies of the same material and orientation as the original surface ply except replace aramid with fiberglass plies (Figure 13/GENERAL). The plies are to overlap the damage and each other as shown in Figure 20/GENERAL.

NOTE: On graphite panels, Type H-2 or H-3 glass fabric may be substituted for graphite fabric in this repair only if graphite fabric is not available.

- (9) Bag repair and cure per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.

O. Repair of Erosion Damage to Panel Edges (Figure 23/GENERAL).

STRUCTURAL REPAIR MANUAL

- (1) Determine the damaged area per Paragraph 4.A./GENERAL. If damage exceeds the limits specified in Figure 23/GENERAL, repair per Paragraph 5.G./GENERAL. If delamination is present, repair per Paragraph 5.A.(2)/GENERAL.
 - (2) Mask the damaged area with masking tape. Use care to keep the rework area within the limits specified in Figure 23/GENERAL.
 - (3) Remove the moisture and contamination from the rework area with a vacuum or oil free compressed air and by heating the area to between 150°F (66°C) and 170°F (77°C). The rate of heating must not exceed 5°F (3°C) per minute. Refer to Paragraph 4.B./GENERAL.
 - (4) Taper sand the damaged area using 180 grit or finer sandpaper. Maintain the limits specified in Figure 23/GENERAL.
 - (5) Clean the area. Refer to Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Seal the area with Resin Mix 1 (BMS 8-301, Class 2). Refer to Figure 1/GENERAL for resin specifications, mixing, and curing procedures.
- P. Repair of Cracked Graphite Stanchion in Cargo Compartment (Figure 25/GENERAL).
- (1) Determine extent of damage. Repair only if damage is within the limits specified in the applicable chapter-section-subject. All stanchions exceeding these limits must be replaced.
 - (2) Mask off the undamaged portion of the stanchion. Allow for a repair area that extends 1.0 in. (25.4 mm) beyond end of crack.
 - (3) Inspect condition of primer coating. If primer is in good condition and free of contaminants such as oil, grease, or dirt, then solvent wipe per Paragraph 5.P.(4)/GENERAL. Contaminated primer must be removed with No. 240 Scotch-Brite or 180 grit or finer sandpaper. Do not damage fibers in the outer-most graphite ply. If glossy resin is exposed beneath the primer coat, this must be removed to a dull finish by light sanding.
 - (4) Remove contaminants from repair area per Paragraph 4.C.(2)(e)/GENERAL.
 - (5) Cut a single ply of BMS 9-3, Type H.2, Style 181-150 fiberglass cloth of sufficient width to overlap the crack by 1.0 in. (25.4 mm) minimum, and a length that will wrap around the stanchion 3 times to obtain a 3 ply buildup.
 - (6) Prepare Resin Mix 1 per Figure 1/GENERAL and impregnate the cloth per Paragraph 4.E.(3)/GENERAL. Apply a thin coat of resin to the repair surface and in the crack.
 - (7) Wrap ply around stanchion 3 times. Overlap crack by 1.0 in. (25.4 mm) minimum. Overlap bottom of stanchion (if applicable) and trim after cure. Take care to remove wrinkles during layup.
- NOTE:** Three separate plies may be used instead of one ply wrapped three times around.
- (8) Complete repair per Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, and Paragraph 4.I./GENERAL.
 - (9) Trim end of stanchion to original shape and drill fastener holes.
- NOTE:** Ply buildup in the area of attachment fasteners may cause attachment fastener and lining fastener interference.
- (10) Restore original finish per AMM 51-21-00/701.

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURE CYCLE SUFFICIENT FOR HANDLING, DRILLING, SANDING
RESIN MIX 1 (LAMINATING RESIN) (BMS 8-301 CLASS 2)	FR 7020 PART A RESIN BASE PART B HARDENER EY 3804 PART A RESIN BASE PART B HARDENER	100 ±2 58 ±0.5	APPROX 30 MINUTES AT 75°F	30 MINUTES AT 150°F ±10°F (66°C ±6°C) OR 6 HOURS AT ROOM TEMPERATURE, 68°F (20°C) ^A
RESIN MIX 2 (POTTING RESIN) (BMS 5-28 TYPE 7)	EPOCAST 89537A RESIN EPOCAST 89537B HARDENER	100 ±1 22 ±1	60 MINUTES AT 70°F (21°C)	12 HRS AT 75°F (24°C) 2 HRS AT 125°F (52°C)
	CG-1305 RESIN CG-1305 HARDENER	100 22		
	FR 7162 RESIN FR 7162 HARDENER	100 ±5 40 ±2		
RESIN MIX 3 (POTTING RESIN)	RESIN MIX 2 MICROBALLOONS	100 5	SAME AS RESIN MIX 2	SAME AS RESIN MIX 2
RESIN MIX 4	RESIN MIX 1 MILLED GLASS FIBER	80 20	SAME AS RESIN MIX 1	SAME AS RESIN MIX 1
RESIN MIX 5	RESIN MIX 2 MILLED GLASS FIBER	80 20	SAME AS RESIN MIX 2	SAME AS RESIN MIX 2
RESIN MIX 6 (SEALER RESIN) (BMS 8-207, TYPE 1, CLASS I)	EC1838A RESIN EC1838B HARDENER	50 50	20 MINUTES AT 77°F (25°C)	2 HRS AT 105° (41°C) TO 125°F (52°C)
RESIN MIX 6 (SEALER RESIN) ALTERNATE (BMS 8-207 TYPE 1, CLASS II)	FR-40 RESIN FR-5413C HARDENER	100 ±1 15 ±0.5	20 MINUTES AT 75° TO 79°F (24° TO 26°C)	12 HRS MIN AT ROOM TEMP (65°F MIN) (19°C MIN) 1 HR MIN AT 150°F (66°C) TO 170°F (77°C)
RESIN MIX 6 (SEALER RESIN) ALTERNATE	EPIBOND 156A RESIN EPIBOND 941 HARDENER	100 ±2 10 ±0.5	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4
RESIN MIX 6 (SEALER RESIN) ALTERNATE	EPIBOND 156A RESIN EPIBOND 156B HARDENER	100 ±2 6 ±0.3	15 TO 25 MINUTES AT 77°F (25°C)	12 HRS AT 70°F (21°C) OR 1 TO 3 HRS AT 150°F (66°C)
RESIN MIX 6 (SEALER RESIN) ALTERNATE	FR-5318S RESIN FR-5318C HARDENER	100 ±2 58 ±1	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4
BMS 5-92, TYPE I, II OR IV LIQUID ADHESIVE	EC 2216A EC 2226B COLORS OPTIONAL	TYPE I 58:42 TYPE II 50:50 TYPE IV 50:50	80 TO 100 MINUTES AT 70°F (21°C) TO 80°F (27°C)	7 DAYS AT 70°F (21°C) TO 80°F (27°C)
BMS 5-25, TYPE II, GRADE 1 ADHESIVE	EPIBOND 1539A ADHESIVE PASTE/B-10 CURING AGENT OR EA901NA ADHESIVE PASTE/B-1 CURING AGENT	EPIBOND 1539A /B-10: 113 PARTS A, 100 PARTS B. EA901NA/B-1: 100 PARTS EA901NA, 23 PARTS B-1.	1 HOUR AT 70°F (21°C) TO 80°F (27°C)	24 HOURS AT 65°F (19°C) TO 80°F (27°C)

**Resin Specifications and Mixing Procedure
Figure 1 (Sheet 1 of 2)**



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STRUCTURAL REPAIR MANUAL

RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURE CYCLE SUFFICIENT FOR HANDLING, DRILLING, SANDING
BMS 5-109, TYPE II (ADHESIVE PASTE)	EA 9394 PART A EA 9394 PART B OR EA 934 NA PART A EA 934 NA PART B	REFER TO MANUFACTURERS' DATA	30 MINUTES	130 MINUTES \pm 10 MINUTES AT 150°F (66°C) \pm 20F (7°C)

NOTES

- MATERIALS MUST GEL AT ROOM TEMPERATURE PRIOR TO HEATING. RATE OF HEAT RISE MUST BE NO GREATER THAN 7°F (4°C) PER MINUTE.
- REFER TO SRM 51-30-03 FOR SOURCES OF MATERIALS.
- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

A FOR OPTIMUM PROPERTIES CURE 180 MINUTES AT 150°F (66°C) OR 5 DAYS AT ROOM TEMPERATURE, 68°F (20°C).

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

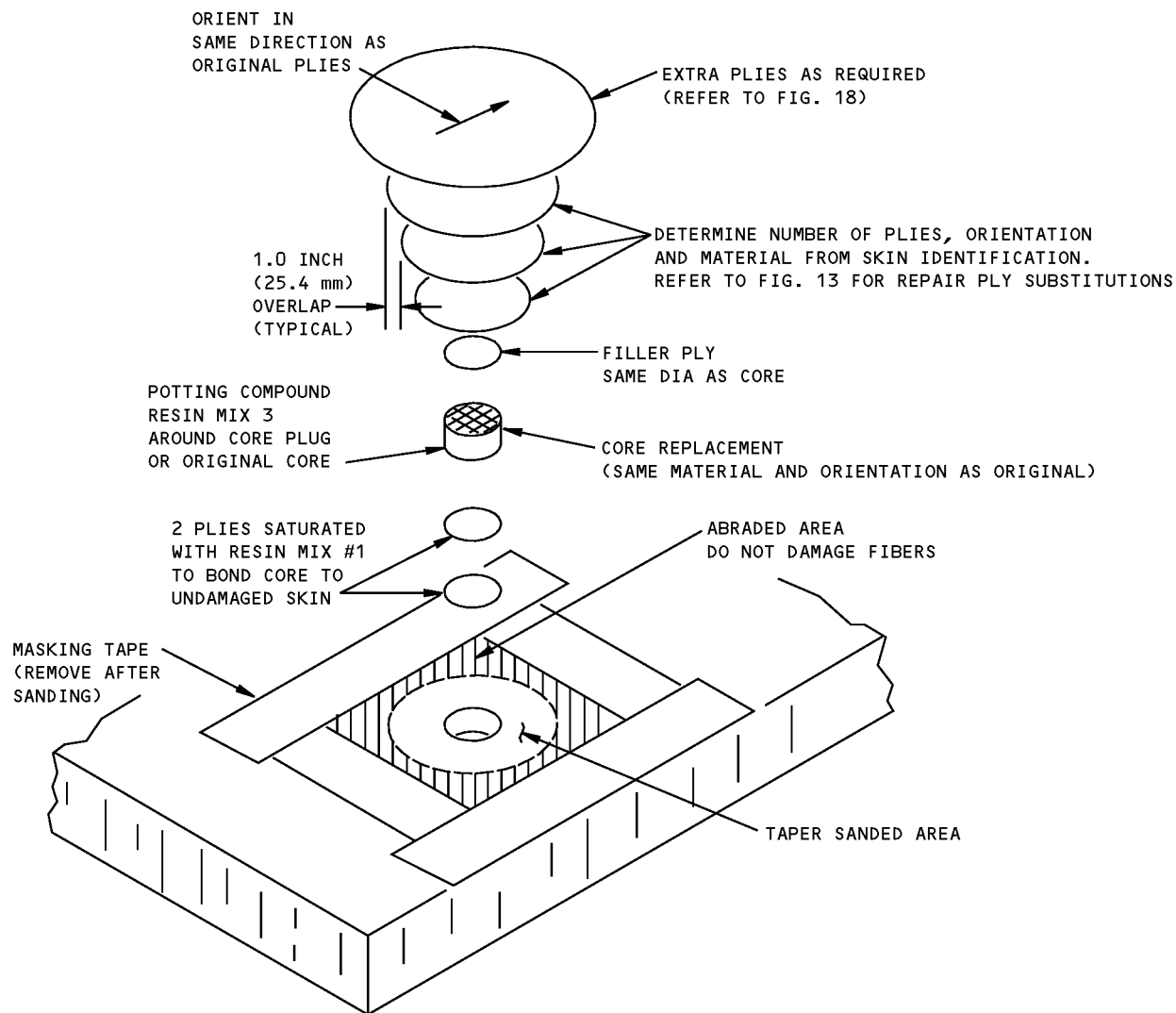
CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

MIXING PROCEDURE

RESIN MIX 1 RESIN MIX 2 RESIN MIX 6	ADD HARDENER TO RESIN AND MIX THOROUGHLY.
RESIN MIX 3 RESIN MIX 4 RESIN MIX 5	1. ADD PHENOLIC MICROBALLOONS TO RESIN AND MIX THOROUGHLY. 2. ADD HARDENER AND MIX THOROUGHLY.
	ADD MILLED GLASS FIBERS TO RESIN MIX TO PROVIDE A CONSISTENCY SIMILAR TO A THIN PUTTY.

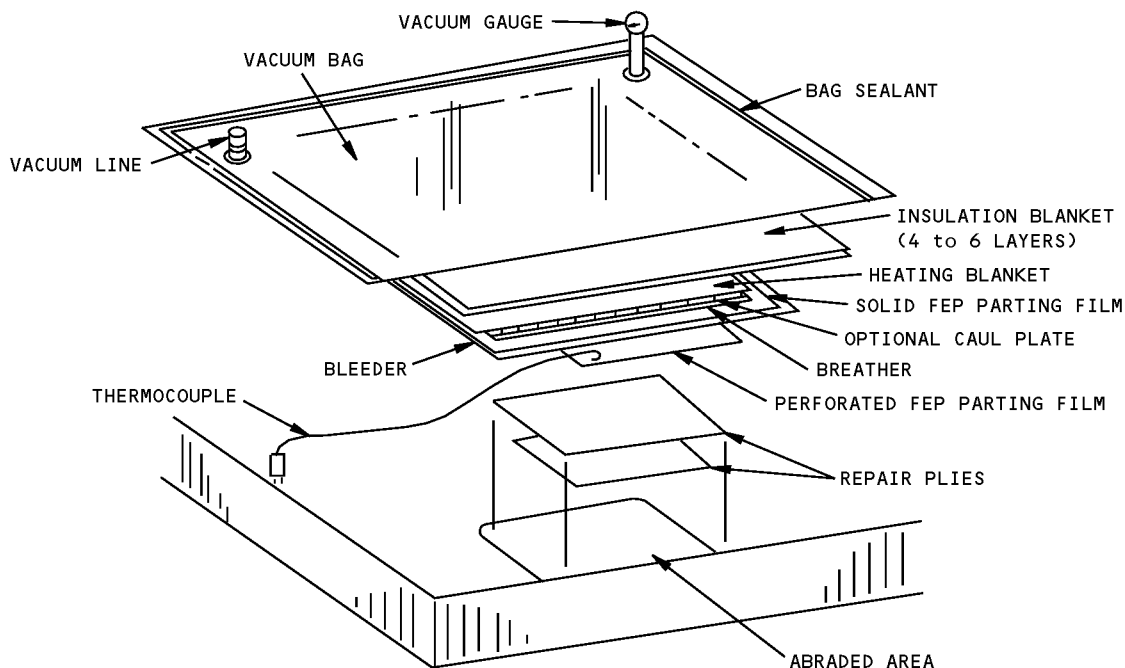
Resin Specifications and Mixing Procedure
Figure 1 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

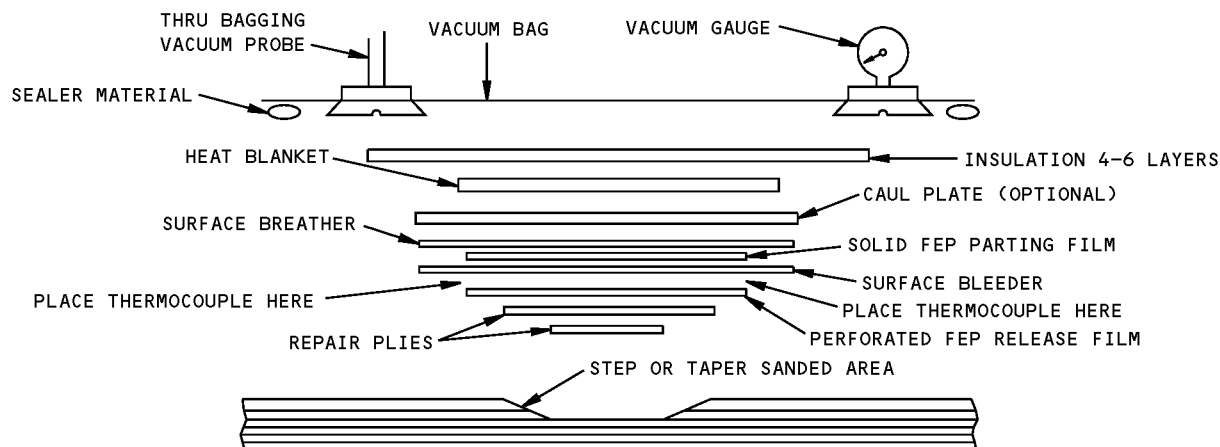


**Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - Wet Layup
Figure 2**

757-200 STRUCTURAL REPAIR MANUAL



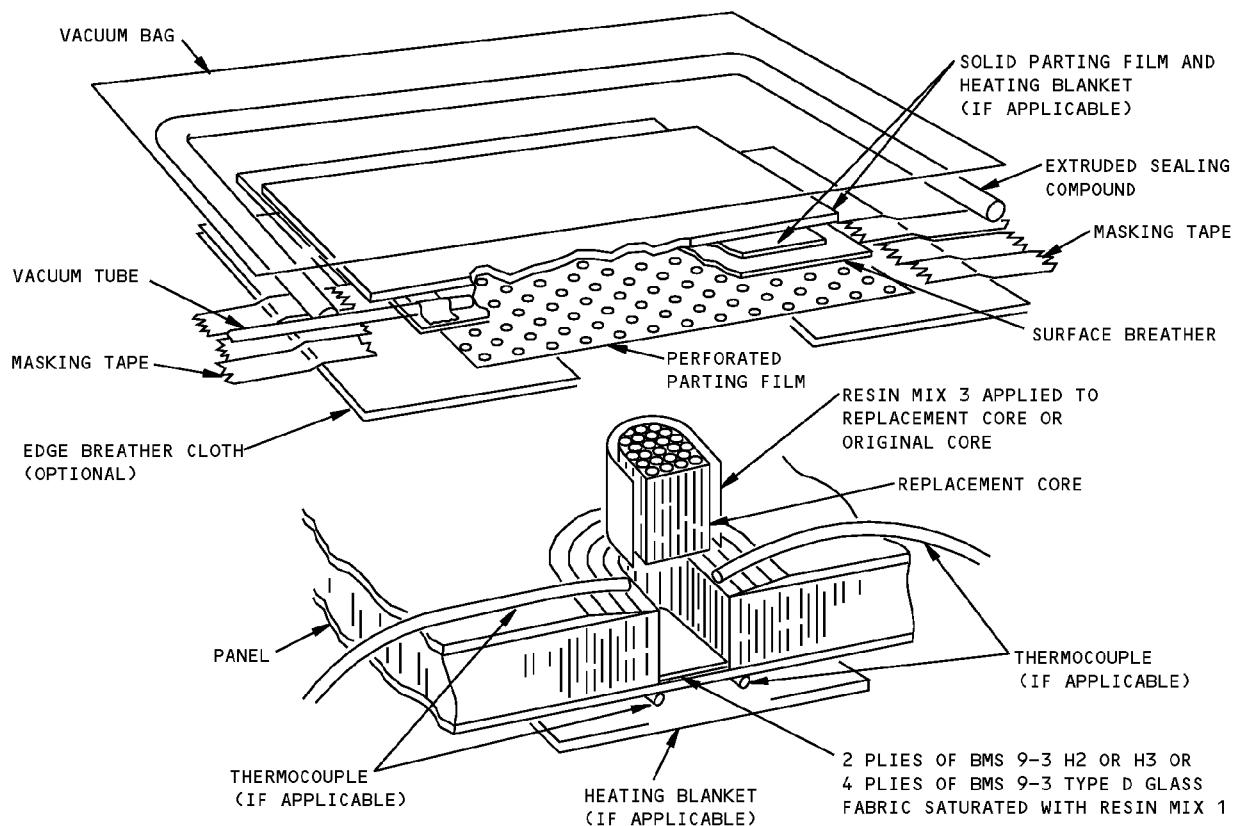
SKIN PLY REPAIR (WET LAYUP)



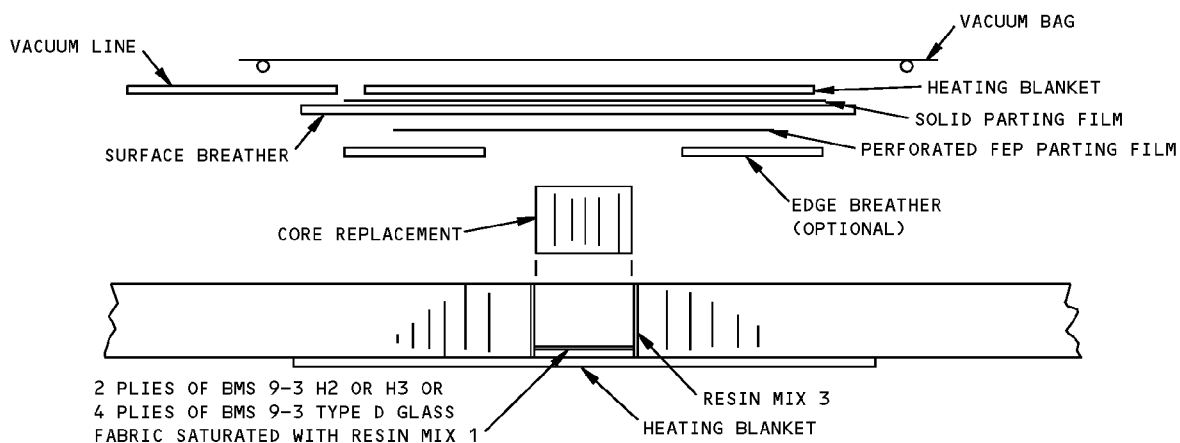
SECTION THRU LAYUP FOR SKIN PLY REPAIR (WET LAYUP)

Application of Pressure During Cure - Wet Layup Figure 3 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



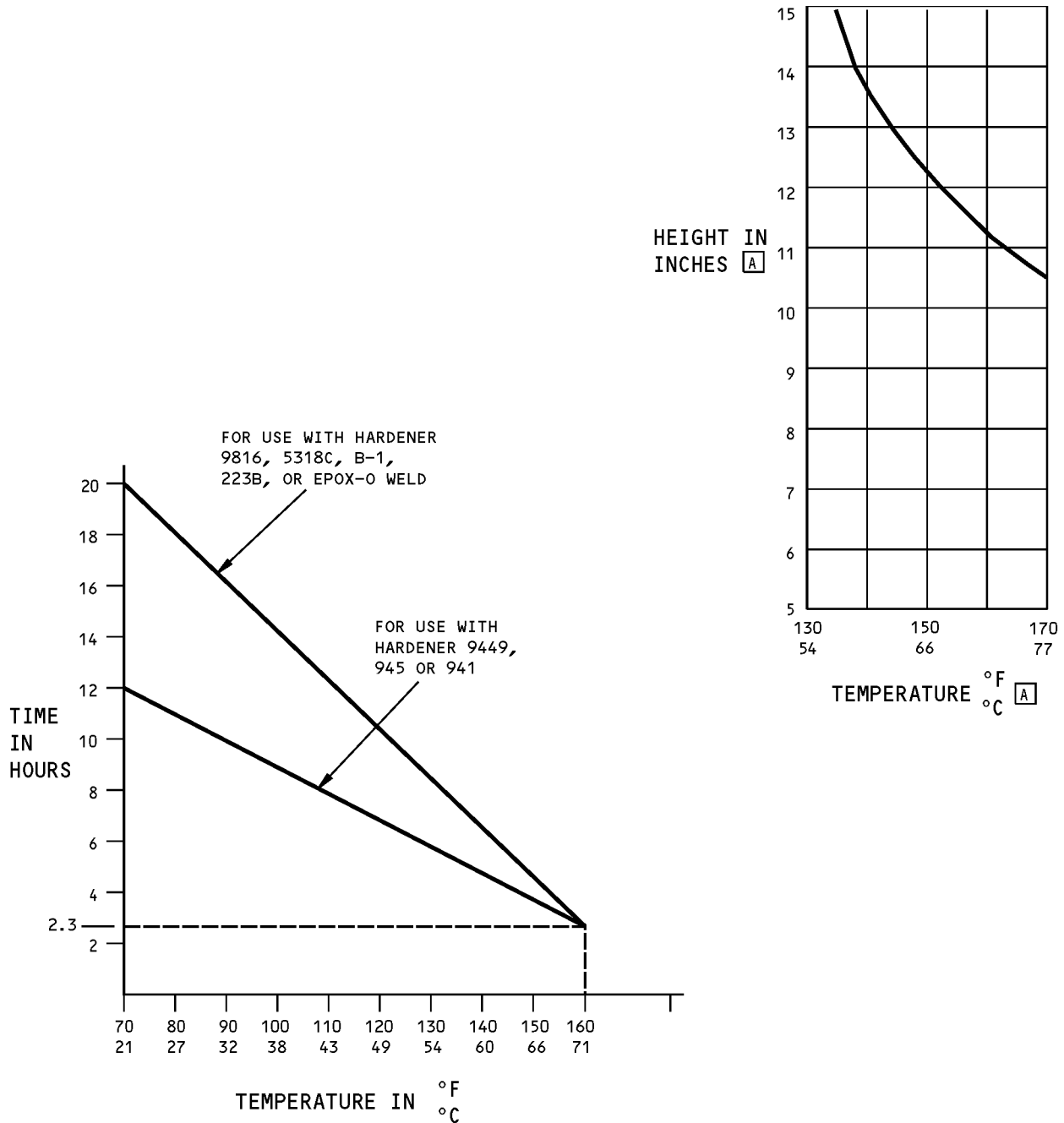
**BAGGING SEQUENCE FOR CORE REPLACEMENT
(WET LAYUP ONLY)**



**SECTION THRU LAYUP FOR CORE REPLACEMENT
(WET LAYUP ONLY)**

**Application of Pressure During Cure - Wet Layup
Figure 3 (Sheet 2 of 2)**

757-200 STRUCTURAL REPAIR MANUAL



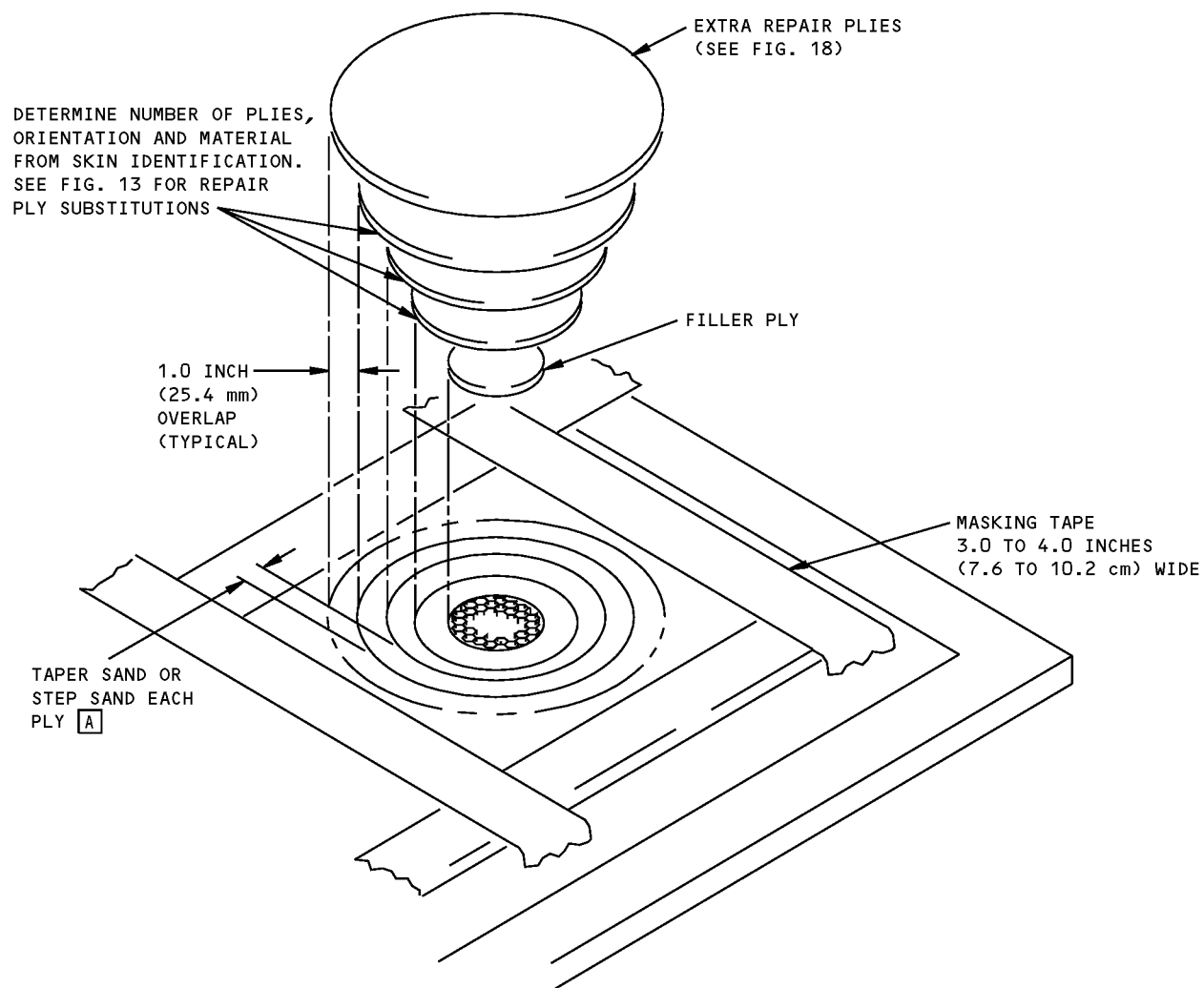
NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE

^A THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

**Potting and Laminating Resin Cure Temperature
Figure 4**

757-200
STRUCTURAL REPAIR MANUAL

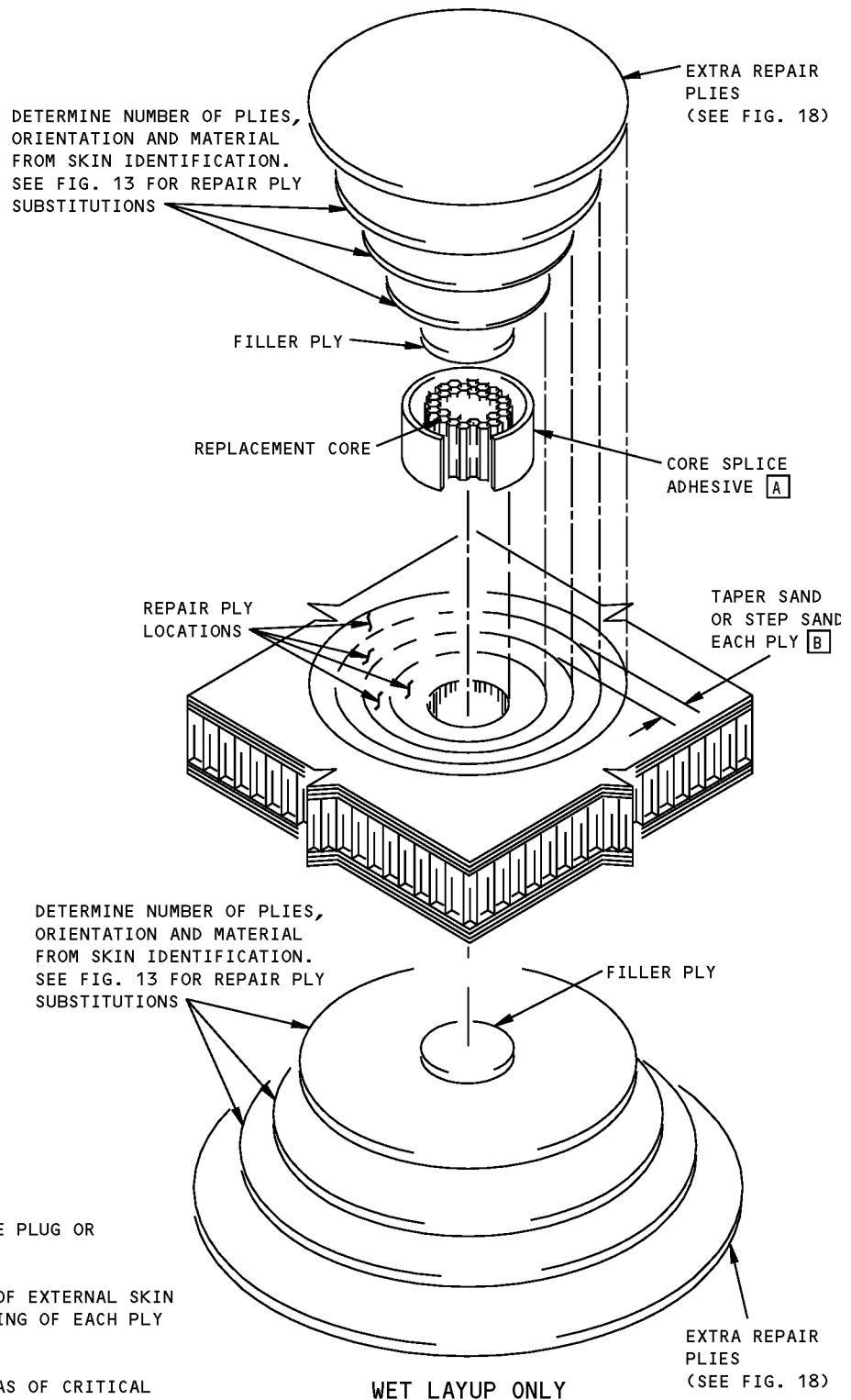


NOTES

- [A] TAPER SANDING OF EACH PLY OF EXTERNAL SKIN IS RECOMMENDED. STEP SANDING OF EACH PLY IS OPTIONAL [B]
- [B] TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. SEE SRM 51-10-01

Repair of Damaged External or Internal Skins of a Sandwich Panel - Wet Layup
Figure 5

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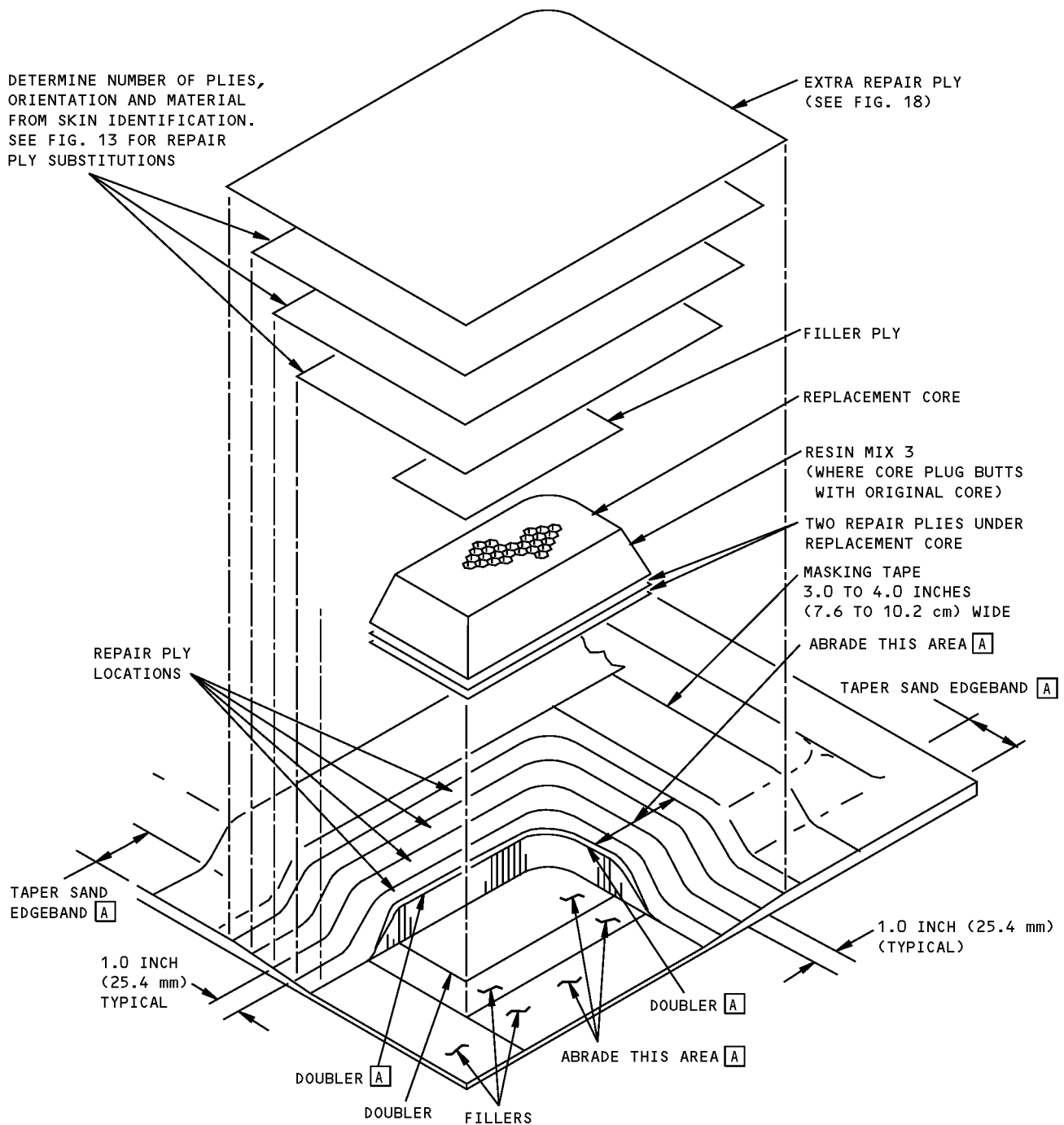
NOTES

- [A] RESIN MIX 3 APPLIED TO CORE PLUG OR ORIGINAL CORE
- [B] TAPER SANDING OF EACH PLY OF EXTERNAL SKIN IS RECOMMENDED. STEP SANDING OF EACH PLY IS OPTIONAL
- [C] TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO 51-10-01

Repair of Large Punctures Through Both Skins of a Sandwich Panel Including Core Damage - Wet Layup
Figure 6

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DETERMINE NUMBER OF PLYS,
ORIENTATION AND MATERIAL
FROM SKIN IDENTIFICATION.
SEE FIG. 13 FOR REPAIR
PLY SUBSTITUTIONS



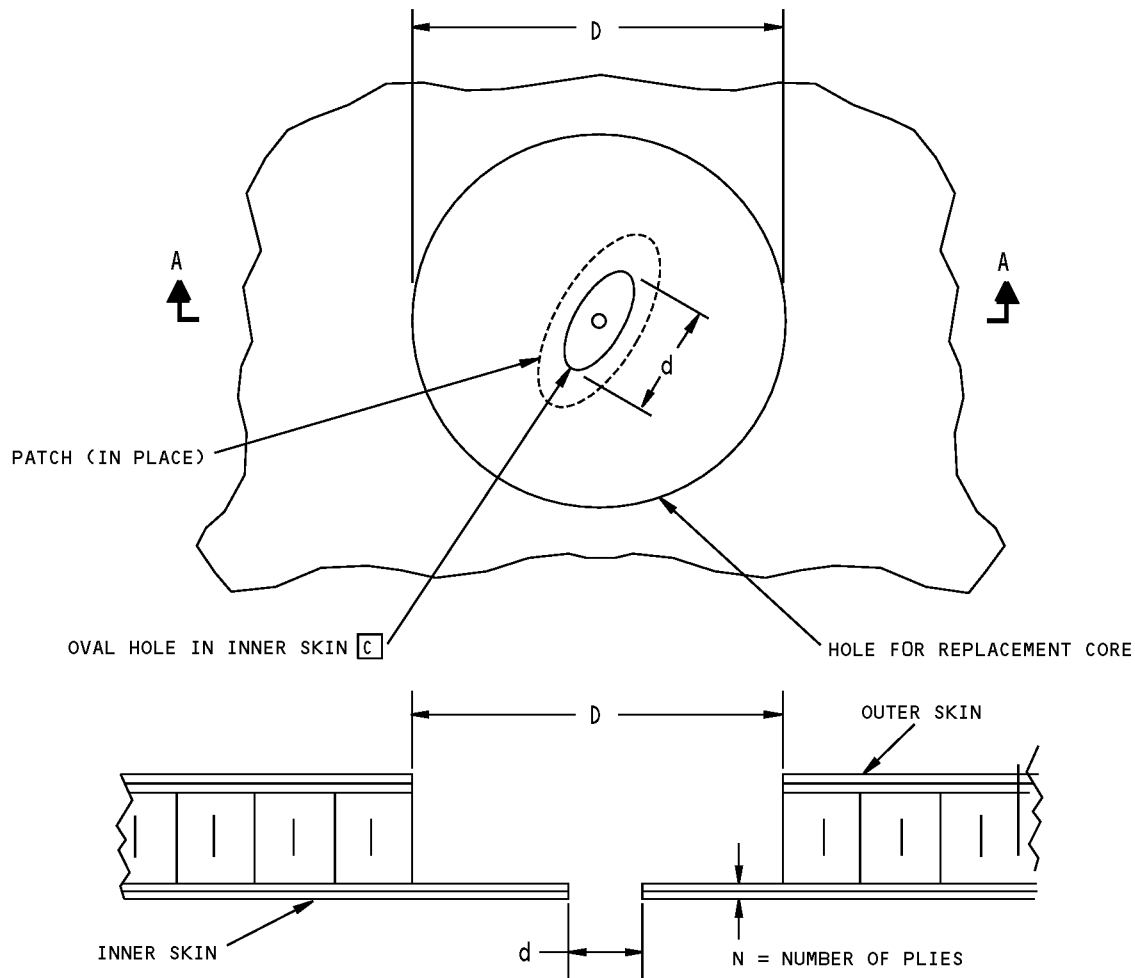
NOTES

WET LAYUP ONLY

- [A] TAPER SANDING IS OPTIONAL TO JUST ABRADING THE SURFACE OF THE SKIN AND DOUBLER PLYS ABOVE AND BELOW THE HONEYCOMB CORE. HOWEVER, TAPER SANDING IS REQUIRED ON THE EDGE BAND

Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel - Wet Layup
Figure 7

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SECTION A-A
(PATCH NOT SHOWN)
DETAIL I

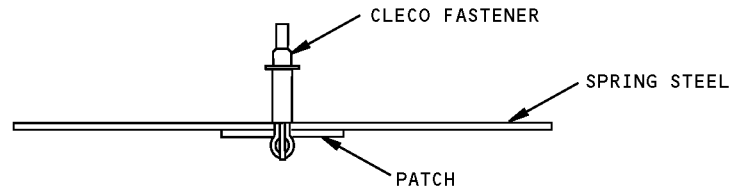
NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
- $D = d + \{N \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)}\}$
 d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN
 N = NUMBER OF PLYS
 D = DIAMETER OF HOLE FOR REPLACEMENT CORE
 FOR EXAMPLE:
 IF $d = 0.50 \text{ INCH (12.7 mm)}$ THEN,
 $D = 0.50 \text{ INCH (12.7 mm)} + \{[2 \text{ PLYS}] \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)}\}$
 $= 3.50 \text{ INCH (88.9 mm) DIAMETER}$

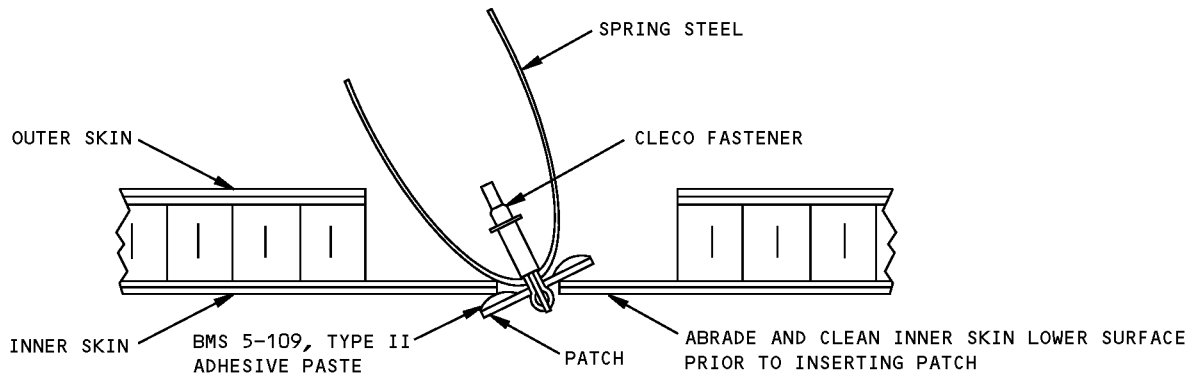
- A** RESIN MIX 3 APPLIED TO CORE PLUG OR ORIGINAL CORE
- B** MAKE TAPER AND OVERLAP PER FIGURE 14
- C** MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR

**Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 1 of 3)**

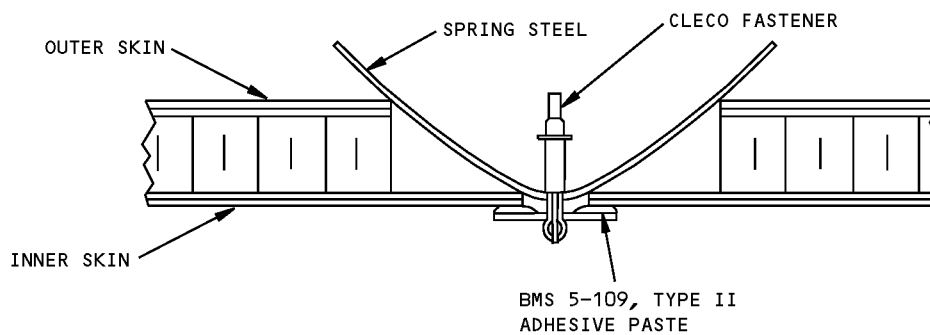
757-200 STRUCTURAL REPAIR MANUAL



ASSEMBLE PATCH AND SPRING STEEL
DETAIL II



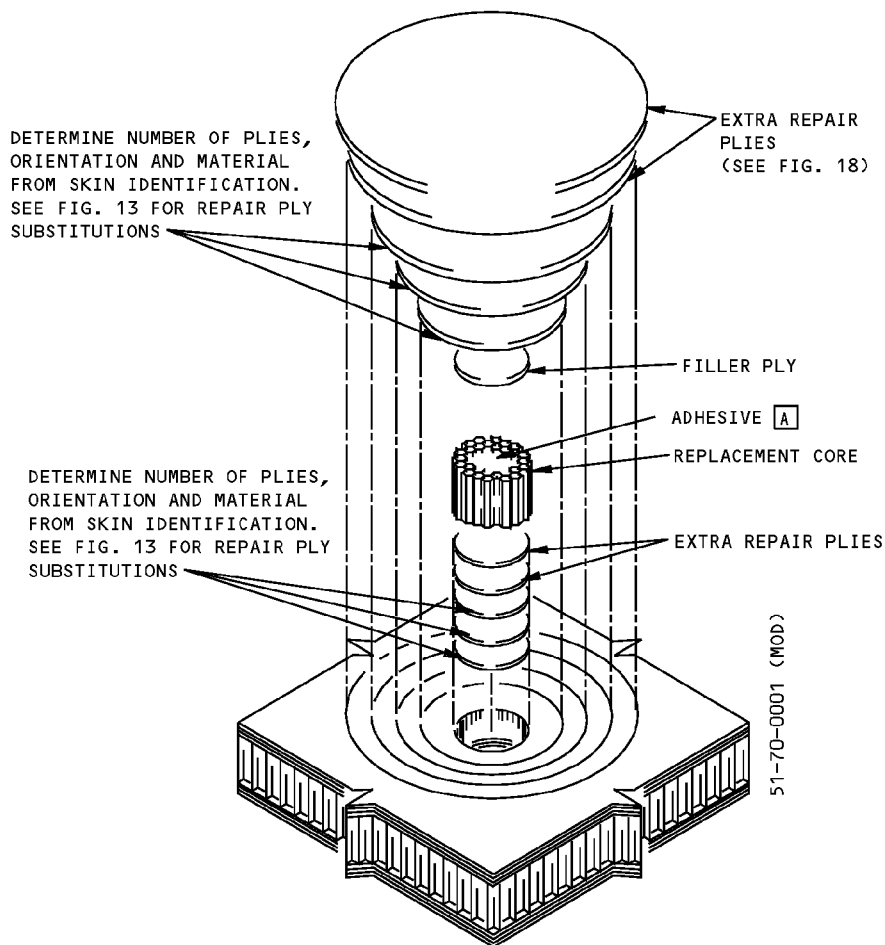
INSERT PATCH INTO OVAL HOLE
DETAIL III



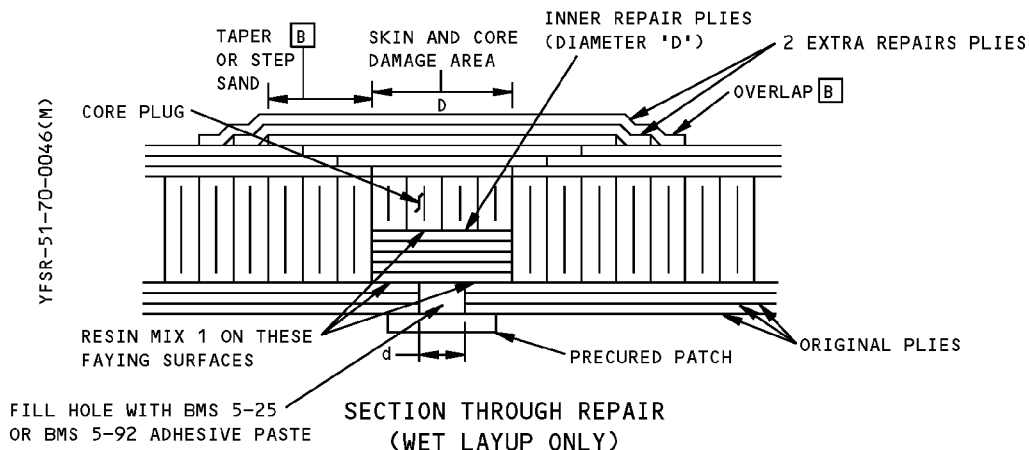
HOLD PATCH IN PLACE WHILE CURING
DETAIL IV

Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL

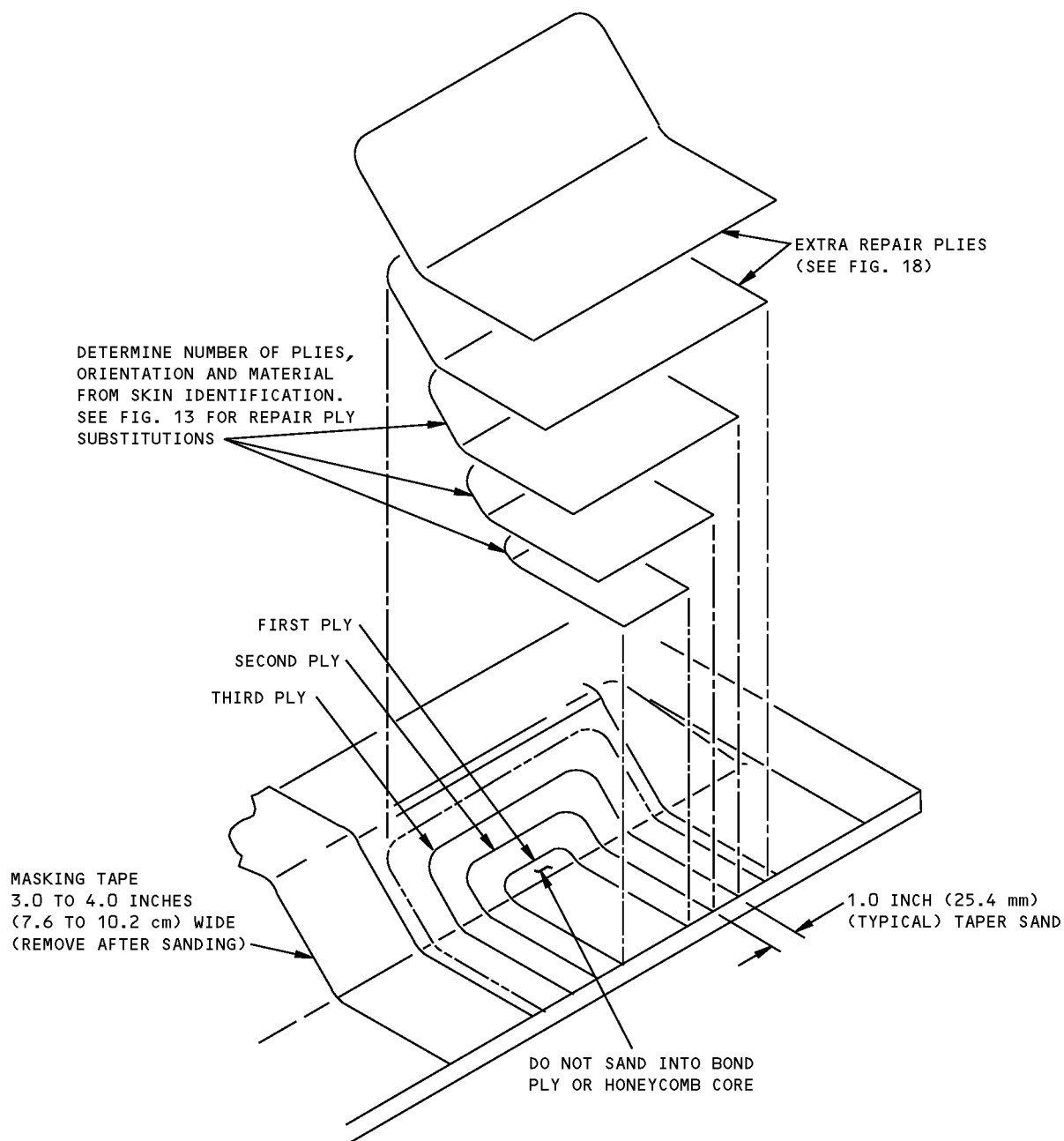


WET LAYUP ONLY



Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 3 of 3)

757-200
STRUCTURAL REPAIR MANUAL



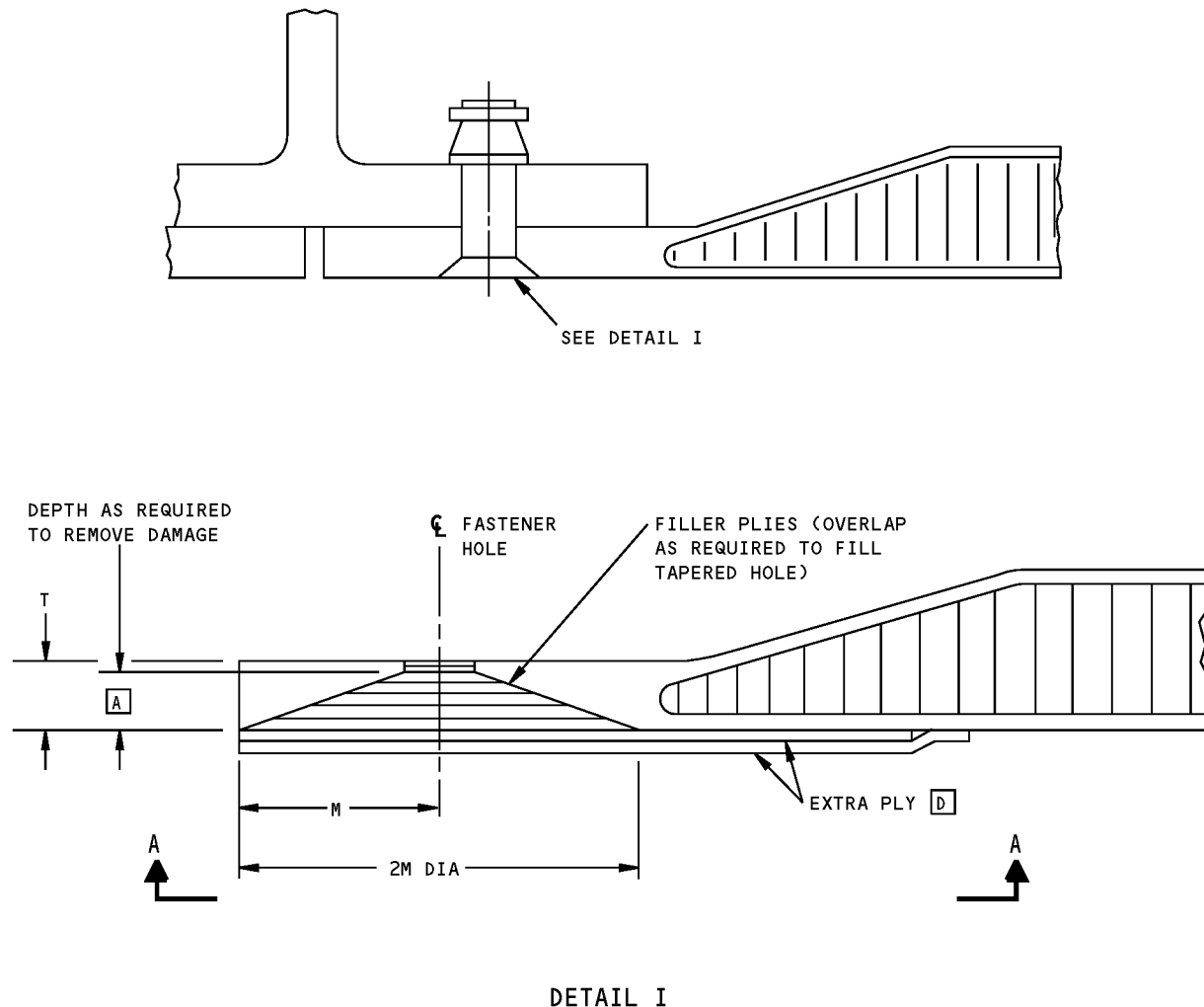
NOTES

- REFER TO PARAGRAPH 5.G. FOR THE REPAIR INSTRUCTIONS.

WET LAYUP ONLY

Repair of Damaged Skin Plies on a Panel Edge - Wet Layup
Figure 9

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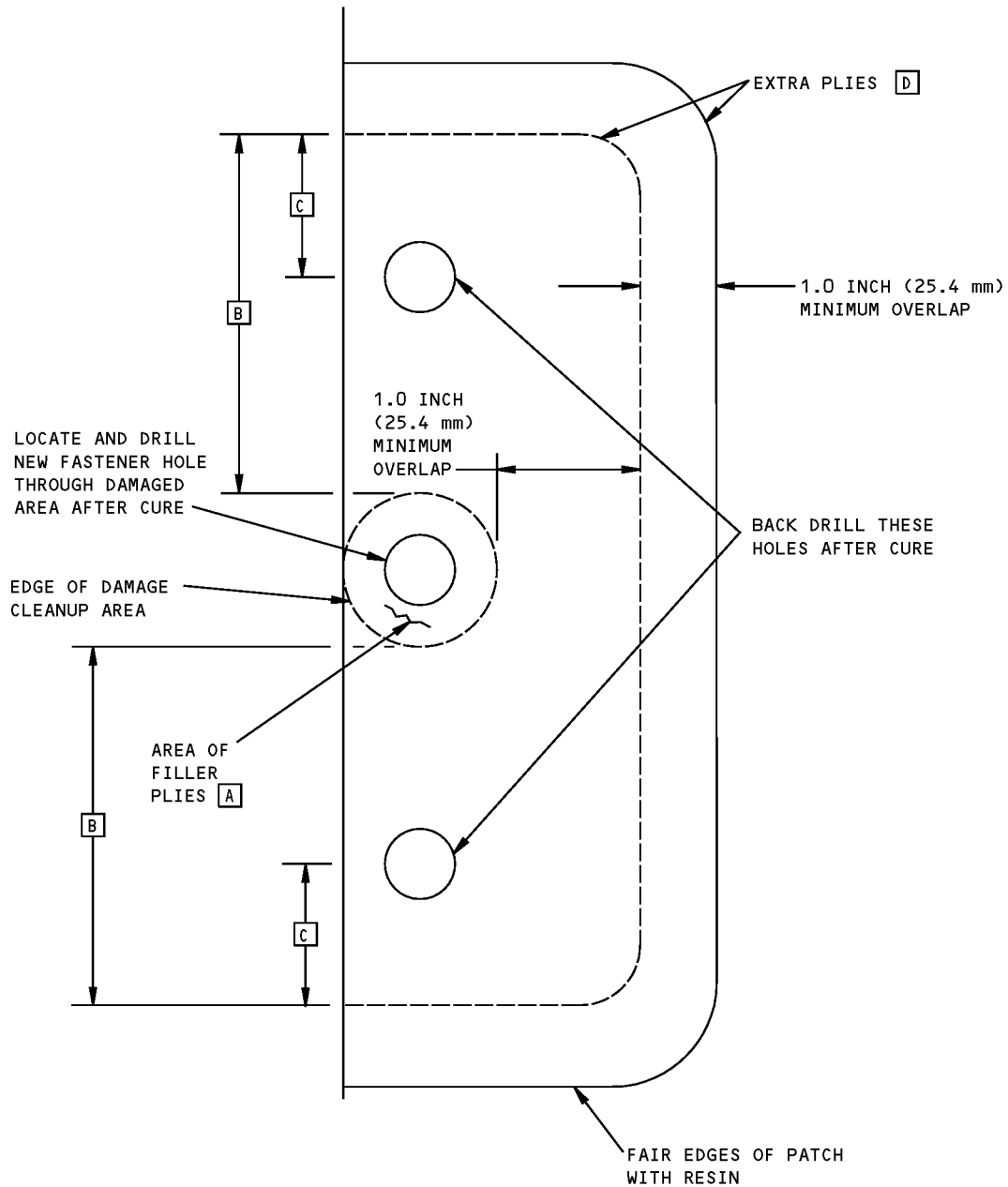


NOTES

- $M = 5T$ MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE.
 - THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES.
 - D = FASTENER DIAMETER
 - REFER TO PARAGRAPH 5.L. FOR THE REPAIR INSTRUCTIONS.
- A** APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA.
 - B** EXTEND EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 1.0 INCH (25.4 mm) PAST EDGE OF DAMAGED AREA
 - C** EXTEND EXTRA REPAIR PLY FAR ENOUGH TO PROVIDE AT LEAST $2D$ EDGE MARGIN.
 - D** ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER.

Repair of Damaged Panel Attach Hole - Wet Layup
Figure 10 (Sheet 1 of 2)

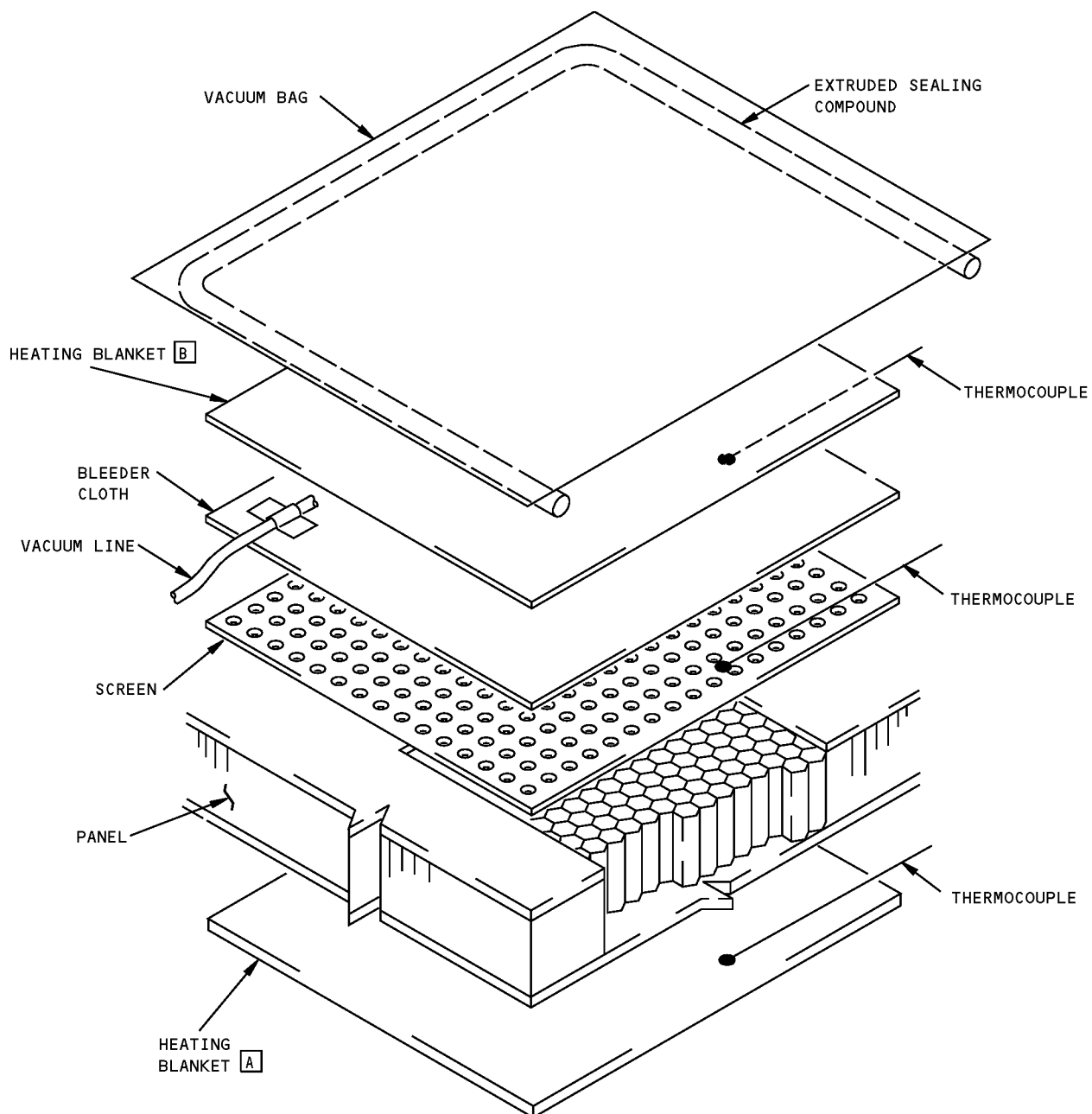
757-200 STRUCTURAL REPAIR MANUAL



SECTION A-A

Repair of Damaged Panel Attach Hole - Wet Layup
Figure 10 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL

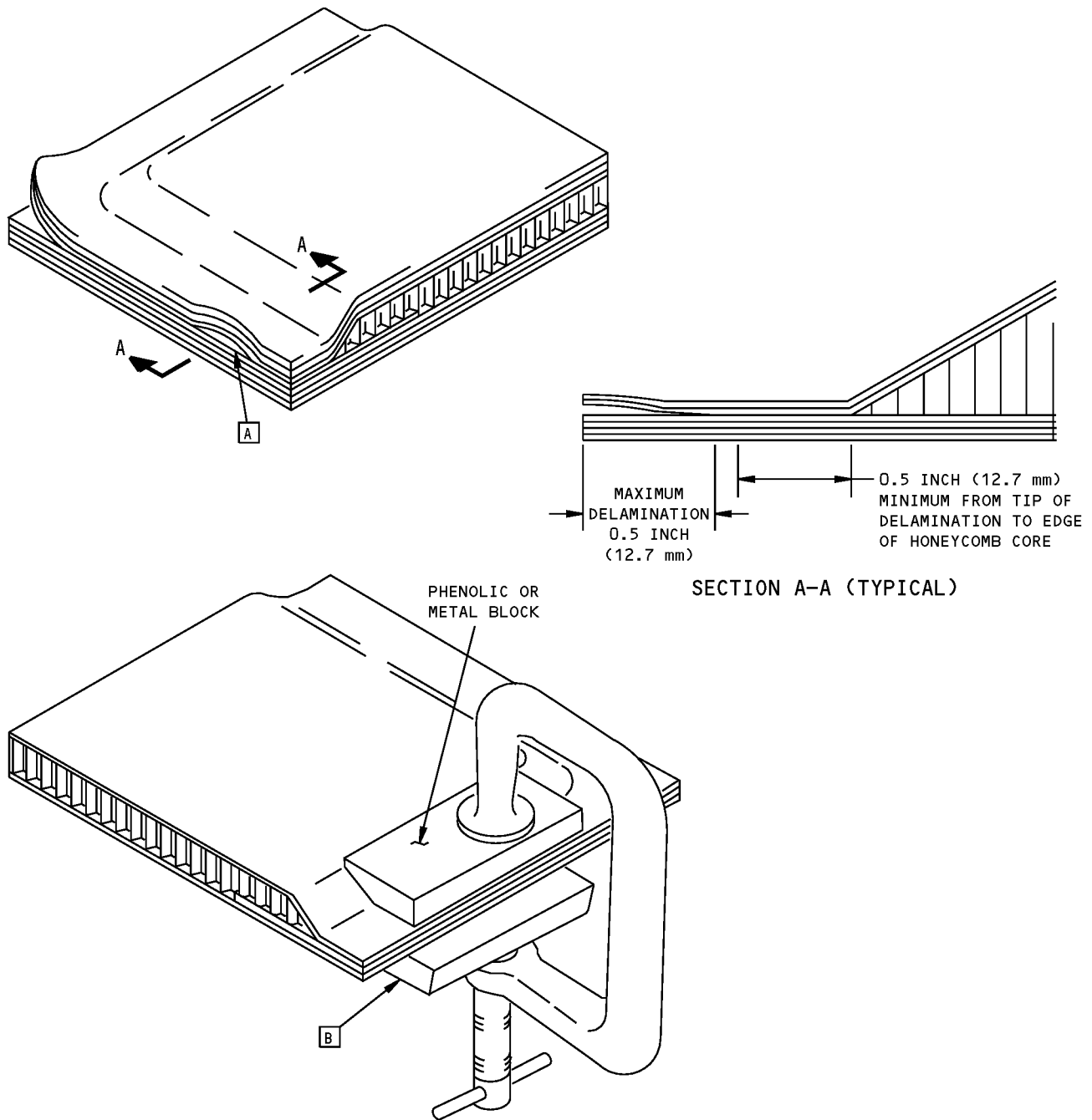


NOTES

- [A]** PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE.
- [B]** ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL.

Water Removal From Honeycomb Sandwich
Figure 11

757-200
STRUCTURAL REPAIR MANUAL



NOTES

- REFER TO PARAGRAPH 5.A.(2) FOR COMPLETE REPAIR INSTRUCTIONS.

A FORCE RESIN MIX 1 INTO DELAMINATED AREA.

B CLAMP PLIES TOGETHER AND CURE.

Repair of Delaminations Between Plies of Panel Edgeband
Figure 12

757-200 STRUCTURAL REPAIR MANUAL

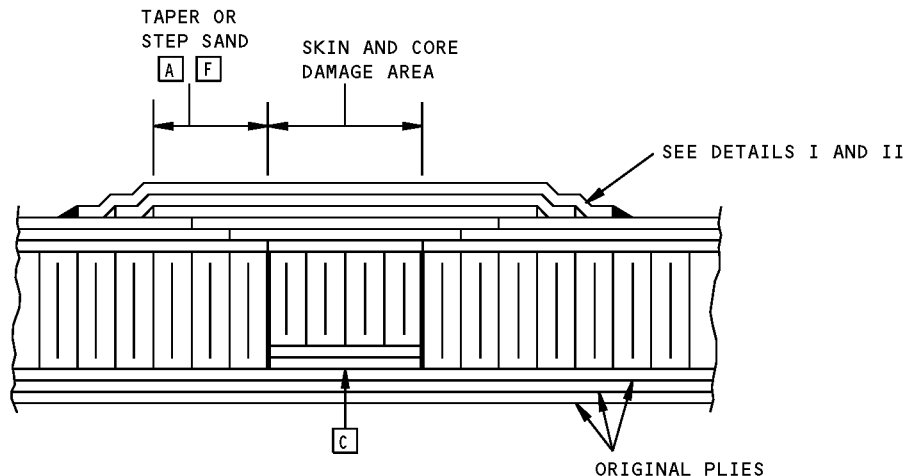
ORIGINAL PLY MATERIAL		REPAIR PLY MATERIAL	REPAIR PLY SUBSTITUTE MATERIAL
GLASS FABRIC	BMS 8-79, TYPE 120	BMS 9-3, TYPE D A	BMS 9-3, TYPE H-2 OR H-3 B
	BMS 8-139, TYPE 120		
	BMS 8-79, TYPE 1581	BMS 9-3, TYPE H-2 A	BMS 9-3, TYPE D OR H-3 C D
	BMS 8-139, TYPE 181		
ARAMID FABRIC	BMS 8-218, STYLE 120	BMS 9-3, TYPE D A (GLASS FABRIC)	BMS 9-3, TYPE H-2 OR H-3 B
	BMS 8-219, STYLE 120		
	BMS 8-218, STYLE 285	BMS 9-3, TYPE H-2 OR H-3 A (GLASS FABRIC)	BMS 9-3, TYPE D C
	BMS 8-219, STYLE 285		
GRAPHITE TAPE	BMS 8-168, TYPE II, CLASS 1, ALL GRADES	BMS 9-8, TYPE I, CLASS 2, STYLE 3K-70-P E (GRAPHITE FABRIC)	NONE
	BMS 8-212, TYPE II, CLASS 1 OR 3, ALL GRADES		
GRAPHITE FABRIC	BMS 8-168, TYPE II, CLASS 2, STYLE 3K-70-PW	BMS 9-8, TYPE I, CLASS 2, STYLE 3K-70-P	NONE
	BMS 8-212, TYPE IV, CLASS 2, STYLE 3K-70-PW		
	BMS 8-256, TYPE I, CLASS 2, STYLE 3K-70-PW		
	BMS 8-258, CLASS 2, STYLE 3K-70-PW		
	BMS 8-212, TYPE III, CLASS 2, STYLE 3K-135-8H	BMS 9-8, TYPE I, CLASS 2, STYLE 3K-135-8H	2 PLIES BMS 9-8, TYPE I, CLASS 2, STYLE 3K-70-PW
ALUMINUM COATED GLASS FABRIC	BMS 8-278, TYPE I ALL CLASSES	BMS 9-3, TYPE H-2 OR H-3 A	NONE
	BMS 8-278, TYPE II ALL CLASSES	BMS 9-3, TYPE D A	NONE

NOTES

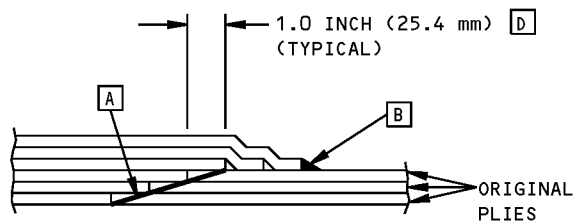
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|---|--|
| <p>A BMS 9-3, CLASSES 2,5 THRU 13, AND 16 THRU 19 CAN BE USED. CLASS 7 IS RECOMMENDED BECAUSE IT IS KNOWN TO HAVE GOOD STORAGE LIFE.</p> <p>B USE ONE PLY OF TYPE H-2 OR H-3 IN PLACE OF TWO PLIES OF TYPE D.</p> <p>C USE THREE PLIES OF TYPE D IN PLACE OF ONE PLY OF TYPE H-2 OR H-3.</p> | <p>D USE ONE PLY OF TYPE H-3 IN PLACE OF ONE PLY OF TYPE H-2.</p> <p>E TWO CONSECUTIVE PLIES OF GRAPHITE FABRIC ARE REQUIRED FOR EACH PLY OF GRAPHITE TAPE. ALIGN THE FABRIC WARP FIBERS IN THE SAME DIRECTION AS THE TAPE FIBERS.</p> |
|---|--|

**Repair Ply Substitutions
Figure 13**

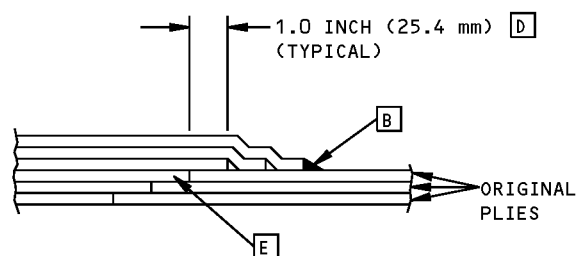
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(WET LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



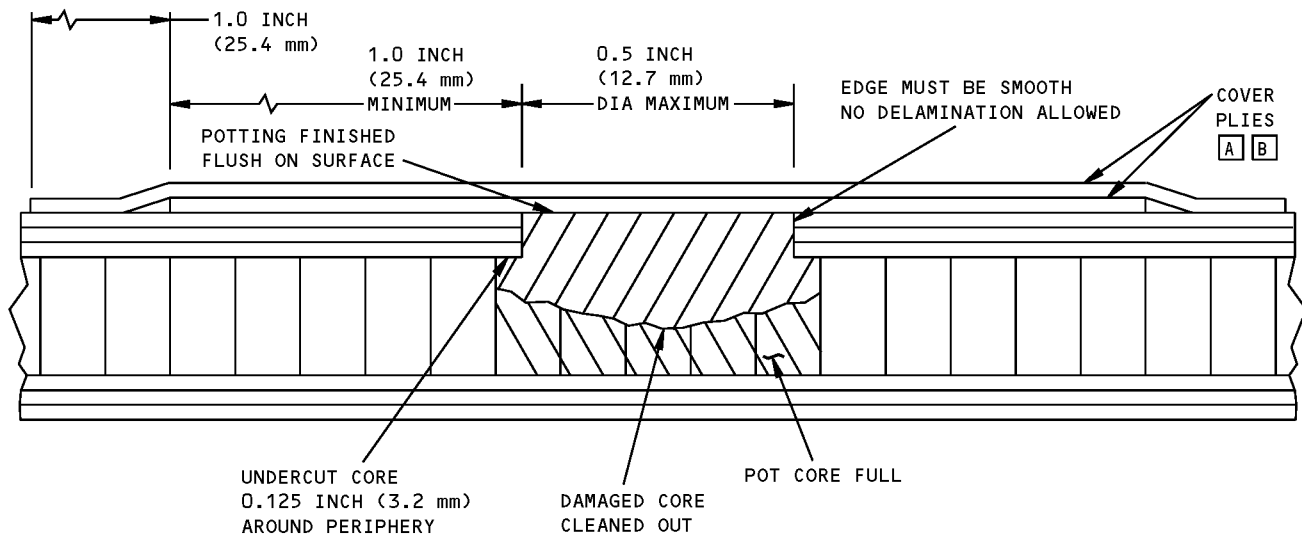
STEP SANDED SKIN
DETAIL II

NOTES

- A** TAPER SAND OR STEP SAND EXISTING PLIES AROUND REPAIR AREA A MINIMUM OF 1.0 INCH (25.4 mm) FOR EACH EXISTING PLY
- B** DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING
- C** SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)
- D** EACH PLY MUST OVERLAP AT LEAST 1.0 INCH (25.4 mm) PAST EDGE OF PRECEDING PLY
- E** REMOVE DAMAGED PLIES IN STEPS
- F** TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO SRM 51-10-01

Sanding and Overlap Requirements
Figure 14

757-200
STRUCTURAL REPAIR MANUAL



TYPICAL SECTION

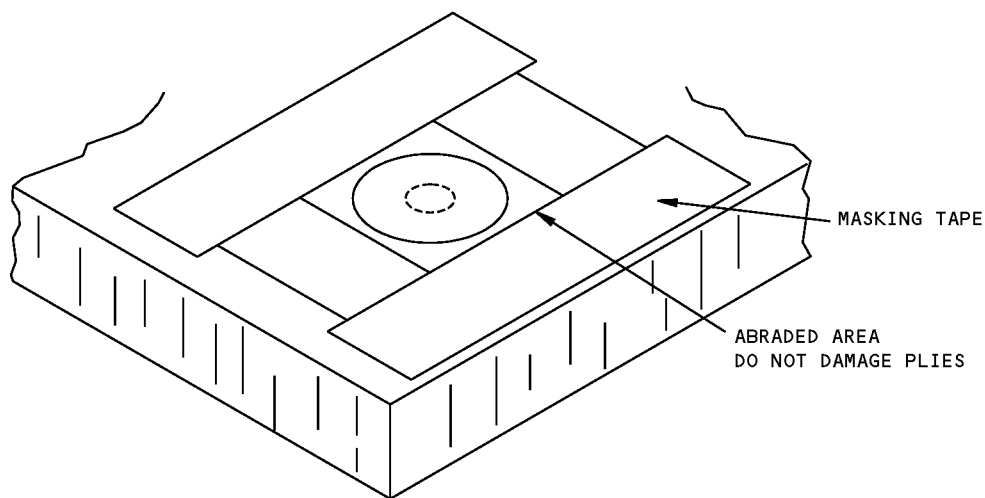
NOTES

- OVERLAP COVER PLIES PER FIG. 14. DO NOT TAPER SAND OR STEP SAND ANY PLIES.

- A** ORIENT COVER PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER.
- B** PREPARE AND APPLY TWO PLIES OF THE SAME MATERIAL AND ORIENTATION AS ORIGINAL SURFACE PLIES PER PARAGRAPH 4.E, EXCEPT USE TYPE H-2 OR H-3 PLIES TO REPLACE ARAMID PLIES.

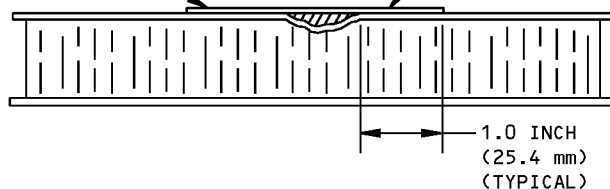
Typical Puncture Repair, 0.50 Inch Diameter or Less - Wet Layup
Figure 15

757-200 STRUCTURAL REPAIR MANUAL



ONE PLY OVERLAY, SAME MATERIAL AND ORIENTATION AS ORIGINAL SURFACE PLY EXCEPT USE GLASS FABRIC TO REPLACE ARAMID PLIES (FIG. 13). SATURATE WITH RESIN MIX 1

FILL DEPRESSION WITH RESIN MIX 2. ALLOW TO CURE 12 HOURS AT 65°F (19°C) MIN OR 2 HOURS AT 125°F (52°C)

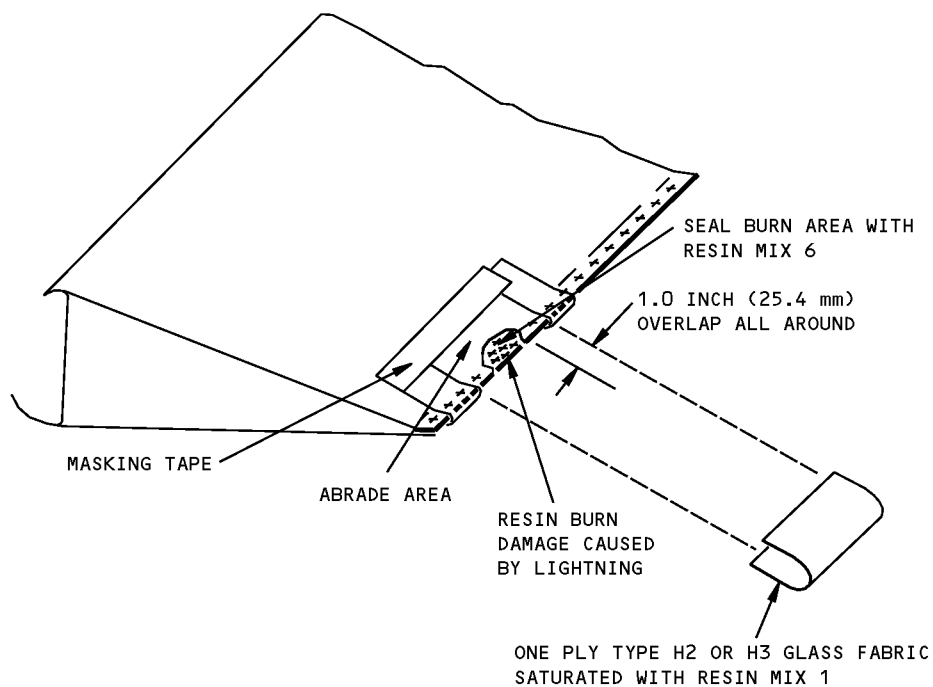


NOTES

- REFINISH REWORKED AREAS AS SHOWN IN AMM 51-20-00.
- REFER TO PARAGRAPH 5.L. FOR THE REPAIR INSTRUCTIONS.

**Typical Repair for Dents - Wet Layup
Figure 16**

757-200
STRUCTURAL REPAIR MANUAL



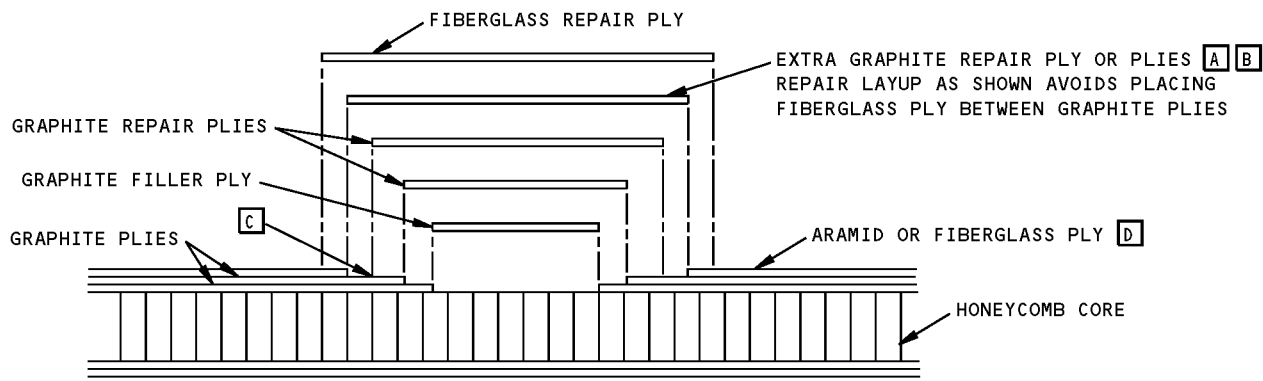
Typical Repair for Lightning Damage at Trailing Edge - Wet Layup
Figure 17

757-200 STRUCTURAL REPAIR MANUAL

COMPONENT MATERIAL	EXTRA PLY MATERIAL B
GRAPHITE FABRIC	GRAPHITE FABRIC, STYLE 3K-70-P
GRAPHITE/ARAMID/GLASS	GRAPHITE FABRIC, STYLE 3K-70-P A
ARAMID	GLASS FABRIC, TYPE H-2 OR H-3
GLASS FABRIC	GLASS FABRIC, TYPE H-2 OR H-3

NOTES

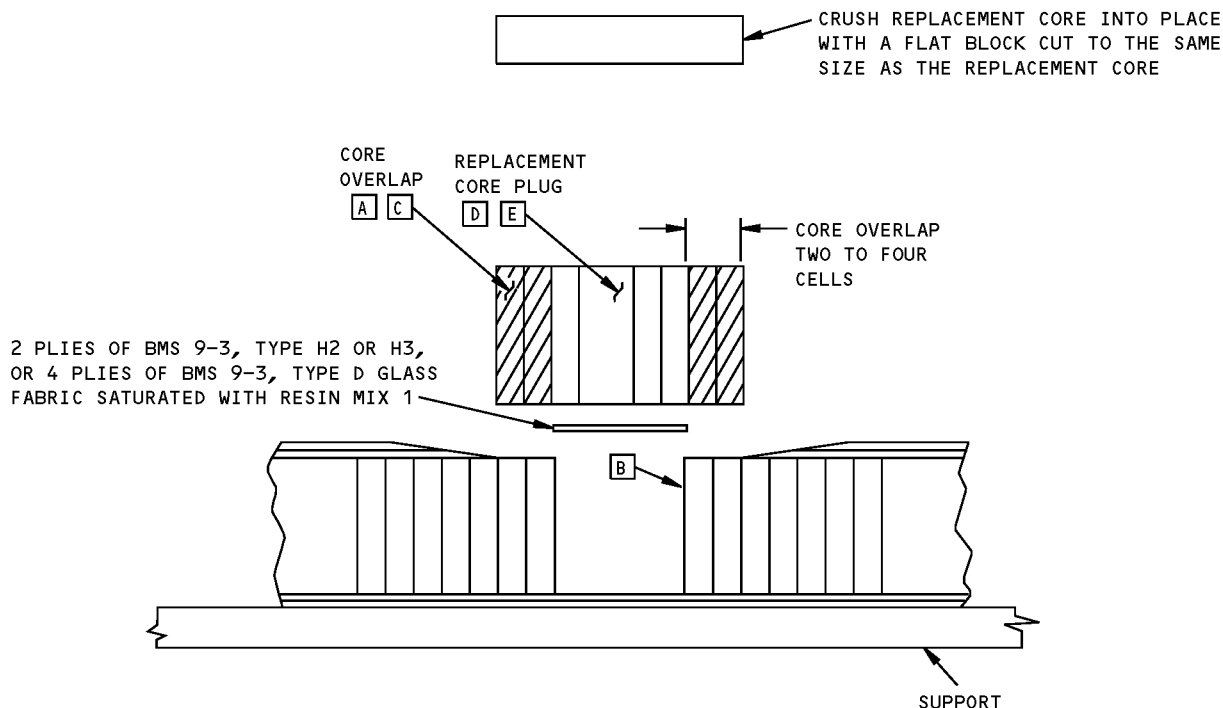
- A** ON HYBRID PANELS, GRAPHITE EXTRA PLIES MUST BE BONDED TO GRAPHITE PLY. SEE DETAIL I.
- B** THE ORIENTATIONS OF THE EXTRA REPAIR PLIES MUST REPEAT THE ORIENTATIONS OF THE EXISTING PLIES IN THE ORIGINAL LAMINATE STARTING WITH THE OUTERMOST PLY.
- C** WHEN EXTRA GRAPHITE REPAIR PLY OR PLIES ARE REQUIRED, THE EXISTING OUTER PLY OF ARAMID, BMS 8-278 ALUMINIZED GLASS FABRIC OR FIBERGLASS MUST BE SANDED TO ALLOW AN OVERLAP OF 1.0 INCH (25.4 mm) FOR EACH EXTRA REPAIR PLY.
- D** IF OUTER PLY CONSISTS OF BMS 8-278 ALUMINIZED GLASS FABRIC PLY OR OTHER CONDUCTIVE COATING, REFER TO SRM 51-70-04, SRM 51-70-05 OR SRM 51-70-14 AS APPLICABLE FOR REPAIR OF THE CONDUCTIVE COATING.



SECTION THRU HYBRID HONEYCOMB SANDWICH
DETAIL I

Extra Repair Ply Materials
Figure 18

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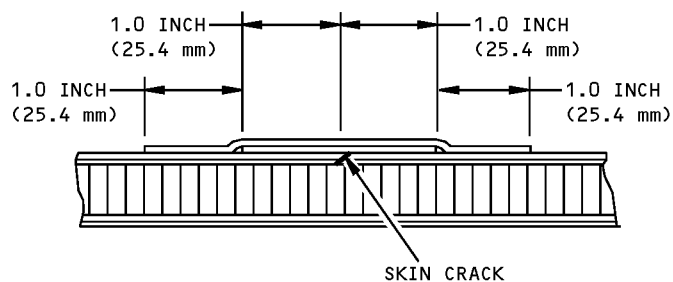
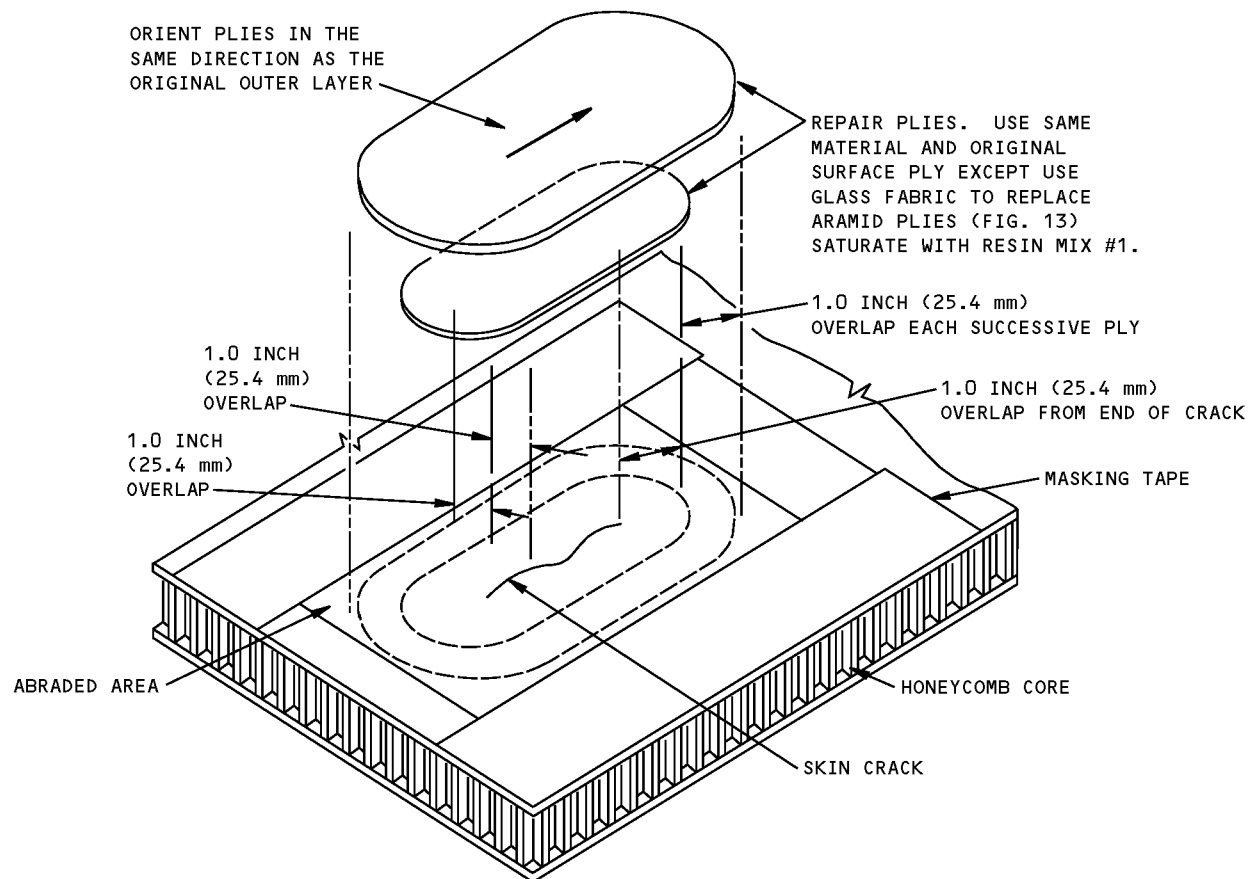


NOTES

- | | |
|---|---|
| <p>[A] WHEN CRUSH SPLICING CORE 1.0 INCH (25.4 mm) OR THICKER THE JOINT MAY BE CHAMFERED.</p> <p>[B] PRIOR TO SPLICING CORE MAY BE STABILIZED WITH SC1008 PHENOLIC RESIN. LIMIT RESIN APPLICATION TO A MAXIMUM OF 1.0 INCH (25.4 mm) BEYOND THE EDGE CORE THAT IS TO BE SPLICED. THINNING RESIN WITH ACETONE IS PERMITTED.</p> <p>[C] USE BMS 8-301, CLASS 2 OR BMS 8-214 EPOXY RESIN AFTER SPLICING TO KEEP THE SPLICE FROM SEPERATING.</p> | <p>[D] ALIGN HONEYCOMB CELLS OF REPAIR PLUG WITH ORIGINAL CORE.</p> <p>[E] REPLACEMENT CORE PLUG MUST BE MADE FROM CORE MATERIAL A MAXIMUM OF TWO GRADES DENSER THAN THE ORIGINAL CORE.</p> |
|---|---|

Core Crush Splicing Requirements - Wet Layup
Figure 19

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SECTION VIEW

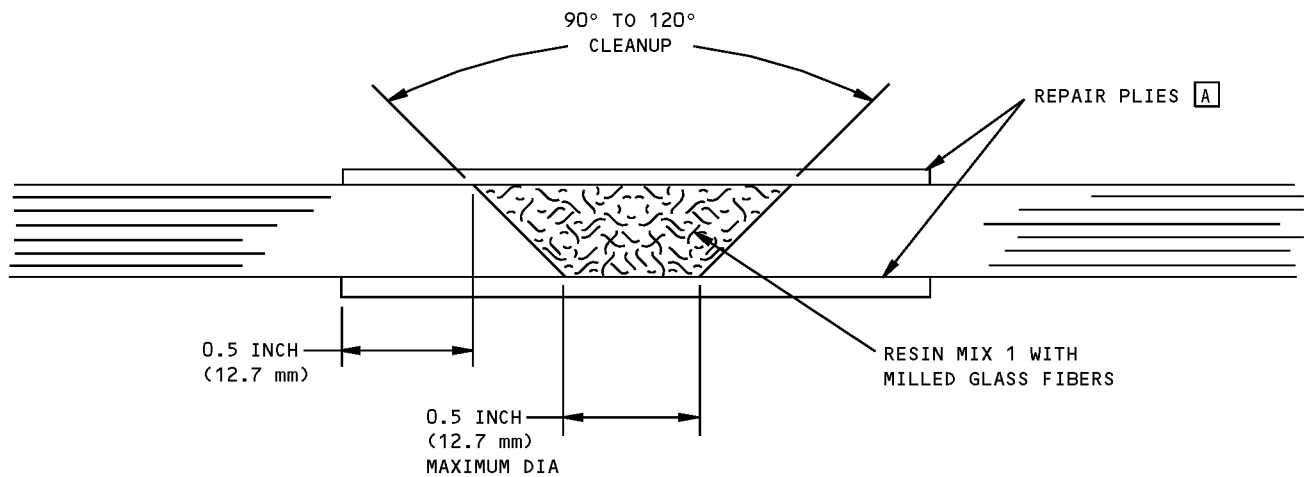
Repair of Small Damage to One Skin
Figure 20



- | | |
|---|---|
| <p>A DETERMINE NUMBER OF PLIES, ORIENTATION, AND MATERIAL FROM SPECIFIC COMPONENT STRUCTURE IDENTIFICATION</p> | <p>C THE ORIENTATION OF THE OUTERMOST EXTRA REPAIR PLY IS TO BE THE SAME AS THE OUTERMOST PLY OF THE ORIGINAL LAMINATE. ANY OTHER EXTRA REPAIR PLY IS TO BE ORIENTED +45° TO THE EXTRA REPAIR PLY IMMEDIATELY ABOVE IT</p> |
| <p>B EXTRA REPAIR PLIES AT THIS LOCATION ARE REQUIRED ONLY IF THE DAMAGE PENETRATES THIS SURFACE</p> | |

Solid Laminate Repair Figure 21

757-200
STRUCTURAL REPAIR MANUAL

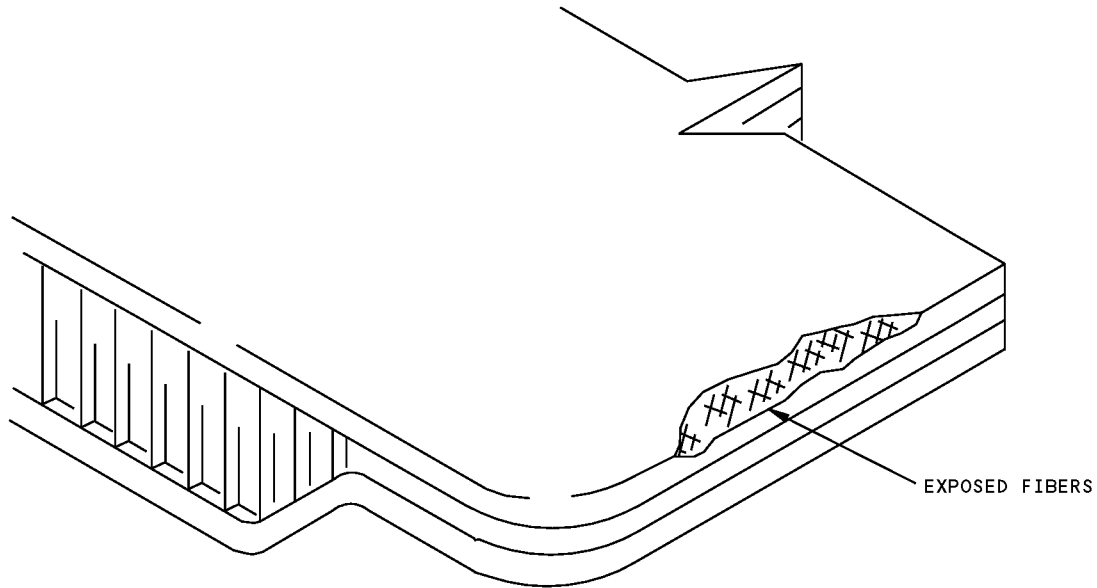


NOTES

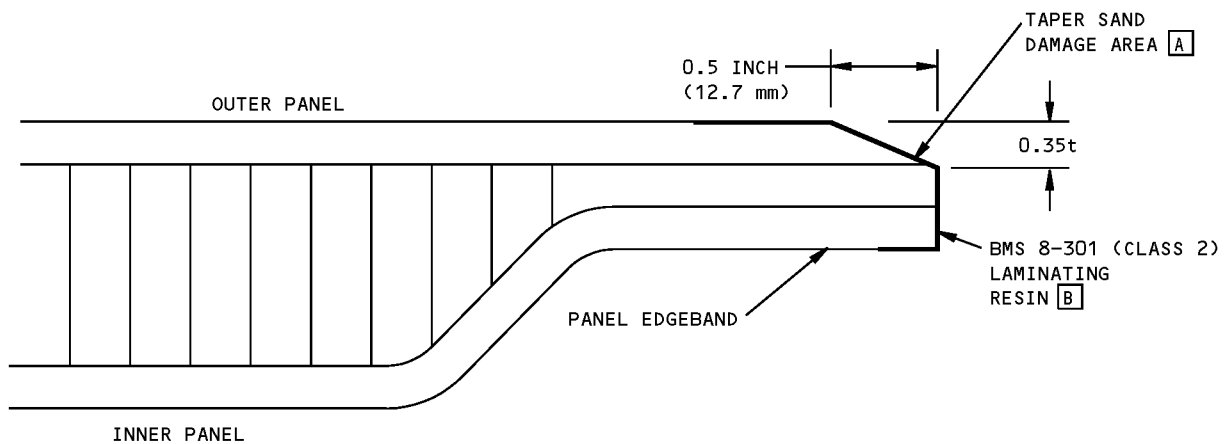
- [A] REPAIR PLIES ARE TO HAVE THE SAME ORIENTATION
AS THE ORIGINAL SURFACE PLIES

Repair of Punctures, 0.50 Inch Diameter or Less, in Solid Laminates
Figure 22

757-200
STRUCTURAL REPAIR MANUAL



PANEL EDGE WITH EROSION DAMAGE



SECTION THRU PANEL

NOTES

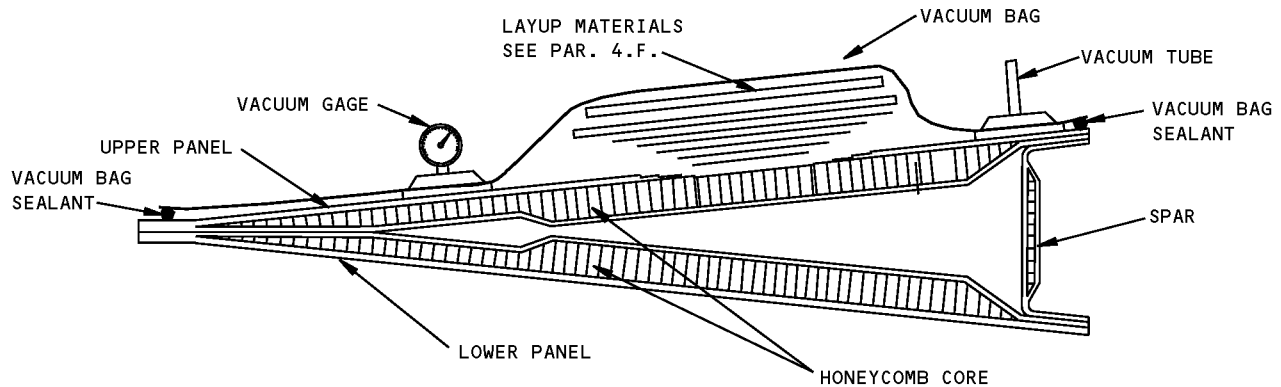
- REFER TO SRM 51-10-01 FOR AERODYNAMIC SMOOTHNESS REQUIREMENTS
- REPAIR IS APPLICABLE TO BOTH HONEYCOMB PANEL EDGE BANDS AND SOLID LAMINATE PANEL EDGES

[A] TAPER SAND EROSION DAMAGE AREA TO 0.5 INCH (12.7 mm) MAX DISTANCE FROM PANEL EDGE AND 0.35t MAX DEPTH. t = PANEL EDGE BAND THICKNESS

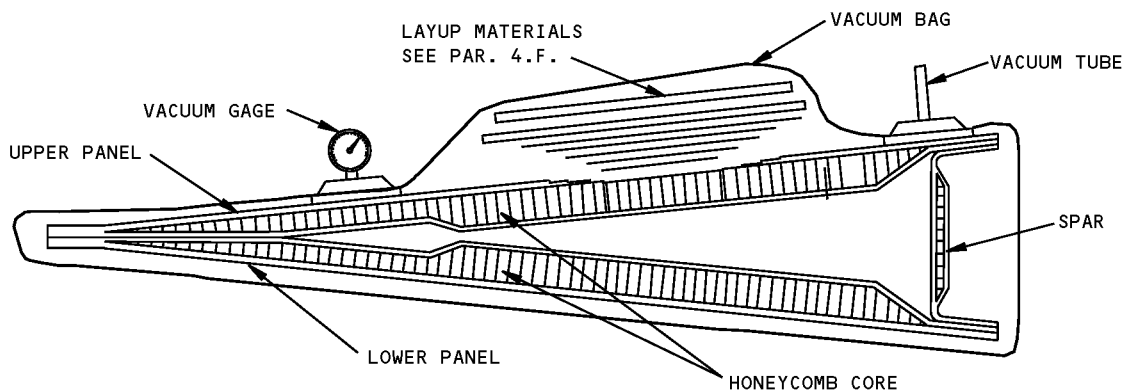
[B] REFER TO FIGURE 1 FOR RESIN SPECIFICATIONS AND MIXING PROCEDURES

Repair of Erosion Damage to Panel Edges
Figure 23

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ACCEPTABLE - VACUUM BAG SEALED TO ONE SIDE ONLY



NOT ACCEPTABLE - VACUUM BAG SEALED AROUND ENTIRE PART
MAY CAUSE ASSEMBLY DISTORTION DURING CURE CYCLE

PARTS CONSISTING OF UPPER AND LOWER PANELS A

NOTES

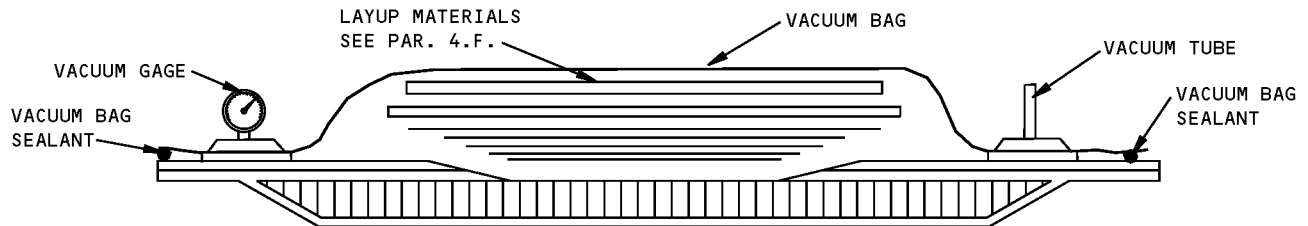
- REFER TO PAR. 4.F. FOR LAYUP AND BAGGING PROCEDURES

A THIS TYPE OF COMPONENT MUST NOT BE COMPLETELY SEALED IN A VACUUM BAG. DAMAGE TO PART WILL OCCUR. VACUUM BAG ONE SIDE OF COMPONENT ONLY

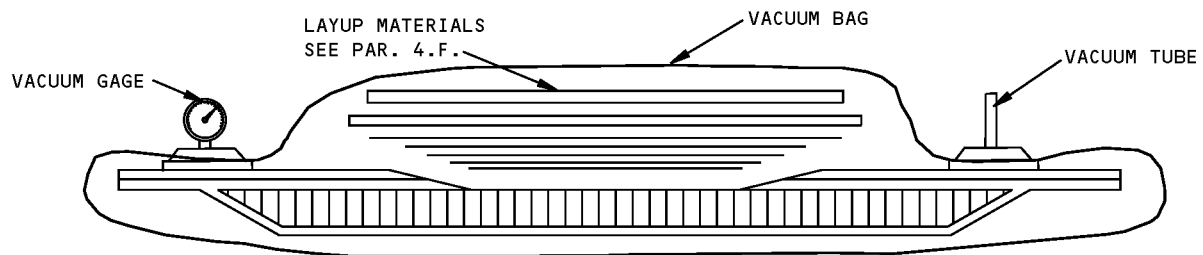
B THIS TYPE OF COMPONENT MAY BE COMPLETELY SEALED IN A VACUUM BAG OR MAY BE SEALED ON ONE SIDE ONLY

Vacuum Bagging Restrictions Figure 24 (Sheet 1 of 2)

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STRUCTURAL REPAIR MANUAL**



ACCEPTABLE - VACUUM BAG SEALED TO ONE SIDE ONLY

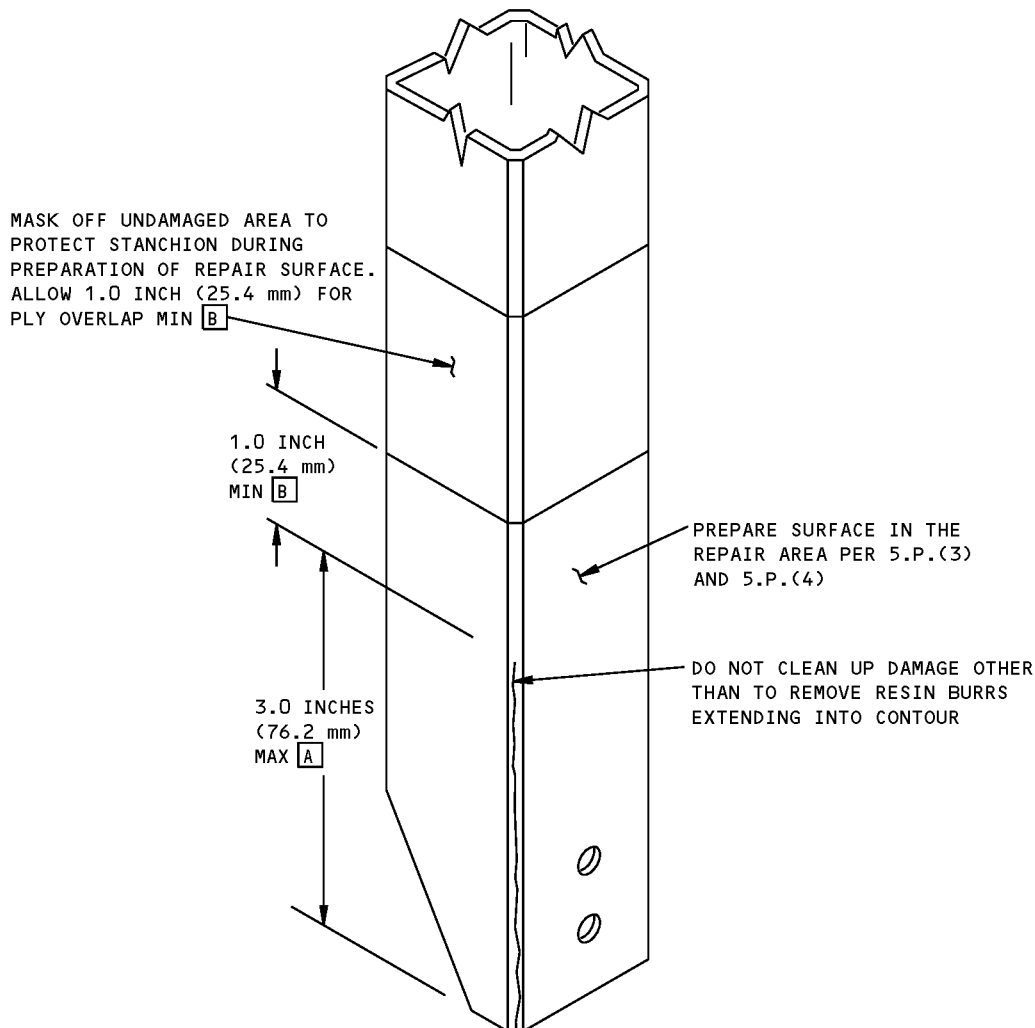


ACCEPTABLE - VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

**Vacuum Bagging Restrictions
Figure 24 (Sheet 2 of 2)**

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LOCATION OF DAMAGE ON STANCHION

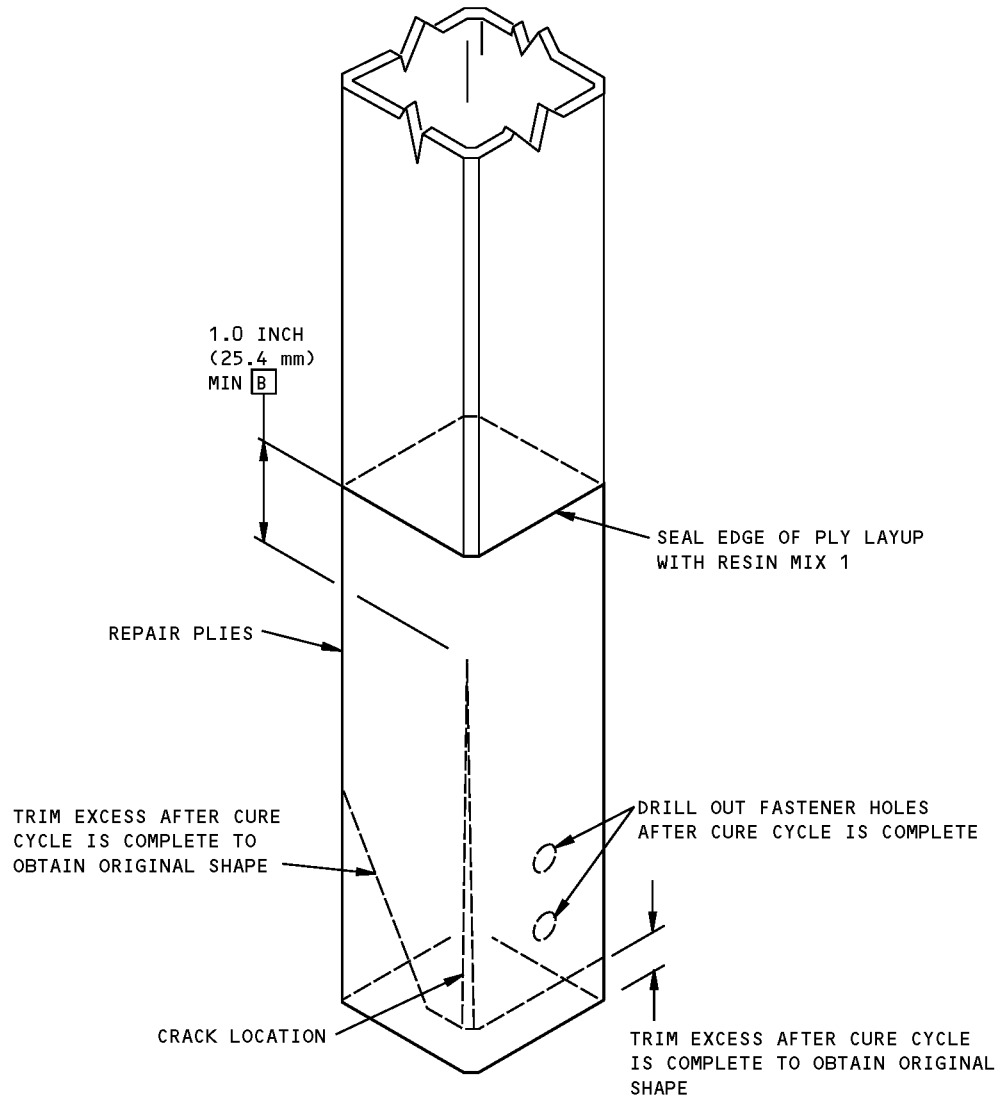
NOTES

- REFER TO PARAGRAPH 5.P. FOR THE REPAIR INSTRUCTIONS
- REFER TO SRM 51-70-16 FOR FINAL TRIMMING OF PART
- REPAIR OF CRACK DAMAGE TO GRAPHITE STANCHIONS IS ALLOWED WHEN CRACK IS FOUND IN CORNER OF STANCHION, CRACK DOES NOT EXCEED 3.0 INCHES (76.2 mm) MAX LENGTH, AND THERE IS NO EVIDENCE OF BUCKLING
- STANCHIONS WITH DAMAGE EXCEEDING THE LIMITS SPECIFIED HEREIN MUST BE REPLACED

- [A] REPAIR ALLOWED FOR CRACK LENGTHS NOT EXCEEDING 3.0 INCHES (76.2 mm) MAX
- [B] REPAIR PLIES MUST OVERLAP CRACK BY 1.0 INCH (25.4 mm) MIN

Repair of Cargo Compartment Graphite Stanchions
Figure 25 (Sheet 1 of 3)

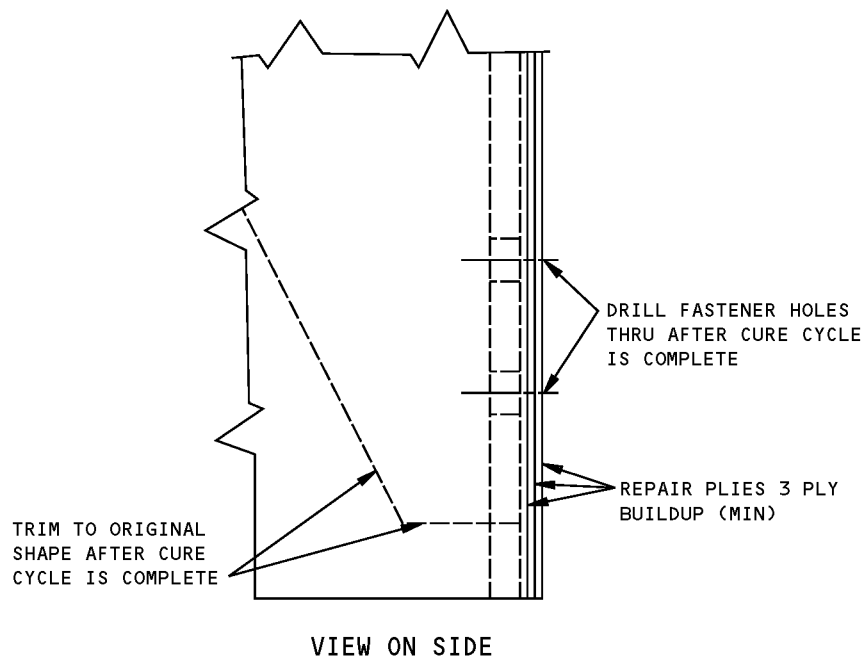
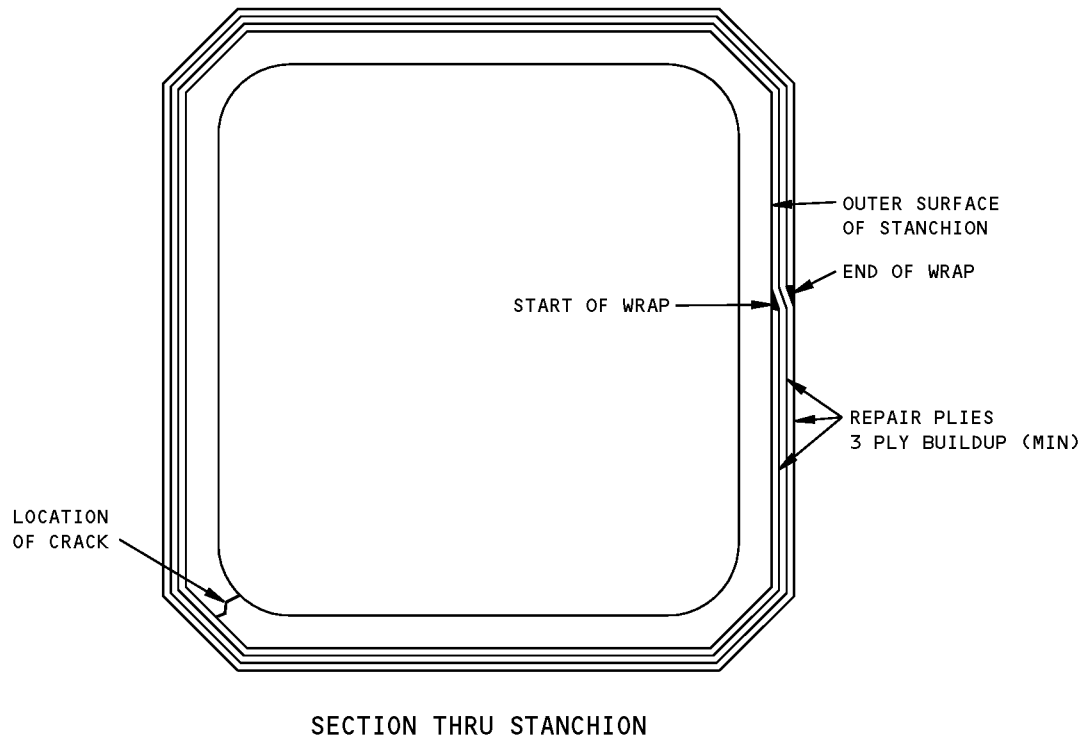
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REPAIR PLY LAYUP ON STANCHION

Repair of Cargo Compartment Graphite Stanchions
Figure 25 (Sheet 2 of 3)

**757-200
STRUCTURAL REPAIR MANUAL**



**Repair of Cargo Compartment Graphite Stanchions
Figure 25 (Sheet 3 of 3)**



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STRUCTURAL REPAIR MANUAL

GENERAL - GRAPHITE AND/OR ARAMID REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH REPAIRS - 350°F (177°C) CURE

1. Applicability

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of graphite tape or fabric, aramid fabric or a combination of graphite, aramid and fiberglass (hybrids). The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands and at fitting locations. This section describes repairs made using 350°F (177°C) cure materials (prepreg layup).

WARNING: DO NOT BREATHE CARBON FIBER DUST. MAKE SURE THAT THERE IS A GOOD FLOW OF AIR WHERE YOU DO THE WORK. USE EQUIPMENT TO HELP YOU BREATHE WHEN YOU WORK IN A CONFINED SPACE. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY.

CAUTION: TO GET AN ACCEPTABLE QUALITY REPAIR, DO AS FOLLOWS:

- REFER TO THE APPLICABLE COMPONENT WHICH YOU ARE GOING TO REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE YOU USE THESE REPAIR INSTRUCTIONS.

- USE THE CORRECT MATERIALS FOR THE TYPE OF COMPONENT AND REPAIR THAT IS MADE.

- USE THE MATERIALS THAT AGREE WITH THE SPECIFICATIONS IN THE SRM.

- ACCURATELY FOLLOW THE SRM PROCEDURES AT EACH STEP OF THE REPAIR. IF YOU DO NOT DO THIS, IT CAN CAUSE A REPAIR THAT IS NOT SATISFACTORY AND IS NOT APPROVED.

350°F (177°C) CURE REPAIRS ARE RESTRICTED TO REPAIRS IN SPECIFIC AREAS OF COMPONENTS.

350°F (177°C) TEMPERATURE MUST NOT BE APPLIED TO AREAS SEALED WITH BMS 5-95 SEALANT, UNLESS SEALANT CAN BE REPLACED FOLLOWING REPAIR.

CAUTION: DO NOT LET CARBON FIBER DUST GO INTO ELECTRICAL EQUIPMENT. CARBON FIBER DUST IS ELECTRICALLY CONDUCTIVE AND IT CAN CAUSE SHORT CIRCUITS IF IT GOES INTO ELECTRICAL EQUIPMENT. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE ELECTRICAL EQUIPMENT.

- B. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage



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Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 4.B./GENERAL	Remove Water from Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedures
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 5.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.H./GENERAL	Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Laminated Panels
Paragraph 5.L./GENERAL	Repair of Surface Dents
Paragraph 5.M./GENERAL	Repair to Aluminum Foil

2. General

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.



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(WARNING PRECEDES)

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR RUBBER GLOVES, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE BARE OR ALUMINUM COATED TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY ALSO BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.

WHEN REINSTALLING ALUMINUM FITTINGS ON GRAPHITE COMPOSITE STRUCTURE, ENSURE THAT THE ORIGINAL CORROSION PROTECTIVE TREATMENT IS MAINTAINED. INSTALL FITTINGS WITH FAYING SURFACE SEAL USING BMS 5-26 IN FUEL TANK AREAS OR BMS 5-95 IN ALL OTHER AREAS.

- A. Use suitable holding fixtures per Paragraph 4.F./GENERAL to prevent distortion and delamination of the structure.
- B. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- C. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- D. Store rolls or precut kits of prepreg and adhesive material below 10°F (-12°C) in sealed moisture proof bags. An identification label must accompany the material inside the bag, with the following information: BMS type, class, grade, supplier name, batch number, roll number, prepreg lot number and date of kit preparation. Record storage time in and out of refrigeration.
- E. Refer to 51-70-02, GENERAL for the locations of principal composite components.
- F. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- G. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
- H. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
 - I. Refer to 51-10-02, GENERAL for inspection and removal of damage.
- J. Refer to 51-70-16, GENERAL for hole drilling and machining of composite structures.
- K. Refer to 51-70-14, GENERAL for repair of flame spray.
- L. Refer to 51-30-06, GENERAL for composite repair material ordering data.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-10-02, GENERAL	Inspection and Removal of Damage
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-05, GENERAL	Repair Sealing
51-30	REPAIR MATERIALS

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(Continued)

Reference	Title
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-60	CONTROL SURFACE BALANCING
51-70-02, GENERAL	Locations of the Principal Composite Components
51-70-03, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
51-70-17, GENERAL	Repairs to 250°F (121°C) and 350°F (177°C) Cured Graphite/Aramid/Fiberglass Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Structure - 200°F (93°C) to 230°F (110°C) Wet Layup Repair Method
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
DOCUMENT D6-49327	Certification of Autoclaves for Metal Bonding and Curing of Composite Structure
DOCUMENT D6-56273	Qualification of Heat Blankets for Hot Bonding
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Repair Procedures Common to Various Repairs

A. Determine Damage.

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- (1) Examine visually for extent of damage.
- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic or thermography methods. Remove contaminants. Refer to Paragraph 4.B./GENERAL for water removal instructions.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental nondestructive inspection (NDI) methods or by tap test. For the tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will give a dull sound. Solidly bonded areas will give a sharp ring. Refer to NDT Part 1, 51-05-01.

B. Remove Water From Damaged Area.

- (1) Remove water from honeycomb sandwich (Figure 11/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum and oil-free compressed air.
 - (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
 - (c) Apply a fiberglass or a metal fine mesh screen over the exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.

STRUCTURAL REPAIR MANUAL

- (g) If the far side is accessible, apply thermocouple and heating blanket to the far side of the honeycomb sandwich panel.

NOTE: If the far side is accessible, it is acceptable to heat the area using a heating blanket only on the far side. An additional heating blanket and vacuum application may be used on the near side at the location shown in Figure 11/GENERAL to accelerate water removal. If the far side is inaccessible, use of a heating blanket on the near side is required.

- (h) When the far side is inaccessible or when using an additional heating blanket, place the heating blanket over the bleeder cloth on the near side.
- (i) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
- (j) Evacuate the layup to a vacuum of 22 in/Hg (75 kPa) minimum.
- (k) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
- (l) Remove layup materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
- (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
- (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

CAUTION: REMOVE (FOR ALL TYPES OF CURE) OR ISOLATE (HEAT BLANKET ONLY) ALUMINUM STRUCTURE TO PREVENT LOSS OF STRENGTH IN THE ALUMINUM PARTS. ALL ALUMINUM ALLOYS, EXCEPT 2219, MUST BE KEPT BELOW 200°F (93°C). ALUMINUM 2219 CAN BE KEPT UP TO 400°F (204°C).

REMOVE SEALANTS, PAINTS AND PRIMERS IN THOSE AREAS WHERE THE TEMPERATURE COULD REACH ABOVE THE MAXIMUM ALLOWABLE TEMPERATURE. REFER TO 51-20-01, GENERAL FOR THE MAXIMUM ALLOWABLE TEMPERATURES.

C. Remove Damage and Prepare Damaged Area

- (1) Damage removal.
- (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.
- NOTE:** Remove only damaged plies, damaged doublers and damaged fillers.
- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. For crush splice repairs (Paragraph 4.D./GENERAL) leave one to three core cells (0.4 in. (10.2 mm) maximum) visible between core cavity and skin (Figure 16/GENERAL). The core area removed should extend at least 0.5 in. (12.7 mm) further than visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side. In cores greater than 1.0 in. (25.4 mm) thick, partially remove core (at least 0.5 in. (12.7 mm) deep) sufficient to clean up damage.
- (c) In areas where contamination cannot be removed by cleaning or drying per Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 4.C.(1)(a)/GENERAL.



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- (e) When core is removed from inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 9/GENERAL, FIGURE 13/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(2) Preparation of damaged area (Figure 13/GENERAL).

- (a) Determine the number of plies that have been cut. Mask off the area around the cutout allowing 0.5 in. (12.7 mm) minimum overlap for each ply replacement, plus 0.5 in. (12.7 mm) extra for each extra repair ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the applicable component structure identification or engineering drawing.

If the damaged area has a layer of aluminum foil, cut back the foil enough to allow a new foil layer to have a 1.0 in. (25.4 mm) minimum overlap beyond the outermost repair ply (Figure 17/GENERAL).

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
 - 1) Remove the paint finish or Tedlar film in the masked off area using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper.
 - 2) If the damage area has a layer of aluminum foil, cut back the foil enough to allow a new foil layer to be at least 1.0 in. (25.4 mm) larger all around than the largest repair ply (Figure 17/GENERAL).
 - a) Strip the aluminum foil by peeling or abrading. Do not damage the underlying composite fibers.
 - b) Carefully abrade to remove the primer on the aluminum foil to a border 1.0 in. (25.4 mm) larger all around than the repair area that was just stripped of foil.
 - c) Taper sand or step sand each ply per Paragraph 4.C.(2)(b)3/GENERAL below.

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- d) Lightly abrade and solvent wipe the primer on the aluminum foil to a border at least 1.0 in. (25.4 mm) larger all around than the band of foil exposed by primer removal in Paragraph 4.C.(2)(b)2b)/GENERAL.
- e) Apply a chemical conversion coating to the foil exposed by primer removal in Paragraph 4.C.(2)(b)2b)/GENERAL.
- 3) Taper sand each ply or simply abrade the surface around the cleaned up damage a minimum of 0.5 in. (12.7 mm) per ply. Refer to Figure 13/GENERAL.
- 4) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
- 5) Abrade surfaces around repair using No. 150 or finer Scotch-Brite abrasive.
- (c) External surface of panel (critical aerodynamic surfaces).
 - 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over a minimum distance of 0.5 in. (12.7 mm) for each existing ply of the laminate.

Step sanding is optional to taper sanding on honeycomb sandwich structure in areas of noncritical aerodynamic smoothness. Refer to 51-10-01, GENERAL for locations of areas of critical aerodynamic smoothness. Always taper sand on solid laminate structures.

NOTE: For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.

- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 0.5 in. (12.7 mm) border using No. 150 or finer sandpaper.
- (d) Edgeband of panel.
 - 1) Taper sand panel edgeband according to Paragraph 4.C.(2)(c)/GENERAL.
- (e) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

- 1) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/ SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.

CAUTION: DO NOT IMMERSE PARTS IN TRICHLOROETHANE OR ALLOW STANDING SOLVENT ON PART. DAMAGE TO PART WILL OCCUR.

D. Fabricate, clean, and install honeycomb replacement core plug.

- (1) Fabricate core plug.



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- (a) Fabricate core plug from core called out on engineering drawing. Refer to specific component structural identification section to determine type of core called out on engineering drawing.
- (b) For butt splicing, the honeycomb core should fit flush with the original core and with the ribbon direction aligned. Trim the core plug no more than 0.05 in. (1.3 mm) of an inch smaller than the cut out. The core plug is to have a tight interference fit in the core cavity after it is wrapped with the foaming adhesive.
- (c) For crush splicing, the honeycomb plug should be made two to four cells larger than the repair cavity and be made from core material which is a maximum of two grades denser than the original core (Figure 16/GENERAL).

NOTE: Crush splicing applies to fiberglass cores (BMS 8-124, Class I) only.

- (d) Trim core plug to full or partial depth of original core as given in Paragraph 4.C.(1)(b)/GENERAL and shown in Figure 2/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive film between core plug and undamaged core or skin (Figure 2/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL).

- (2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED THE IMMERSION CRITERIA THAT FOLLOWS . DAMAGE TO CORE MATERIAL WILL OCCUR.

DO NOT IMMERSE PARTS IN TRICHLOROETHANE SOLVENT OR ALLOW STANDING SOLVENT ON PART. DAMAGE TO PART WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99) bath for 60 seconds.
- (b) Locally contaminated areas can be washed with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
- (c) The core must be completely dry, clean, and free of evidence of solvents before installation.

CAUTION: WHEN HANDLING ADHESIVE FILM WEAR CLEAN WHITE GLOVES TO PREVENT CONTAMINATION.



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(CAUTION PRECEDES)

DO NOT TOUCH THE ADHESIVE FILM WITH BARE HANDS OR OTHER PARTS OF THE BODY.

DO NOT FOLD, STRETCH OR OTHERWISE THIN THE ADHESIVE FILM.

- (3) Install core plug (Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL, typical).

NOTE: Most of the materials used in this procedure have limited life and require controlled storage conditions. Refer to the applicable material specifications for the maximum time out of the controlled storage and for the uncontrolled storage conditions.

Before opening the adhesive film wrapper, condition refrigerated adhesives to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of adhesive horizontally through its axis free from other rolls or objects.

- (a) For partial core replacement, cut two pieces of BMS 5-154, Grade 03 or four pieces of BMS 5-154, Grade 05 adhesive film and one piece of 120 fiberglass prepreg fabric to fit the repair hole. Place in position as shown in Figure 2/GENERAL, Section A-A.
- (b) For full depth core replacement, where damage does not extend through both skins, trim a piece of BMS 8-245, Grade 05 adhesive film to fit repair hole. Place on the inside surface of the undamaged skin (Figure 2/GENERAL, Figure 3/GENERAL, Figure 7/GENERAL, and Figure 13/GENERAL).
- (c) If both skins are damaged, tape a metal caul plate (such as 0.032 in. (0.813 mm) thick aluminum) against the exterior surface of the far side skin and repair as for damage to one skin only. Repair the far side skin in a subsequent repair cycle.
- (d) For butt splicing, wrap the edges of the core plug with BMS 5-90, Type III or Type IV, Class 350, Grade 50 foaming adhesive and install in the repair cavity. Align the honeycomb ribbon with the original core ribbon direction.
- (e) For crush splicing, prepare and install the core plug per Figure 16/GENERAL. Align the honeycomb core ribbon with the original core ribbon direction.
- (f) Put the layup materials and equipment in place per Figure 3 (Sheet 2).
 - 1) If the damage extends through both face skins, vacuum bag both sides of the panel (or the entire part) using the layup shown in Figure 3 (Sheet 2).
 - 2) If the replacement core plug is less than or equal to 0.5 in. (12.7 mm) thick, use the heating blanket on the near side and locate at least two separate thermocouples on the panel surface at the bondline.
 - 3) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and both sides are accessible, use heating blankets on both sides. Locate at least two separate thermocouples on the near side at the bondline and one on the far side corresponding to the center of the repair.

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- 4) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and only one side is accessible, use the heating blanket on the near side and put at least two separate thermocouples into the repair hole so the thermocouples touch the repair materials at the bottom of the repair hole.

NOTE: The ends of these thermocouples will be cured into the adhesive. Cut the thermocouples leaving the embedded ends behind before applying the repair plies. Only the portion of the thermocouple embedded in the core can be left in the repair. The thermocouples cannot come between the repair plies and the sanded surfaces of the original plies.

- (g) Evacuate the repair area to a vacuum of 22 in/Hg (75 kPa) minimum.
- (h) Cure a minimum of 120 minutes at 345 to 365°F (174 to 185°C) (Figure 14/GENERAL).
- (i) Allow the repair area to cool under vacuum until the temperature of the repair area is 125°F (52°C) or less. Then release restraints (if applicable) and remove layup materials and equipment.
- (j) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (k) Vacuum to remove sanding residue from core cells.

NOTE: The core plug and the repair plies can be cured at the same time if the temperature can be adequately monitored by thermocouple placed on the outside surfaces of the panel (refer to Paragraph 4.D.(3)(f)2)/GENERAL, Paragraph 4.D.(3)(f)3)/GENERAL, and Paragraph 4.D.(3)(f)4)/GENERAL). If the thermocouples must be embedded in the repair core adhesive, then the core plug must be cured separately to avoid curing the thermocouple between the repair plies and the sanded surface of the original plies.

CAUTION: DO NOT CURE MORE THAN TEN (10) PLIES DURING ONE CURE CYCLE FOR HEAT BLANKET AND OVEN CURES. IF THE REPAIR HAS MORE THAN 10 PLIES, DIVIDE THE REPAIR PLIES EVENLY INTO MULTIPLE CURE CYCLES. IF YOU DO NOT OBEY, POROSITY AND BULGES CAN OCCUR AND THE SUBSEQUENT REPAIR WILL BE UNSATISFACTORY.

E. Prepare and Apply Preimpregnated (Prepreg) Repair Plies.

NOTE: Refer to applicable paragraphs for preparation of prepreg glass, aramid and graphite fabrics. For hybrid components refer to applicable material paragraphs for each individual ply.

Before opening the prepreg material or adhesive film wrapper, condition refrigerated materials to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of material horizontally through its axis free from other rolls or objects.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

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STRUCTURAL REPAIR MANUAL

(CAUTION PRECEDES)

THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

(1) Prepare prepreg glass fabric repair plies (BMS 8-139).

- (a) Refer to the specific component structural identification to determine type and orientation of glass fabric used in original structure. Repair existing plies of original structure with BMS 8-139, Style 1581 (Figure 12/GENERAL).
- (b) From BMS 8-139, Style 1581 preimpregnated material, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(1)(c)/GENERAL for substitution of prepreg glass fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 15/GENERAL for extra repair ply material and orientation.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

(c) Substitution of prepreg glass fabric plies (Figure 12/GENERAL).

- 1) If BMS 8-139, Style 1581 prepreg material is not available, three plies of BMS 8-139, Style 120 prepreg material may be substituted for each ply of Style 1581 prepreg material required.

(2) Prepare prepreg aramid fabric repair plies (BMS 8-218).

NOTE: Before opening the prepreg material or adhesive film wrapper, condition refrigerated materials to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of material horizontally through its axis free from other rolls or objects.

CAUTION: THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

- (a) Refer to the specific component structural identification to determine number, style and orientation of aramid fabric used in original structure (Figure 2/GENERAL).

STRUCTURAL REPAIR MANUAL

- (b) From each type of material required, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(2)(c)/GENERAL for the substitution for prepreg aramid fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 15/GENERAL for extra repair ply material and orientation.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) Substitution of prepreg glass fabric plies (Figure 12/GENERAL) for aramid plies.

- 1) If BMS 8-139, Style 1581 prepreg material is not available, three plies of BMS 8-139, Style 120 prepreg material may be substituted for each ply of Style 1581 prepreg material required.
- 2) One ply of BMS 8-139, Style 120 prepreg material can be used for each ply of BMS 8-218, Style 120 aramid prepreg material.
- 3) One ply of BMS 8-139, Style 1581 prepreg material can be used for each ply of BMS 8-218, Style 285 aramid prepreg material.

- (3) Prepare prepreg graphite repair plies (BMS 8-212 and BMS 8-256).

NOTE: Before opening the prepreg material or adhesive film wrapper, condition refrigerated materials to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of material horizontally through its axis free from other rolls or objects.

CAUTION: TAPE IS A UNIDIRECTIONAL FIBER. WHEN USED IN A LAYUP, THE PREDOMINATE STIFFNESS IS IN THE DIRECTION OF THE FIBER. TAPE HAS LITTLE OR NO STIFFNESS IN THE TRANSVERSE DIRECTION.

FABRIC HAS BIDIRECTIONAL PROPERTIES. WHEN SUBSTITUTED FOR TAPE, FABRIC ADDS STIFFNESS IN THE TRANSVERSE DIRECTION. THE EFFECTS OF THIS ADDITIONAL TRANSVERSE STIFFNESS ON THE COMPONENT AND SUBSTRUCTURE MUST BE CONSIDERED PRIOR TO COMMITTING A MAJOR SUBSTITUTION IN A REPAIR.

THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

- (a) Refer to the specific component structural identification section to determine number, style, and orientation of graphite tape or fabric plies used in original structure (Figure 2/GENERAL). Use the same material for the repair plies as was used in the original component (Figure 12/GENERAL).

STRUCTURAL REPAIR MANUAL

- (b) From each type of material required, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(3)(c)/GENERAL for the substitution of prepreg fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 15/GENERAL for extra repair ply material and orientation.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) No substitutes are permitted for graphite fabric repair plies. Refer to Figure 12/GENERAL.

- (4) Apply the repair plies (Figure 2/GENERAL and Figure 13/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with strips of graphite preimpregnated material before application of the repair plies. Use the same graphite material as used in the repair plies.

CAUTION: ENSURE THAT PARTING FILM AND POLYETHYLENE SEPARATOR ARE REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Make a temporary vacuum bag system.

NOTE: This vacuum bag is used to compact the repair plies and prevent contamination of the repair. Do not use this vacuum bag system for the repair cure.

- 1) Put one layer of perforated parting film above the repair.
 - 2) Put one layer of glass fabric cloth as a surface breather above the repair.
 - 3) Apply the vacuum sealing compound around the repair area.
 - 4) Put the vacuum bag material over the repair area. Seal the edges with the vacuum sealing compound.
 - 5) Attach a vacuum line above the surface breather.
- (b) Cut two plies of BMS 5-154, Type II, Class I, Grade 05 adhesive film, 0.125 in. (3.2 mm) larger than the largest patch ply which also covers the entire repair area.

NOTE: The second ply of adhesive film will be used as a nonstructural sanding ply. As an option, substitute a ply of BMS 8-139, Style 1581 fiberglass prepreg cut to the same size as the adhesive ply. The fiberglass ply is less likely to entrap air during the cure.

This nonstructural sanding ply is the final ply and covers the entire repair. After curing, this ply may be sanded as required to obtain a smooth surface for refinishing. Be careful not to sand through this nonstructural sanding ply into the structural repair plies below it.

Repairs to aluminum foil will require both plies of adhesive film and one ply of BMS 8-139, Style 1581 fiberglass prepreg.

STRUCTURAL REPAIR MANUAL

- (c) Place one layer of adhesive film over the entire repair area.
- (d) Install the repair plies and if necessary the sanding ply also.

NOTE: Add filler plies as necessary to get a smooth repair. Do not use more than four filler plies on one repair area.

- 1) Install the smallest repair ply first.
- 2) Make sure that the warp direction of each repair ply that you put in the repair is correct and that the overlap is correct.
- 3) Install the next ply. Make sure that it is smooth with no wrinkles.
- 4) Remove the separator sheet.
- 5) You must do the steps that follow for repairs that have one or more graphite (Carbon Fiber Reinforced Plastic (CFRP) repair plies).

NOTE: Although it is only necessary to compact repairs containing CFRP repair plies, Boeing recommends that you compact all repairs.

- a) Compact each ply (or plies) with the temporary vacuum system as follows:

- 1 minute for each ply (one ply at a time), or
- 2 minutes for each two plies (two plies at a time), or
- 6 minutes for each three plies (three plies at a time)

NOTE: Do not compact more than three plies at a time. An adhesive ply counts the same as a repair ply.

- b) Do Paragraph 4.E.(4)(d)2)/GENERAL, Paragraph 4.E.(4)(d)3)/GENERAL, Paragraph 4.E.(4)(d)4)/GENERAL, and Paragraph 4.E.(4)(d)5)/GENERAL again for all of the repair plies as necessary to complete the layup.
- (e) Apply a cover ply of BMS 8-139, Style 1581 fiberglass prepreg or the second ply of adhesive film over the replaced plies. If the repair includes repair to aluminum foil, use the second ply of adhesive film.
- (f) If the repair area has a layer of aluminum foil, repair the foil per Paragraph 5.M./GENERAL before proceeding with the bagging and cure of the part.

F. Layup and Bagging Procedure.

- (1) Place one layer of perforated FEP parting film over the replacement plies and extending at least 1 in. (25.4 mm) beyond the largest patch ply.
- (2) Put on the thermocouples.

- (a) If you use an autoclave or an oven, then do the step that follows:

- 1) Put one or more thermocouples at the location where the temperature will increase the fastest and one or more thermocouples where the temperature will increase the slowest.

NOTE: Boeing recommends that you put one or more thermocouples at the thick areas of the part and tool and the thin areas of the part and tool. Use more than two thermocouples when more than 900 in² (5806 cm²) of a panel surface is repaired. Insulation is not necessary in the repair area for autoclave or oven cures.

- (b) If you use a heat blanket, then do the step that follows:

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- 1) Secure three thermocouples (spaced evenly around the repair) to the panel at the edge of the repair and secure them to the temperature recording device.
- (3) Place a layer of dry peel ply over the perforated FEP.

NOTE: The peel ply must be cut large enough to make contact with the surface breather.

- (4) Place one layer of solid FEP parting film over the layup extending to 0.5 in. (12.7 mm) short of the edge of the dry peel ply.
- (5) If you use a heat blanket, then place it over the repair area.

NOTE: The heat blanket must extend a minimum of 2 in. (5 cm) beyond the edge of the patch.

When you use a heat blanket that is longer than 12 in. (30 cm) on one side, it is recommended that you use an aluminum pressure plate (0.040 in. (1.02 mm) thick max) to minimize localized heating.

If you use two or more pads, then you must also use a pressure plate.

- (a) If the area to be repaired is near or attached to aluminum structure that was not removed in Paragraph 4.C./GENERAL, do the steps that follow:
 - 1) Isolate the aluminum structure from the areas that will get hot.
 - 2) Add one or more thermocouples to put on the aluminum structure. Make sure that the temperature does not go above 200°F (93°C).
 - 3) You can put insulation around all other metals to prevent cold locations in the repair.
- (6) Place a layer of Airweave SS or Style 120 glass fabric over the solid FEP as a surface breather, or, if heat blanket is used, place four to six layers of breather material over the heat blanket to act as an insulator and a surface breather.

NOTE: The surface breather material and the dry peel ply must make contact.

- (7) Lay the vacuum line over the edge of the breather material.
- (8) Apply extruded sealing compound around the entire repair area, 2 in. (5 cm) to 6 in. (15 cm) outside the edge of the heat blanket.

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CAUTION: HOLLOW COMPOSITE COMPONENTS SUCH AS RUDDERS, ELEVATORS, AND AILERONS MUST NOT BE COMPLETELY BAGGED BECAUSE THEY MAY COLLAPSE UNDER 22 IN/HG (75 KPA) VACUUM. ATTACH VACUUM BAG TO ONE SIDE OF COMPONENT ONLY OR ATTACH SEPARATE VACUUM BAGS TO EACH SIDE TO ENSURE THAT ATMOSPHERIC PRESSURE IS MAINTAINED INSIDE OF COMPONENT DURING REPAIR. COMPONENTS CONSISTING OF A SINGLE PANEL MADE OF FULL DEPTH HONEYCOMB CORE WITH LAMINATE FACE SHEETS AND EDGE BANDS MAY BE COMPLETELY BAGGED (FIGURE 18/GENERAL).

- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. In some cases, it is optional to vacuum bag the entire part.

NOTE: The entire repair surface must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts sagging and distortion could occur due to the weight of the part.

- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
- (11) Check the vacuum bag for leak paths.
- G. Cure the repair. Do Paragraph 4.G.(1)/GENERAL for the autoclave procedure, Paragraph 4.G.(2)/GENERAL for the oven cure procedure, or do Paragraph 4.G.(3)/GENERAL for the heat blanket/heat lamp cure procedure.

- (1) For autoclave cure, see Figure 14 (Sheet 1), Detail I and do the steps that follow:

NOTE: Boeing recommends that you use a certified autoclave when you do the procedure that follows. DOCUMENT D6-49327, Certification of Autoclaves, is a procedure that Boeing uses, and you can use this as a guide to certify your autoclave.

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Pressurize the autoclave to 40 to 50 psig (276 to 345 kPa gauge). Open the vacuum bag to the atmosphere when the autoclave pressure is above 20 psig (138 kPa gauge).

NOTE: Boeing recommends that you fill and pressurize the autoclave with an inert gas such as CO₂ or N₂ when you cure a repair above 250°F (121°C).

- (c) Increase the temperature of the autoclave until it is at 130°F (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 1°F to 5°F (0.5°C to 3°C) for each minute until all thermocouples are in the cure temperature range.

NOTE: Boeing recommends that you increase the temperature at a rate of 1°F to 3°F (0.5°C to 1.7°C) when the stack of repair plies are more than 0.25 inch (6 mm) thick.

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- (d) Hold the cure temperature for the specified time as given in Figure 14 (Sheet 1), Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature range during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (e) Keep the vacuum bag connection to the atmosphere open and the autoclave pressurized until after the cure is complete and the temperature of the part has decreased to 125°F (52°C).
- (f) Decrease the autoclave temperature at a maximum rate of 5°F (3°C) for each minute.
- (g) When the temperature is less than 125°F (52°C), release the autoclave pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONNEL.

- (2) If you use an oven to cure the repair, see Figure 14 (Sheet 1), Detail I and do the steps that follow:

NOTE: Use a circulating oven that has equipment that can supply a vacuum and can control the temperatures as given in this procedure.

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the oven until it is at 130°F (54°C). When the temperature is at 150°F (54°C), increase the temperatures at a rate of 1°F to 5°F (0.5°C to 3°C) for each minute until all thermocouples are in the cure temperature range.
- (d) Hold the cure temperature for the specified time as given in Figure 14 (Sheet 1), Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (e) Decrease the oven temperature at a maximum rate of 5°F (3°C) for each minute.
- (f) When the temperature is less than 125°F (52°C), remove the vacuum pressure.
- (g) Remove the vacuum bag equipment from the part and tool.

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WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONNEL.

(3) For heat blanket cure, see Figure 14 (Sheet 2), Detail II and do the steps that follow:

NOTE: Boeing recommends that you use a qualified heat blanket when you do the procedure that follows. DOCUMENT D6-56273, Qualification of Heat Blankets for Hot Bonding, is a procedure that Boeing uses, and you can use this as a guide to qualify your heat blanket.

- (a) Make sure there is a minimum of three thermocouples for each heat blanket used. Refer to Paragraph 4.F./GENERAL.
- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum vacuum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the heat source until the temperature of the repair is at 130°F (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 1°F to 5°F (0.5°C to 3°C) for each minute until all thermocouples are at the cure temperature.

NOTE: When you use a hot bond console, obey the manufacturer's operation instructions.

- (d) If necessary, put insulation on the cooler areas of the repair area, opposite of the heat source.
- (e) Hold the cure temperature for the specified time as given in Figure 14 (Sheet 2), Detail II.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (f) Decrease the temperature at a rate maximum of 5°F (3°C) for each minute.
- (g) When the temperature decreases to less than 125°F (52°C), release the vacuum pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

H. Refinish After Repair.

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of top most repair ply as necessary to fair the edge. Do not sand through the nonstructural sanding ply into the structural repair plies below it.
- (2) Apply finish to the repaired surface using the following applicable methods.
 - (a) Where clear Tedlar film surfaces have been removed, seal with a brush coat of Resin Mix 3 (Figure 1/GENERAL). Cure for 6 to 8 hours at room temperature or at elevated temperature per Figure 4/GENERAL.
 - (b) Where gray or white Tedlar film surfaces have been removed, seal with Resin Mix 3 (Figure 1/GENERAL). Cure 6 to 8 hours at room temperature (or per Figure 4/GENERAL) and apply one coat of BMS 10-11 primer and one coat of BMS 10-60, Type II enamel (gray, BAC705; white, BAC7106).
 - (c) Where the conductive coating BMS 10-21 has been removed, reapply per AMM 51-24-02.

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- (d) Where the abrasion resistant Teflon finish has been removed from the internal surface of the panel edgeband, reapply the finish per AMM 51-24-13.
- (e) Where the original painted surfaces have been removed, restore original finish per AMM 51-21-00/701.
- (f) Where sealant has been removed from around fittings or fay surfaces to facilitate repairs, reapply BMS 5-95 sealant per 51-20-05, GENERAL.
- (g) Where bolts have been removed from aluminum fittings common to graphite, reinstall bolts wet with BMS 5-95 sealant and fillet seal around bolt heads and nuts.

I. Perform Post-Repair Requirements

- (1) Make an inspection of the repair that was done to make sure that the repair is satisfactory. The inspection must include these areas:
 - The area that was hot.
 - A minimum width of 2 in. (5 cm) all around the area that was hot.

If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: Examples of inspection procedures are given in NDT Part 1, 51-01-01. Other inspection methods that have been examined and found satisfactory by the airline can be used.

WARNING: FLIGHT SAFETY DEMANDS THAT CERTAIN CONTROL SURFACES BE PROPERLY BALANCED AT ALL TIMES.

- (2) Following repair of control surface, balance must be checked to determine whether or not rebalancing is required. Rebalance as necessary per CONTROL SURFACE BALANCING, SECTION/51-60.

CAUTION: REPAIRS MADE TO CONTROL SURFACES AND/OR ADJACENT STRUCTURE MUST NOT INTERFERE WITH THE DESIGNED OPERATION OF THE CONTROL SURFACES. DAMAGE TO AIRPLANE STRUCTURE MAY OCCUR.

- (3) Check all repairs for clearance and noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

CAUTION: REPAIRS MUST NOT COVER EXISTING DRAIN HOLES IN PANELS. WATER WILL ACCUMULATE IF DRAIN HOLES ARE COVERED.

- (4) If repair covers the drain hole, drill through the repair at existing location.

NOTE: Drain holes are usually 0.375 in. (9.52 mm) diameter. Refer to AMM 51-41-01.

5. **Typical Repairs**

NOTE: These repairs apply to all 350°F (177°C) graphite/aramid/glass fabric reinforced honeycomb components, except radomes, when called out in applicable repair index of specific structure.

CAUTION: ESTABLISH COMPONENT MATERIAL AND REPAIR LIMITS PRIOR TO PROCEEDING WITH ANY REPAIRS.

A. Repair of Delaminations Between Plies.

- (1) Delamination of plies over core area of panel (Figure 5/GENERAL).
 - (a) Determine damage per Paragraph 4.A./GENERAL. Ensure that water and other contamination are removed per Paragraph 4.B./GENERAL.

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- (b) Cut away delaminated plies per Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area per Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband.
- (a) Repair this type of damage per 51-70-17, GENERAL.
- B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel.
- (1) Repair this type of damage per 51-70-17, GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Figure 2/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from damaged area. Refer to Paragraph 4.B./GENERAL.
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
 - (5) Sand core plug flush with surrounding surface, leaving allowance for film adhesive and slight core crush during cure.
 - (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Figure 6/GENERAL).

NOTE: For repair where access to inner surface is limited, refer to Paragraph 5.F./GENERAL.

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area. Refer to Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL, except do not perform Paragraph 4.D.(3)(e)/GENERAL, Paragraph 4.D.(3)(f)/GENERAL, Paragraph 4.D.(3)(g)/GENERAL, Paragraph 4.D.(3)(h)/GENERAL, Paragraph 4.D.(3)(i)/GENERAL, and Paragraph 4.D.(3)(j)/GENERAL.
- (5) Prepare and apply repair plies to one surface of the panel according to Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
- (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
- (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (8) Prepare and apply repair plies to the other surface of the panel according to Paragraph 4.E./GENERAL.

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- (9) Complete repair per Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

E. Replacement of Honeycomb Core on Damaged Edge of Panel (Figure 7/GENERAL).

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
- (5) Sand core plug approximately flush with surrounding core material, leaving allowance for film adhesive and slight core crush during cure.
- (6) Clean surfaces according to Paragraph 4.C.(2)(e)/GENERAL.
- (7) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side (Figure 8/GENERAL).

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side. Refer to Figure 8/GENERAL when making this repair.

- (1) Determine extent of damage (Paragraph 4.A./GENERAL).
- (2) Ensure that all contamination and water is removed from damaged area. Refer to Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area per Paragraph 4.C./GENERAL and the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + \{N \times [1.0 \text{ in. (25.4 mm) for each ply}]\} + 1.0 \text{ in. (25.4 mm)}$

d = major diameter of oval hole in inner skin and is limited to 1.5 in. (38.1 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole, refer to Figure 8 (Sheet 1), Detail I.
 - (c) Taper sand the outer skin plies per Paragraph 4.C.(2)/GENERAL.
 - (4) Fabricate an airtight patch, Figure 8/GENERAL, Details II thru V to cover the oval hole from the inaccessible side as follows:
 - (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
 - (b) Cover the mold with parting film or release agent.

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- (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 4.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D diameter.
 - (d) Bag and cure the patch per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Place thermocouples at the edge of the patch before cure.
 - (e) Remove the patch from the mold.
 - (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
 - (g) Drill a 0.125 in. (3.175 mm) diameter hole in the center of the patch for a Cleco fastener.
 - (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
 - (i) Fabricate a strip of spring steel 1.0 in. (25 mm) X 10.0 in. (254 mm) and drill a 0.125 in. (3.175 mm) diameter hole in the center for the Cleco fastener.
NOTE: This repair illustrates the use of a spring steel clamp. However, any suitable retaining device may be used.
 - (j) Assemble the patch and spring steel together with a 0.125 in. (3.175 mm) diameter Cleco fastener, see Figure 8 (Sheet 2), Detail II.
- (5) Remove Tedlar, if required and abrade the underside of the inner skin to a distance of 0.4 in. (10.2 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean out the repair area with oil-free compressed air. Wipe the surface with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
- (7) Bend up both ends of the spring steel and apply adhesive BMS 5-109 adhesive paste.
- (8) Holding the spring steel up - insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
- (9) Cure the adhesive per Figure 1/GENERAL. When cure is complete, remove the Cleco fastener and spring. Fill hole for Cleco fastener with BMS 5-109, Type II adhesive paste, or BMS 5-95, Class B-1/2 sealant, and let it cure.

NOTE: Cure BMS 5-109 adhesive paste as given in Figure 1/GENERAL. Cure BMS 5-95 sealant as given in 51-20-05, GENERAL.

- (10) Clean out the repair area per Paragraph 5.F.(6)/GENERAL.
 - (11) Apply adhesive film BMS 5-154, Grade 03 or 05, 0.10 in. (2.5 mm) bigger than diameter D to the surface of the inner skin which fays with the inner skin repair plies.
 - (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin.
 - (13) Fabricate, clean, and install core plug per Paragraph 4.D./GENERAL.
 - (14) Prepare and apply repair plies to the outer skin surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Figure 9/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.

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- (2) Remove all contamination and water from damaged area. Area must be completely dried out. Refer to Paragraph 4.B./GENERAL.

CAUTION: DO NOT SAND INTO BOND PLY OR CORE (FIGURE 9/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. BOND PLY IS ADJACENT TO CORE.

- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.

CAUTION: ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURES.

- (4) Prepare and apply repair plies and complete the repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

H. Repair of Damage and Punctures in Solid Laminate Panels.

NOTE: This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.

NOTE: Taper sand edges of plies around repair on damaged side of panel.

- (4) Prepare and apply repair plies and complete the repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

NOTE: If cleaned up damage penetrates solid laminate, secure a metal caul plate (such as 0.016 in. (0.4 mm) thick aluminum) to far side of panel to support repair plies.

I. Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels.

NOTE: This repair applies to components made from laminated graphite/aramid/glass fabric or tape plies and epoxy resin without a honeycomb core.

- (1) Check for delamination per Paragraph 4.A./GENERAL.
- (2) If no delamination is found, clean up damage to a smooth, rounded shape. Repair per Paragraph 5.B./GENERAL.
- (3) If delamination is found, repair per Paragraph 5.H./GENERAL.

J. Repair of Delaminations Between Plies in Solid Laminate Panels.

NOTE: This repair applies to components made from laminated graphite/aramid/glass fabric or tape plies and epoxy resin without a honeycomb core.

- (1) Repair delaminations using methods described in Paragraph 5.H./GENERAL.

K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels (Figure 10/GENERAL).

- (1) Determine the extent of damage according to Paragraph 4.A./GENERAL.

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- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage according to Figure 10/GENERAL and Paragraph 4.C.(2)(d)/GENERAL.
- (4) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.

CAUTION: ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURES.

- (5) Prepare and apply repair plies according to Paragraph 4.E./GENERAL and Figure 10/GENERAL.
- (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (7) Refinish the repair according to Paragraph 4.H./GENERAL.
- (8) Drill and countersink fastener holes.
- (9) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.

L. Repair of Surface Dents.

- (1) Check for delamination and broken fibers per Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair per Paragraph 5.A./GENERAL.
- (3) If broken fibers are found, repair per Paragraph 5.B./GENERAL or Paragraph 5.C./GENERAL.
- (4) If no delamination or broken fibers are found, repair per 51-70-03, GENERAL.

M. Repair of BMS 8-289 Aluminum Foil (Figure 17/GENERAL and Paragraph 4.C.(2)(b2)/GENERAL).

NOTE: Do this repair in addition to the applicable repair of the underlying plies.

- (1) Determine the extent of and remove damage. Apply repair materials to the underlying composite structure per Paragraph 5.A./GENERAL, Paragraph 5.B./GENERAL, Paragraph 5.C./GENERAL, Paragraph 5.D./GENERAL, Paragraph 5.E./GENERAL, and Paragraph 5.F./GENERAL up to and including the step for applying the repair plies to the surface that had aluminum foil.
- (2) Apply a chemical conversion coating to the nonadhesive side of the splice strip, cover ply, and aluminum surfaces that will contact the splice strip and cover ply.
- (3) Butt-splice a ply of BMS 8-289, Type 0/350/x/x/x over the repair area, adhesive side down, with a 0.25 in. (6.4 mm) maximum gap and no overlap allowance.
- (4) Lay up splice strips of BMS 8-289, Type 0/350/x/x/x Form II, adhesive side up, so that they overlap each side of the splice line by about 1.25 in. (31.8 mm). Form I foil is optional, but requires a chemical conversion coating on the nonadhesive side and 0.5 in. (12.7 mm) diameter holes on 2.0 in. (50.8 mm) centers.

NOTE: Do not allow the cover ply or splice strip to extend into the edgeband area of the panel. Electrical splicing is not allowed on the laminated edgeband faying surface.

- (5) Apply a layer of BMS 5-145, Type I, Grade 03 or 05 adhesive then a cover ply of BMS 8-139, Style 120 prepreg over the repair so that both plies overlap the outer edge of the splice by 1.0 in. (25.4 mm).



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- (6) Vacuum bag and cure the repair per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
RESIN MIX 3 (SEALER RESIN)	EPIBOND 156A RESIN EPIBOND 156B HARDENER	100 ±2 6 ±0.3	15 TO 25 MINUTES AT 77°F (25°C)	12 HOURS AT 70°F (21°C) OR 1 TO 3 HRS AT 150°F (66°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE	FIBER-RESIN 5318S FIBER-RESIN 5318C	100 ±2 50 ±1	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4 OR 24 HOURS MIN. AT 70°F (21°C)
RESIN MIX 3 EPOX-O WELD (SEALER RESIN) ALTERNATE	TWO COMPONENT KIT	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT		
			45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4 OR 24 HOURS MIN. AT 70°F (21°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE	EPIBOND 156A RESIN EPIBOND 941 HARDENER	100 ±2 10 ±0.5	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4 OR 15 HOURS MIN. AT 70°F (21°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE BMS 8-207, TYPE 1, CLASS II 350°F (177°C)	FR-40 RESIN 5413C HARDENER	100 ±1 15 ±0.5	20 MINUTES AT 75°F (24°C) TO 79°F (26°C)	12 HOURS MIN AT ROOM TEMP. (65°F [18°C] MIN) 1 HOUR MIN AT 150°F (66°C) TO 170°F (77°C)
RESIN MIX 9 BMS 8-214, TYPE 1	EPOCAST 31A RESIN EPOCAST 927B HARDENER	100 ±1 19 ±0.5	8 HOURS AT 70°F (21°C)	90 MINUTES AT 350 ±10°F (177 ±6°C)
RESIN MIX 9 (ALTERNATE) BMS 8-301, CLASS I, GRADE 1	EA9390 A/B	100 ±0.5 56 ±0.5	2 HOURS AT 70°F (21°C)	220 MINUTES AT 200 ±10°F (93 ±6°C) 180 MINUTES AT 230 ±10°F (110 ±6°C)
BMS 8-301 CLASS 2 LAMINATING RESIN	FR 7020 PART A RESIN BASE PART B HARDENER EY3804 PART A RESIN BASE PART B HARDENER	100 ±2 58 ±0.5	30 MINUTES AT 75°F	180 MINUTES AT 150°F (68°C) 5 DAY AT ROOM TEMP 68°F (20°C)
BMS 5-90 TYPE III, CLASS 350-10-10, GRADE 50 (FOAMING ADHESIVE FILM)	REFER TO SRM 51-30-03		B C	SEE TEXT
BMS 5-90 TYPE IV, CLASS 350-10-10, (FOAMING EXTRUDABLE ADHESIVE)	REFER TO SRM 51-30-03		B C	SEE TEXT
BMS 5-109, TYPE II (ADHESIVE PASTE)	EA 9394 PART A EA 9394 PART B OR EA 934 NA PART A EA 934 NA PART B	REFER TO MANUFACTURERS DATA	30 MINUTES	30 MINUTES ±10 MINUTES AT 150°F (66°C) ±20°F (7°C)

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 1 of 4)



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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
BMS 5-154 TYPE II, CLASS 1, GRADE 03	REFER TO SRM 51-30-03		10 DAYS AT 95°F (35°C)	SEE TEXT
BMS 5-154 TYPE II, CLASS 2, GRADE 03	REFER TO SRM 51-30-03		30 DAYS AT 95°F (35°C)	SEE TEXT
BMS 5-154 TYPE II, CLASS 1, GRADE 05	REFER TO SRM 51-30-03		10 DAYS AT 95°F (35°C)	SEE TEXT
BMS 5-154 TYPE II, CLASS 2, GRADE 05	REFER TO SRM 51-30-03		30 DAYS AT 95°F (35°C)	SEE TEXT
BMS 8-139 (GLASS PREPREG) CLASS II STYLE: 120 1581	REFER TO SRM 51-30-03		15 DAYS AT 65°F (18°C) TO 80°F (27°C) 1 DAY AT 81°F (27°C) TO 110°F (43°C)	SEE TEXT
BMS 8-218 (ARAMID PREPREG) STYLE 120 STYLE 285	REFER TO SRM 51-30-03		A	SEE TEXT
BMS 8-212 (GRAPHITE PREPREG) CLASS II (FABRIC) TYPE I: STYLE 3K-70-PW STYLE 3K-135-8H TYPE III: STYLE 3K-135-8H	REFER TO SRM 51-30-03		17 DAYS AT 65°F (18°C) TO 80°F (27°C) ↓	SEE TEXT ↓

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 2 of 4)

757-200 STRUCTURAL REPAIR MANUAL

RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
BMS 8-212 (GRAPHITE PREPREG) CLASS II (FABRIC) TYPE IV: STYLE 3K-70-PW	REFER TO SRM 51-30-03		17 DAYS AT 65°F (18°C) TO 80°F (27°C) ↓	SEE TEXT ↓
BMS 8-212 (GRAPHITE PREPREG) CLASS II (FABRIC) TYPE IV (CONT'D): STYLE 3K-70-PW	REFER TO SRM 51-30-03		17 DAYS AT 65°F (18°C) TO 80°F (27°C)	SEE TEXT ↓
BMS 8-256 (GRAPHITE PREPREG) CLASS II (FABRIC) STYLE 3K-70-PW	REFER TO SRM 51-30-03		10 DAYS AT 65°F (18°C) TO 80°F (27°C)	SEE TEXT ↓

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 3 of 4)



757-200 STRUCTURAL REPAIR MANUAL

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

	MIXING PROCEDURE
RESIN MIX 3 RESIN MIX 9 BMS 8-301	ADD HARDENER TO RESIN AND MIX THOROUGHLY
BMS 5-90 BMS 5-154	REMOVE WRAPPER BEFORE USE

NOTES

- WHEN YOU USE THIS REPAIR REFER TO:
 - SRM 51-30-00 FOR SOURCES OF MATERIALS
 - SRM 51-30-06 FOR MATERIAL ORDERING DATA.

A OUT-TIME OF THIS MATERIAL IS SPECIFIED IN TERMS OF 168 EXPOSURE UNITS AT TEMPERATURES BETWEEN 40°F (4°C) AND 80°F (27°C) AND 24 UNITS OF EXPOSURE BETWEEN 80°F (27°C) AND 110°F (43°C). OUT-TIME ACCUMULATES FROM THE DATE OF PURCHASER RECEIPT UNTIL THE CURE CYCLE IS INITIATED. MATERIALS EXPOSED TO TEMPERATURES ABOVE 110°F (43°C) SHALL BE REJECTED. ONE EXPOSURE UNIT IS ACQUIRED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 40°F (4°C) AND 80°F (27°C). SEVEN EXPOSURE UNITS ARE ACQUIRED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 81°F (27°C) AND 110°F (43°C).

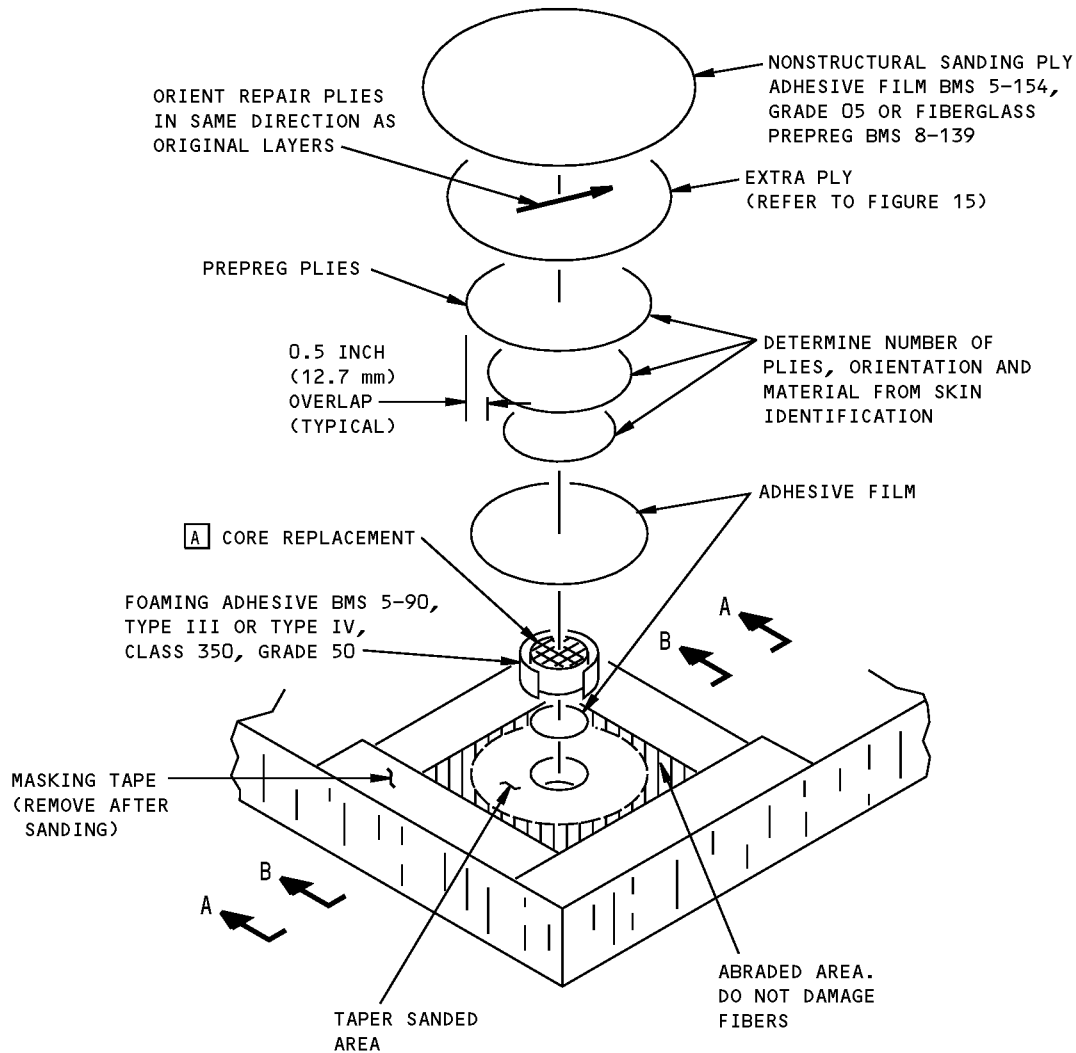
B REMOVE THE ADHESIVE MATERIAL FROM THE COLD STORAGE AREA. KEEP THE MATERIAL IN AN AREA WHERE THE TEMPERATURE IS 65°F (18°C) TO 90°C (32°C) FOR A MINIMUM OF 30 MINUTES FOR EACH POUND OF WEIGHT.

CONDENSATION ON THE OUTSIDE OF THE ROLL IS NOT AN ACCURATE INDICATOR THAT THE MATERIAL IS READY TO BE USED. MAKE SURE THE MATERIAL TEMPERATURE IS EQUAL TO ROOM TEMPERATURE BEFORE YOU USE IT.

C IF THE TOTAL TIME OUT OF COLD STORAGE IS NOT MORE THAN 10 DAYS, THE MATERIAL CAN BE PUT BACK INTO STORAGE. THIS CAN BE DONE ONE OR MORE TIMES.

**Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 4 of 4)**

757-200 STRUCTURAL REPAIR MANUAL

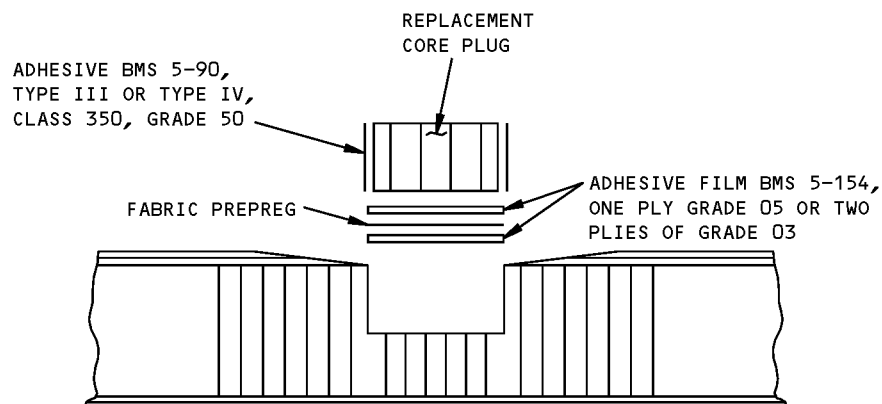


NOTES

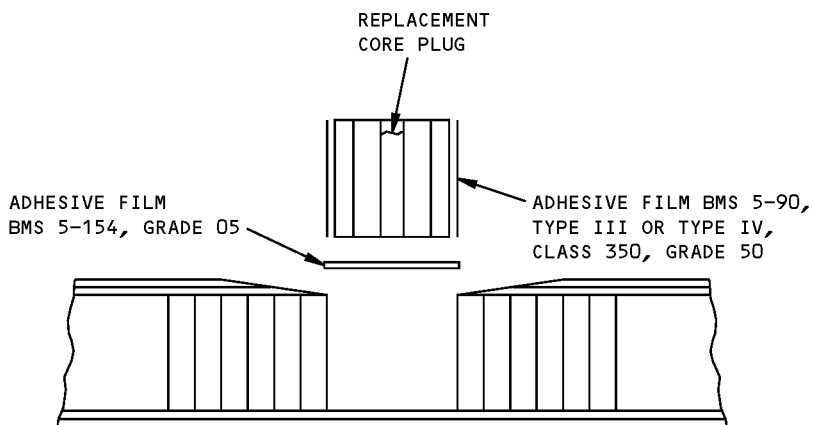
- [A] BUTT SPLICING SHOWN. FOR CRUSH SPLICING REFER TO FIG. 16.

Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 350 Degrees F (177 Degrees C) Cure
Figure 2 (Sheet 1 of 2)

757-200
STRUCTURAL REPAIR MANUAL



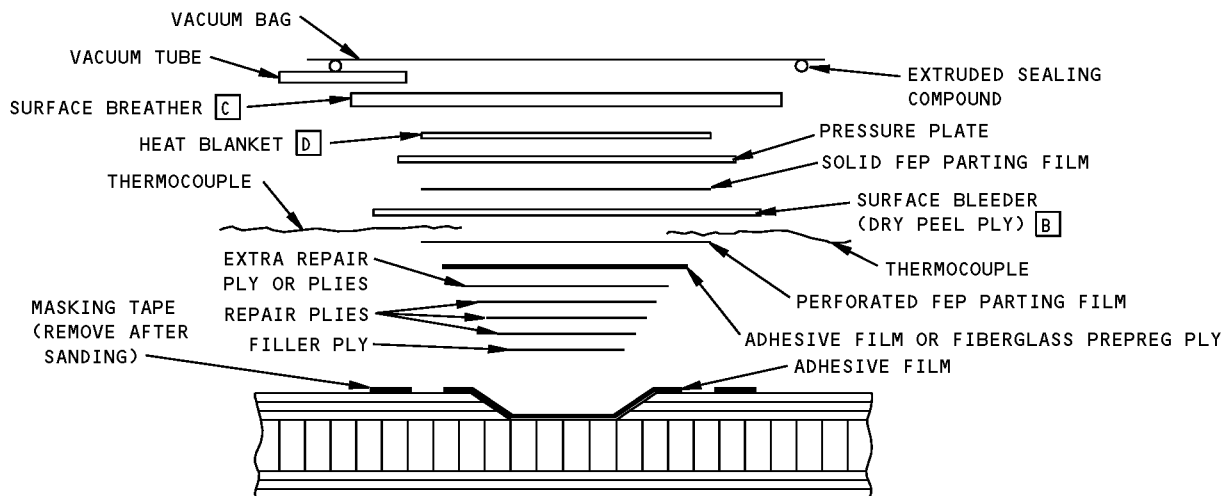
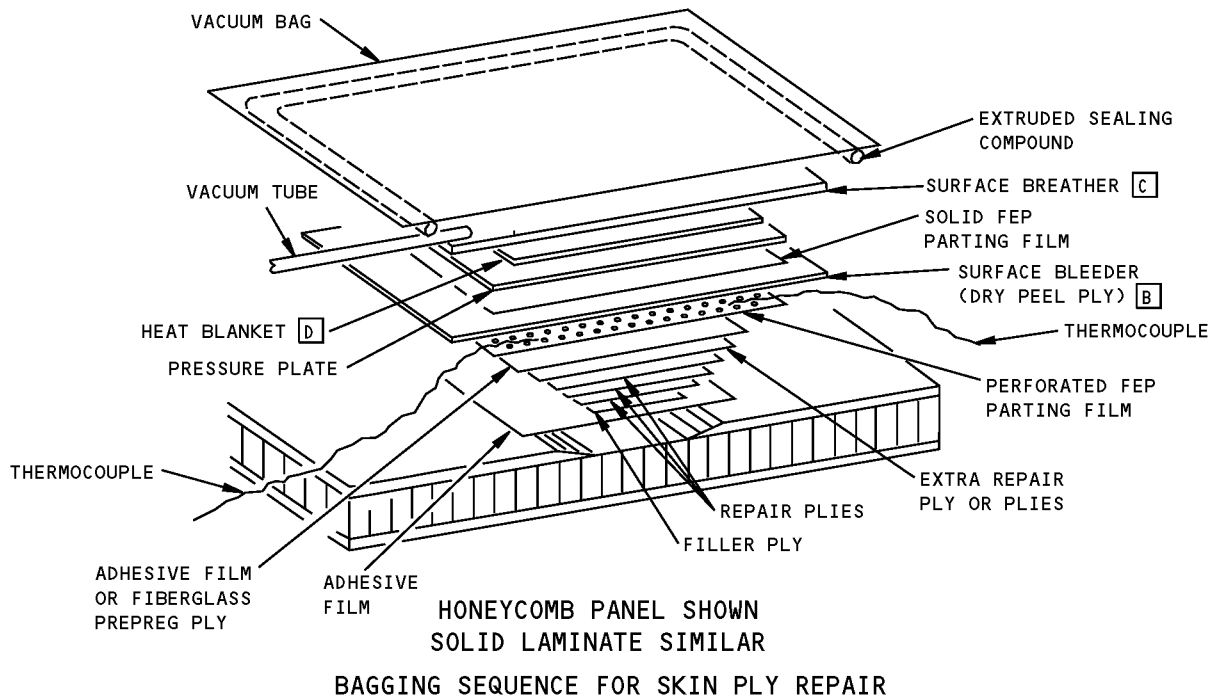
SECTION THRU REPAIR AREA -
PARTIAL DEPTH CORE REPLACEMENT
SECTION A-A



SECTION THRU REPAIR AREA -
FULL DEPTH CORE REPLACEMENT
SECTION B-B

Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 350 Degrees F (177 Degrees C) Cure
Figure 2 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

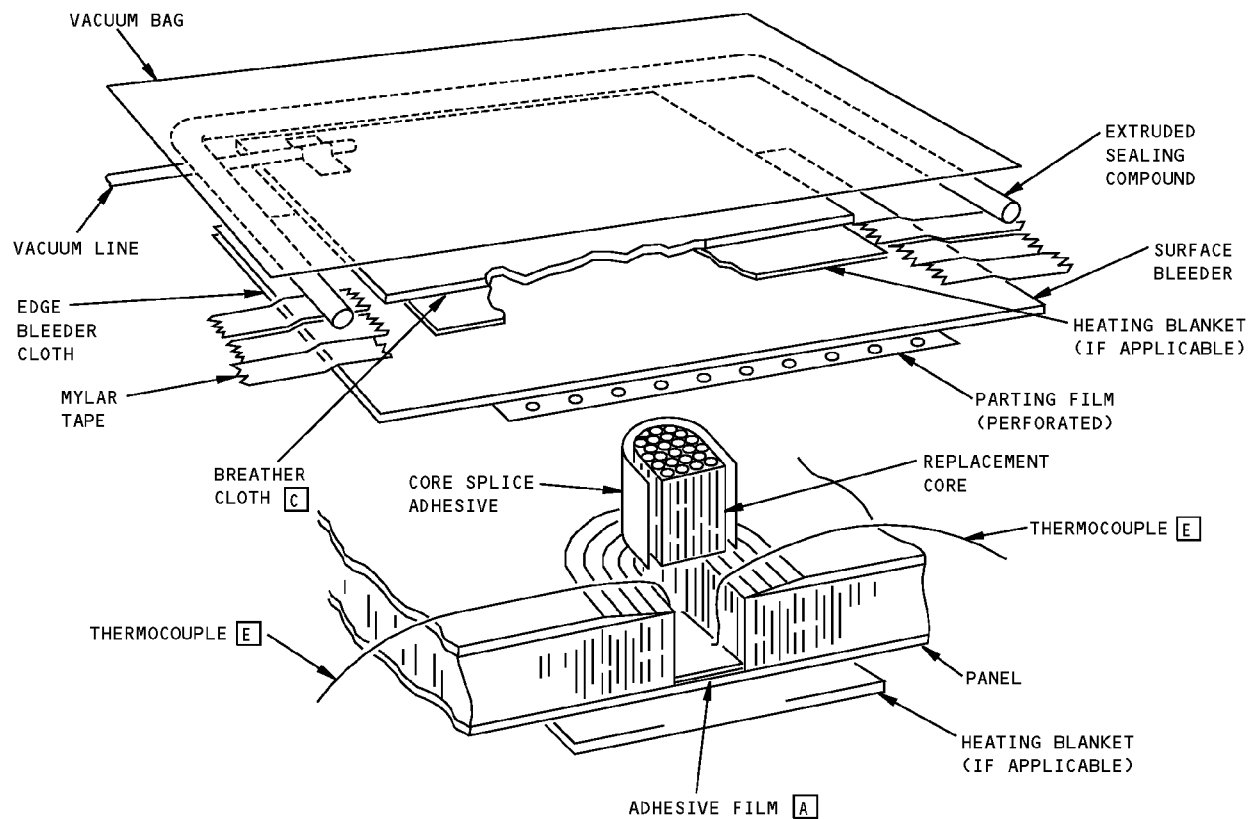


NOTES

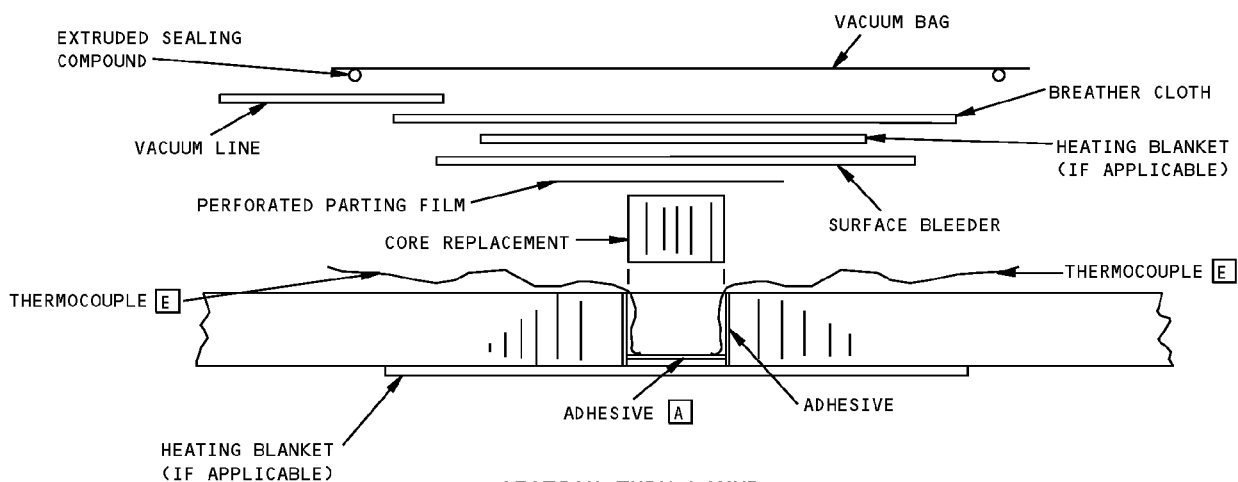
- | | |
|---|--|
| <p>[A] ONE PLY OF ADHESIVE FILM (FOR FULL DEPTH CORE REPLACEMENT, WHERE DAMAGE DOES NOT EXTEND THROUGH BOTH SKINS). FOR PARTIAL CORE REPLACEMENT USE TWO PLIES OF ADHESIVE FILM WITH ONE PLY OF BMS 8-212, TYPE IV, CLASS 2 OR BMS 8-256 CLASS 2 GRAPHITE BETWEEN THEM.</p> <p>[B] DRY PEEL PLY MUST MAKE CONTACT WITH THE SURFACE BREATHER MATERIAL.</p> | <p>[C] WHEN USING A HEATING BLANKET, USE 4 TO 6 LAYERS OF BREATHER MATERIAL TO PREVENT DAMAGE TO VACUUM BAG.</p> <p>[D] HEATING BLANKET MUST EXTEND A MINIMUM OF 2 INCHES (50 mm) BEYOND EDGE OF REPAIR PATCH.</p> <p>[E] FOR THERMOCOUPLE PLACEMENT, REFER TO PARAGRAPH 4.D.(3)(f).</p> |
|---|--|

Application of Pressure During Cure - 350 Degrees F (177 Degrees C) Cure
Figure 3 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



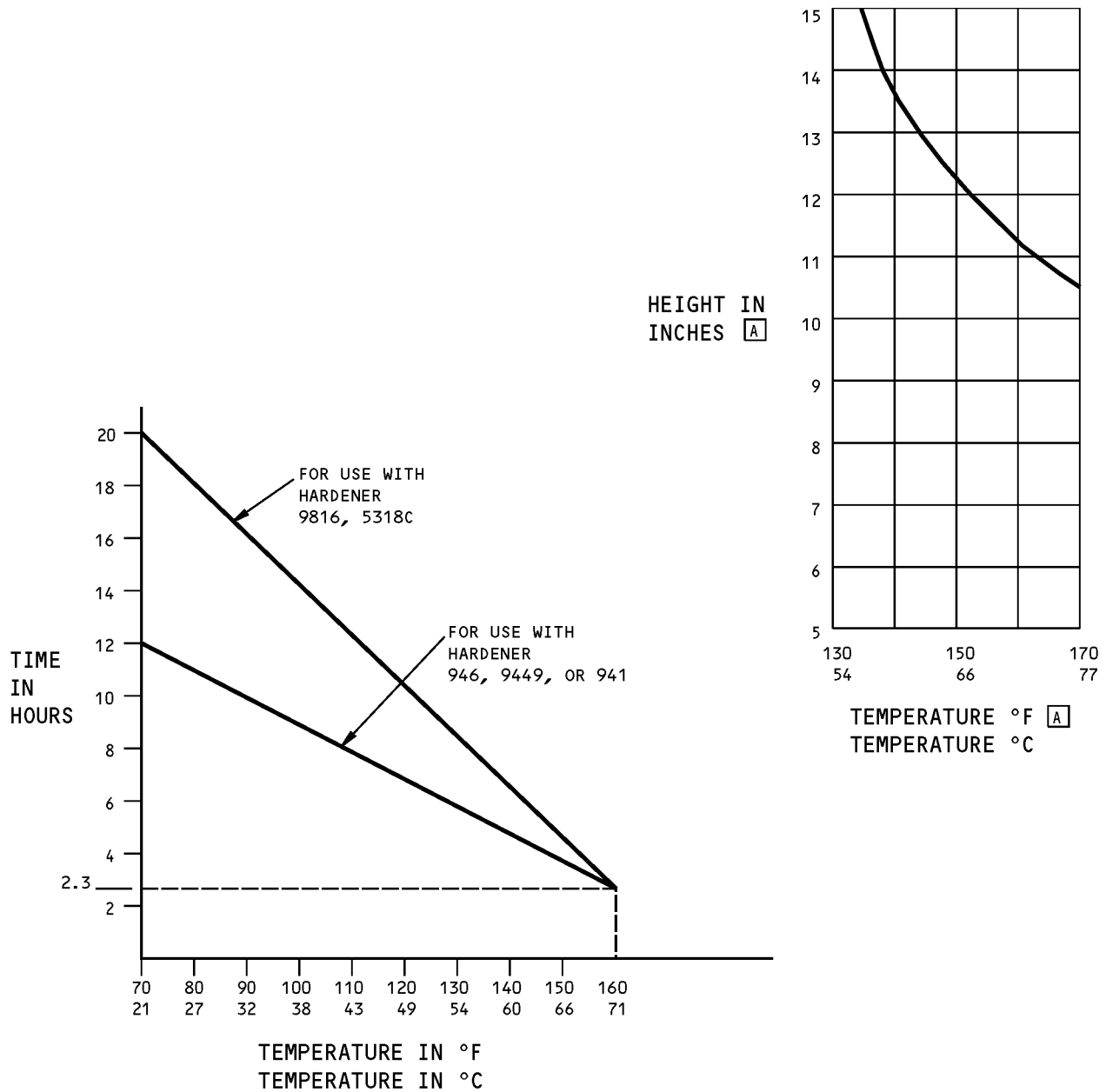
BAGGING SEQUENCE FOR CORE REPLACEMENT - 350°F (177°C) CURE



SECTION THRU LAYUP FOR CORE REPLACEMENT - 350°F (177°C) LAYUP ONLY

Application of Pressure During Cure - 350 Degrees F (177 Degrees C) Cure
Figure 3 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL



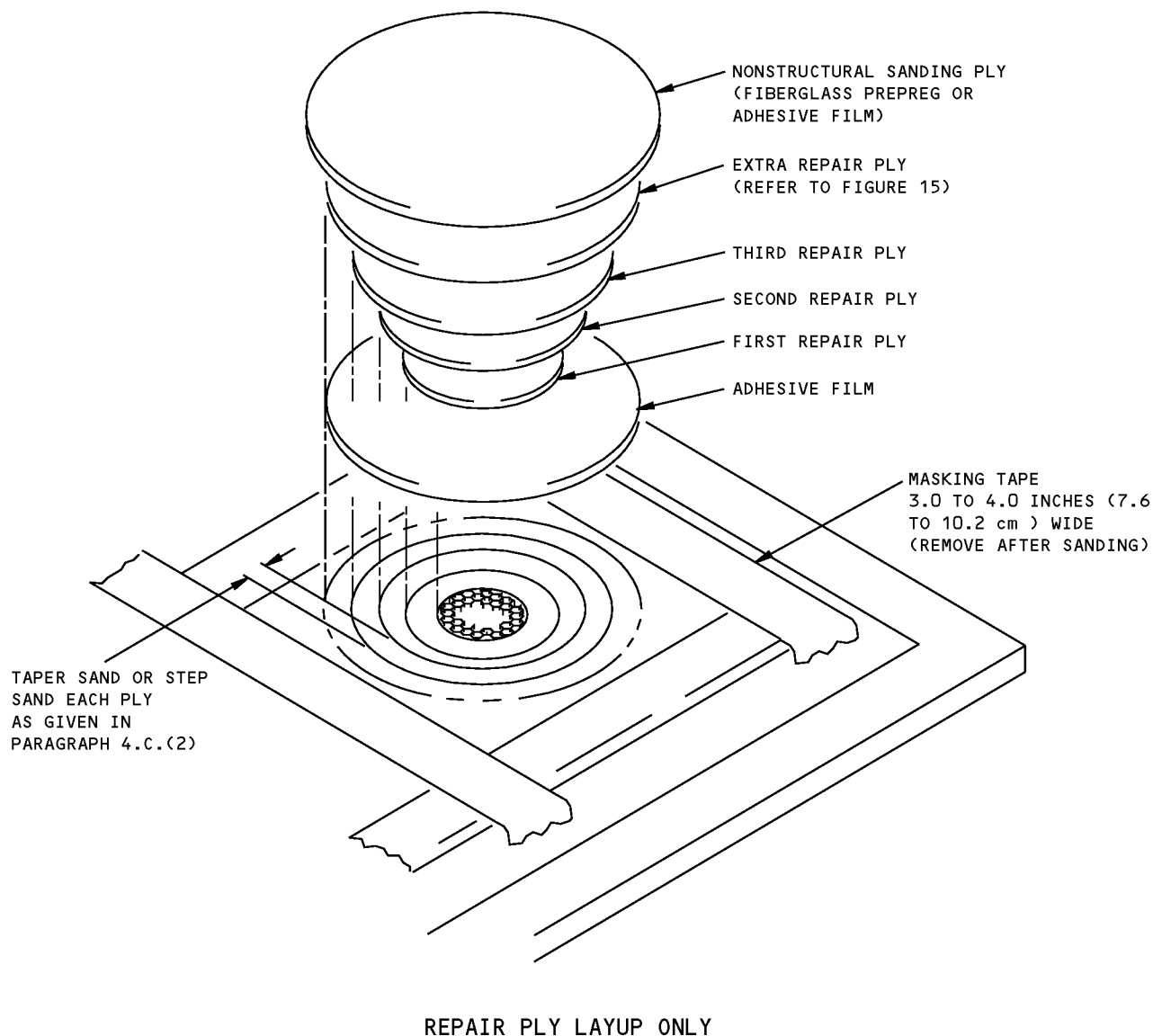
NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE

[A] THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

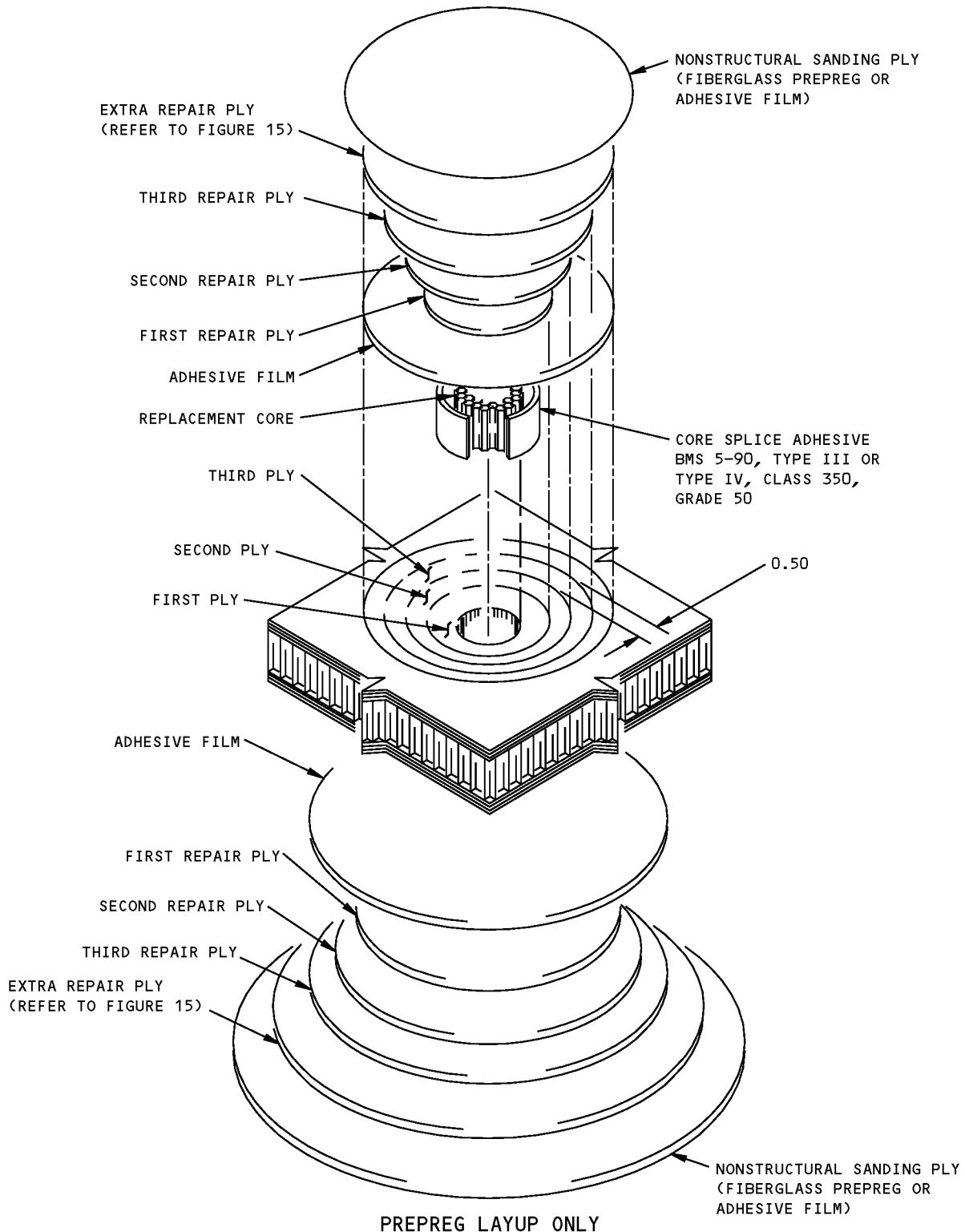
**Potting and Laminating Resin Cure Temperature
Figure 4**

757-200
STRUCTURAL REPAIR MANUAL



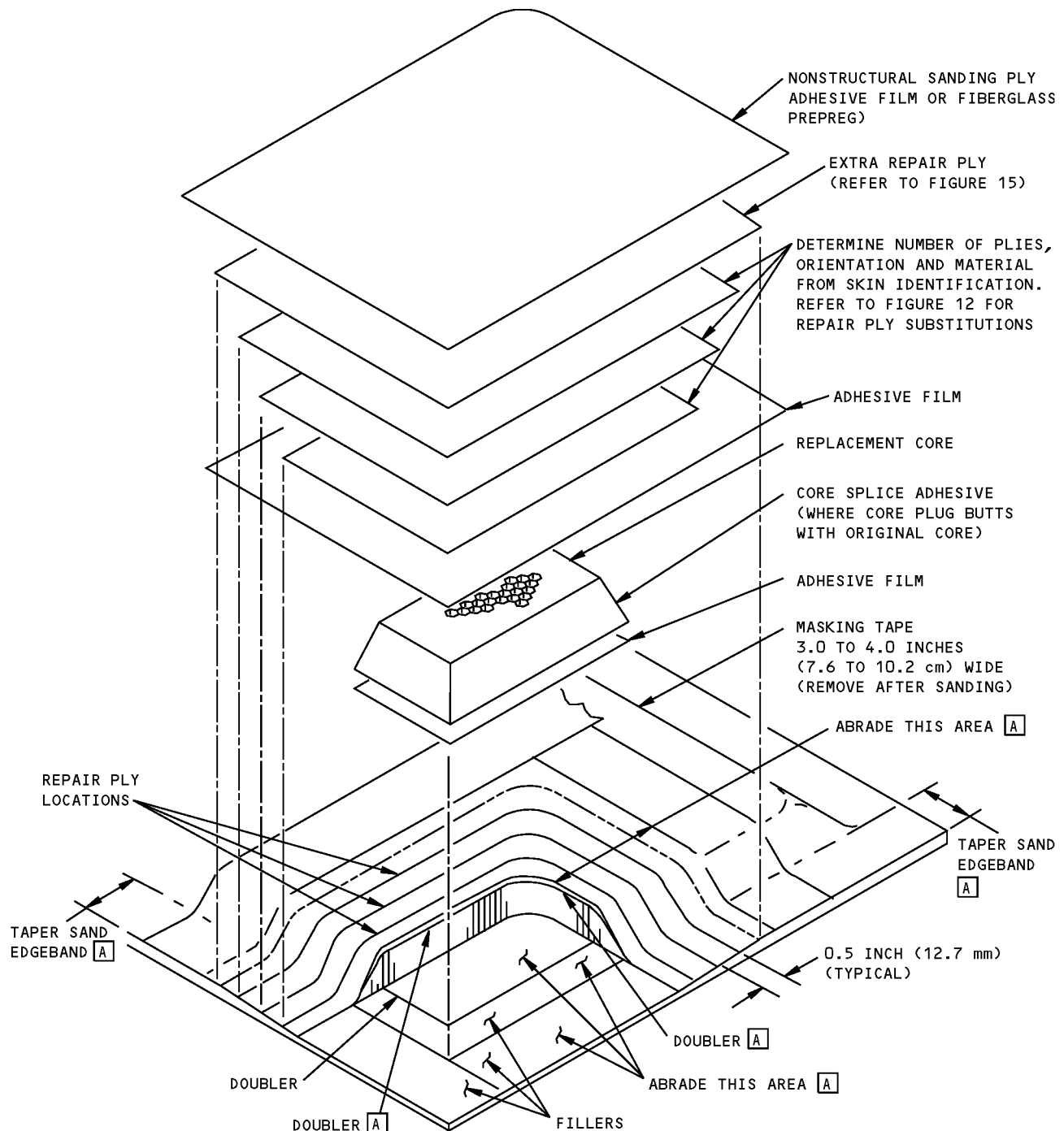
Repair of Damaged External or Internal Skins of a Sandwich Panel - 350 Degrees F (177 Degrees C) Cure
Figure 5

**757-200
STRUCTURAL REPAIR MANUAL**



**Repair of Large Punctures Thru Both Skins of a Sandwich Panel Including Core Damage - 350 Degrees F (177 Degrees C) Cure
Figure 6**

757-200 STRUCTURAL REPAIR MANUAL



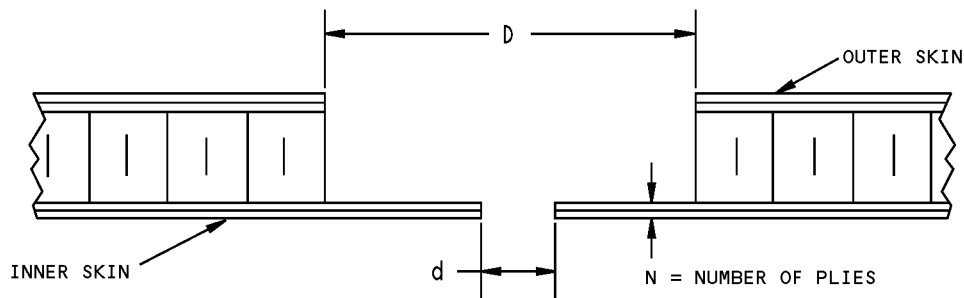
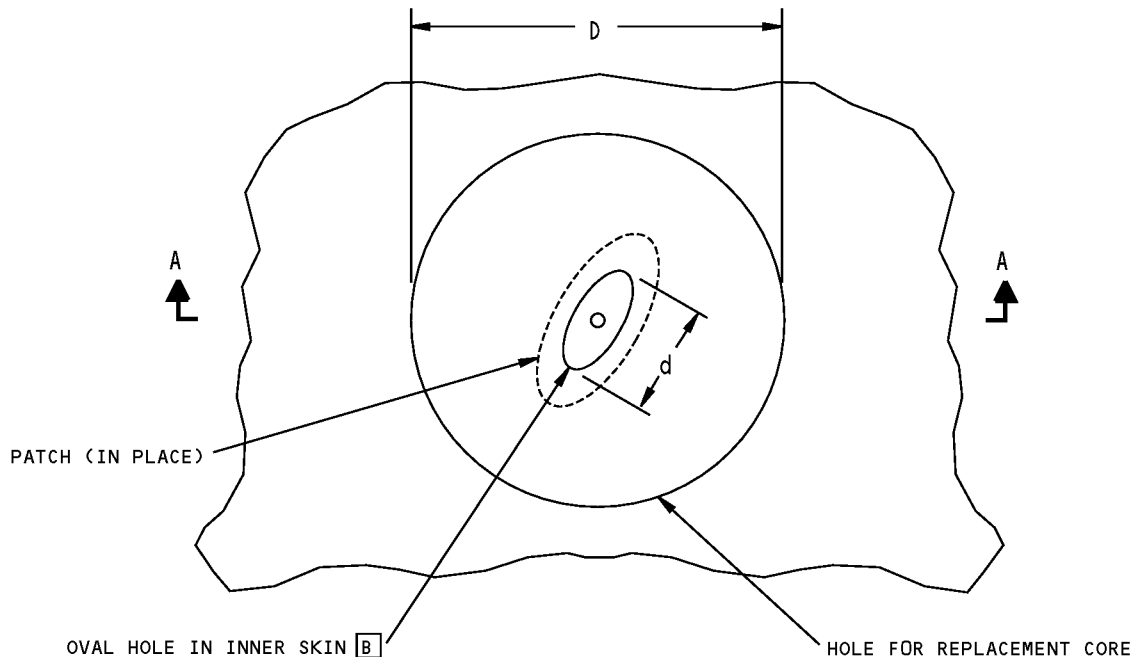
NOTES

PREPREG LAYUP ONLY

- [A] TAPER SANDING IS OPTIONAL TO JUST ABRADING THE SURFACE OF THE SKIN AND DOUBLER PLIES ABOVE AND BELOW THE HONEYCOMB CORE. HOWEVER, TAPER SANDING IS REQUIRED ON THE EDGE BAND.

**Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel - 350 Degrees F (177 Degrees C) Cure
Figure 7**

757-200 STRUCTURAL REPAIR MANUAL



SECTION A-A
(PATCH NOT SHOWN)

DETAIL I

NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
- $D = d + \{N \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}]\} + 1.0 \text{ INCH (25.4 mm)}$
- d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN. SIZE LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR
- N = NUMBER OF PLIES
- D = DIAMETER OF HOLE FOR REPLACEMENT CORE

EXAMPLE:

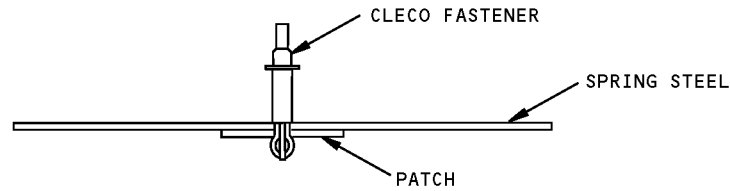
IF $d = 0.5 \text{ INCH (12.7 mm)}$
 THEN, $D = 0.5 \text{ INCH (12.7 mm)} + \{[2 \text{ PLIES}] \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}]\} + 1.0 \text{ INCH (25.4 mm)}$
 $D = 3.50 \text{ INCHES (88.9 mm) DIAMETER}$

- A** MAKE TAPER AND OVERLAP PER FIGURE 13
- B** MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR

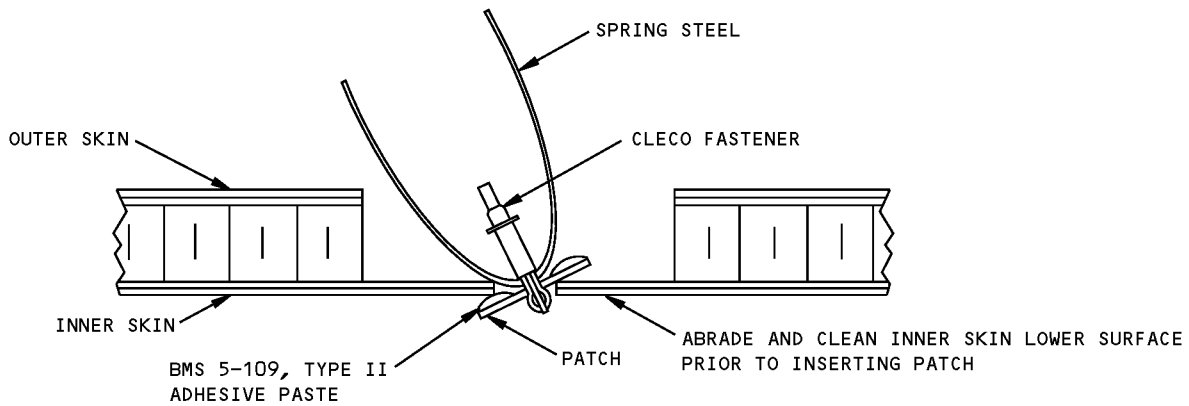
Repair of Damage to External and Internal Skins with Access Limited to One Side - 350 Degrees F (177 Degrees C) Cure

Figure 8 (Sheet 1 of 3)

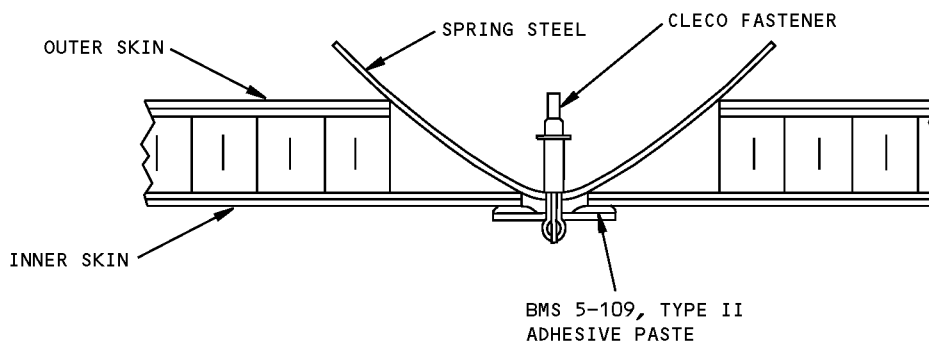
757-200 STRUCTURAL REPAIR MANUAL



ASSEMBLE PATCH AND SPRING STEEL
DETAIL II



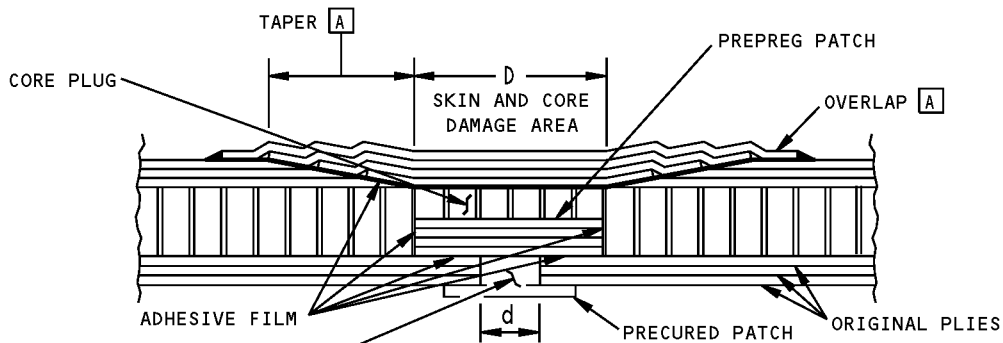
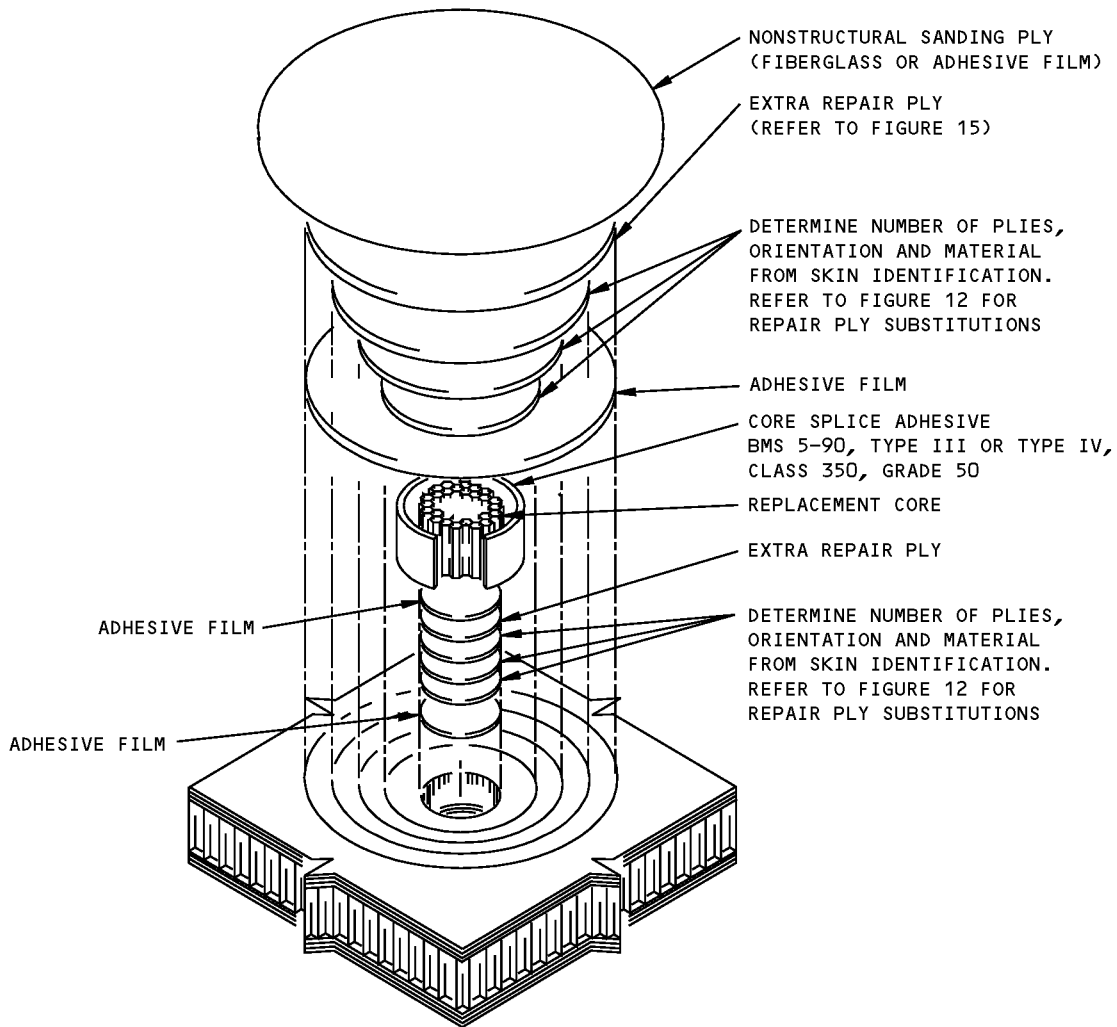
INSERT PATCH INTO OVAL HOLE
DETAIL III



HOLD PATCH IN PLACE WHILE CURING
DETAIL IV

Repair of Damage to External and Internal Skins with Access Limited to One Side - 350 Degrees F (177 Degrees
C) Cure
Figure 8 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



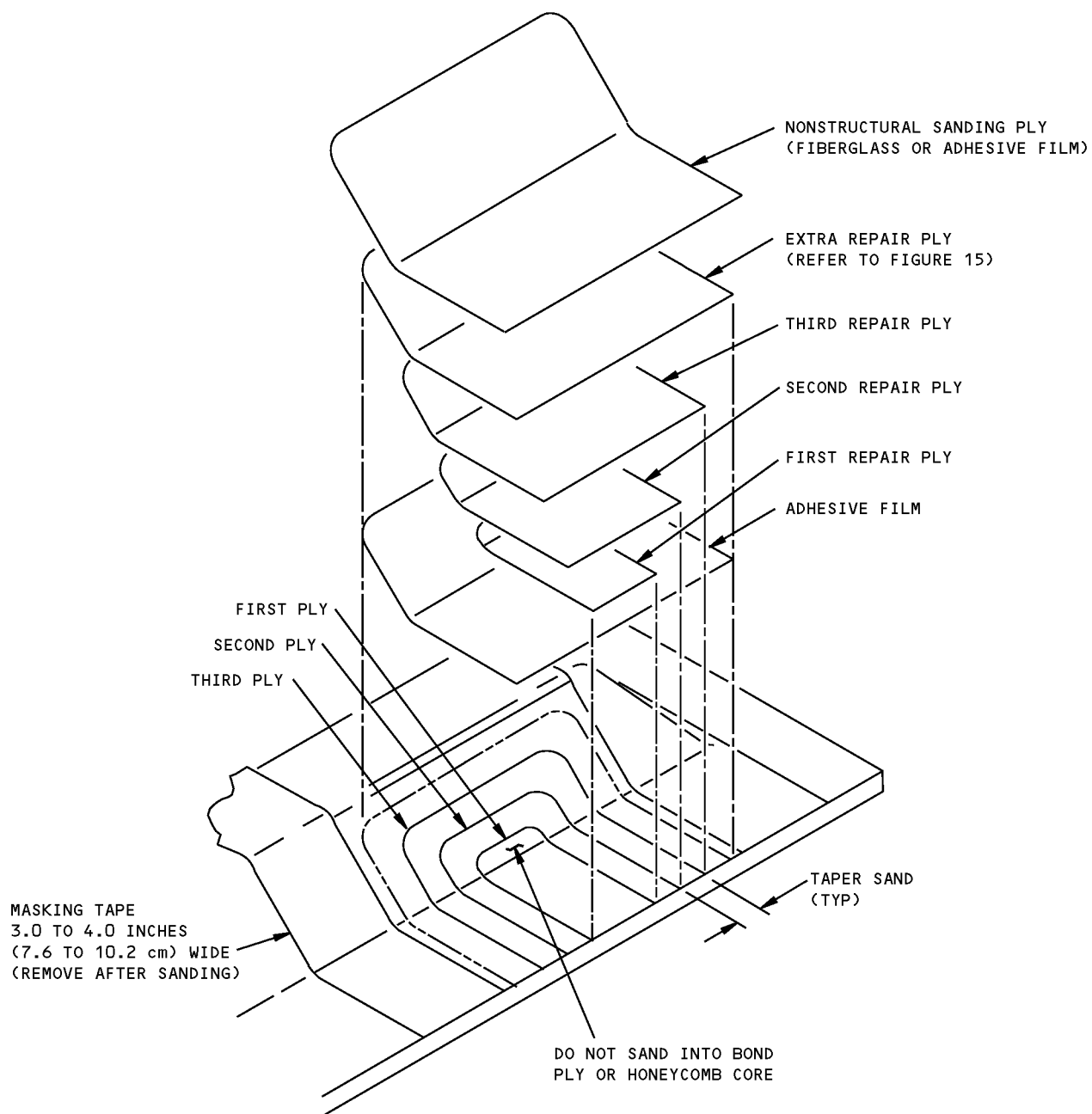
FILL HOLE WITH BMS 5-109, TYPE II
ADHESIVE PASTE OR BMS 5-95,
CLASS B 1/2 SEALANT

SECTION THROUGH REPAIR

PREPREG LAYUP ONLY DETAIL V

**Repair of Damage to External and Internal Skins with Access Limited to One Side - 350 Degrees F (177 Degrees
C) Cure**
Figure 8 (Sheet 3 of 3)

757-200 STRUCTURAL REPAIR MANUAL



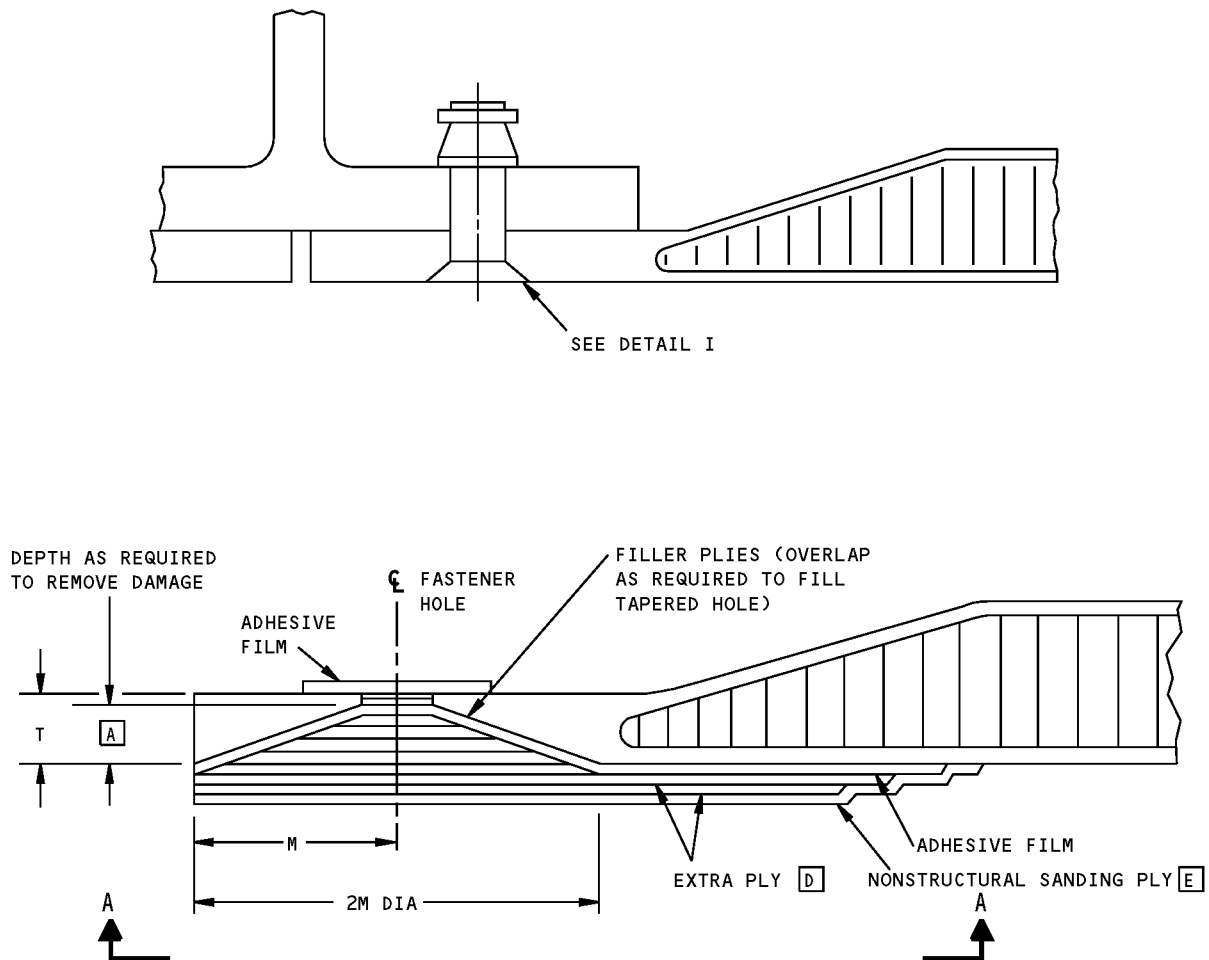
PREPREG LAYUP ONLY

NOTES

- REFER TO PARAGRAPH 5.G. FOR THE REPAIR INSTRUCTIONS.

**Repair of Damaged Skin Plies On A Panel Edge - 350 Degrees F (177 Degrees C) Cure
Figure 9**

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- REFER TO PARAGRAPH 5.K. FOR THE REPAIR INSTRUCTIONS.
- D EQUALS FASTENER DIAMETER
- $M = 5T$ MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE.
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES.

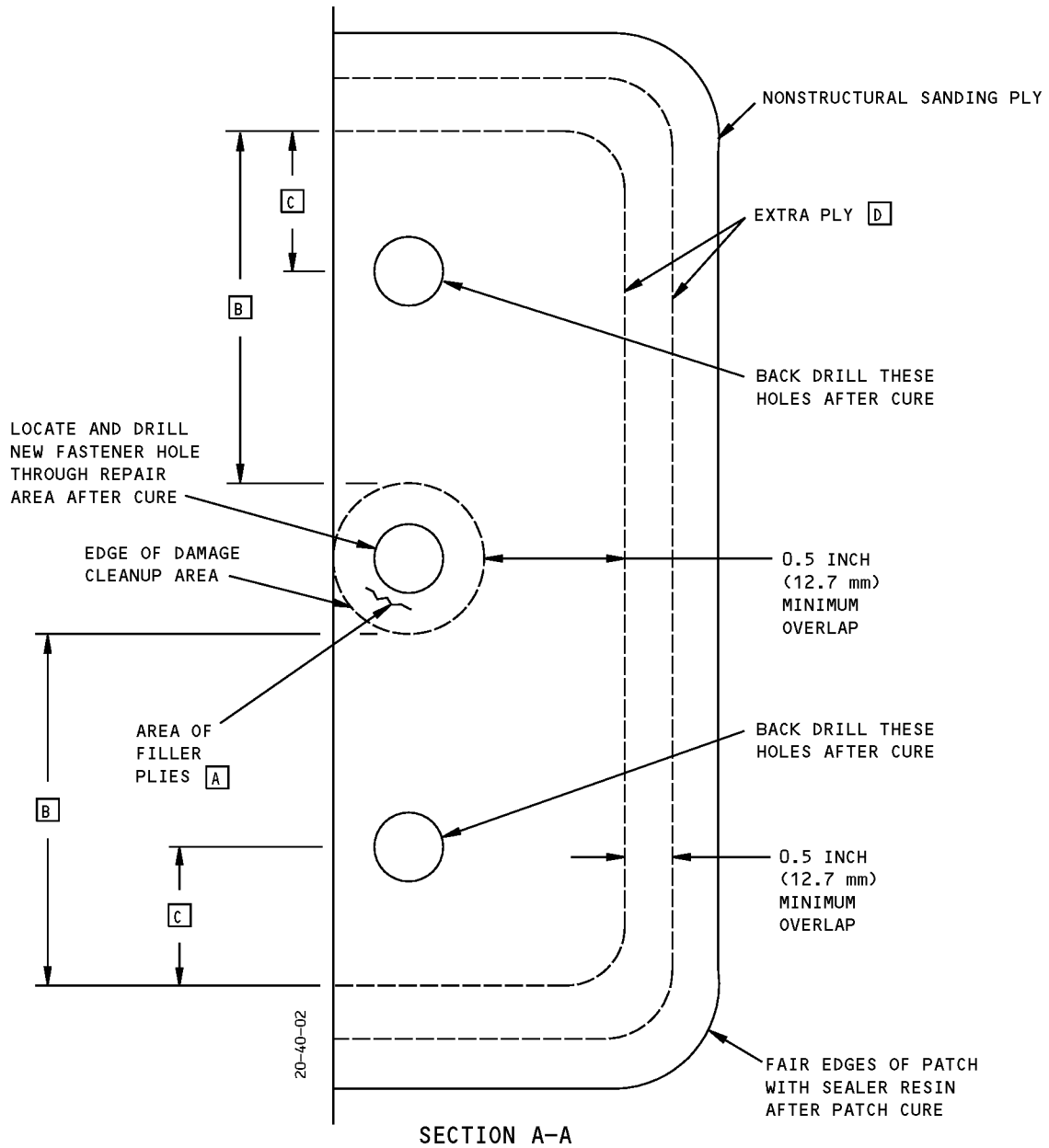
[A] APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA.

DETAIL I

- [B] EXTEND FIRST EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF DAMAGED AREA.
- [C] EXTEND FIRST EXTRA PLY FAR ENOUGH TO PROVIDE AT LEAST 2D EDGE MARGIN.
- [D] ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER (REFER TO FIG. 15).
- [E] ADHESIVE FILM BMS 5-154, GRADE 05 OR FIBERGLASS PREPREG PLY BMS 8-139.

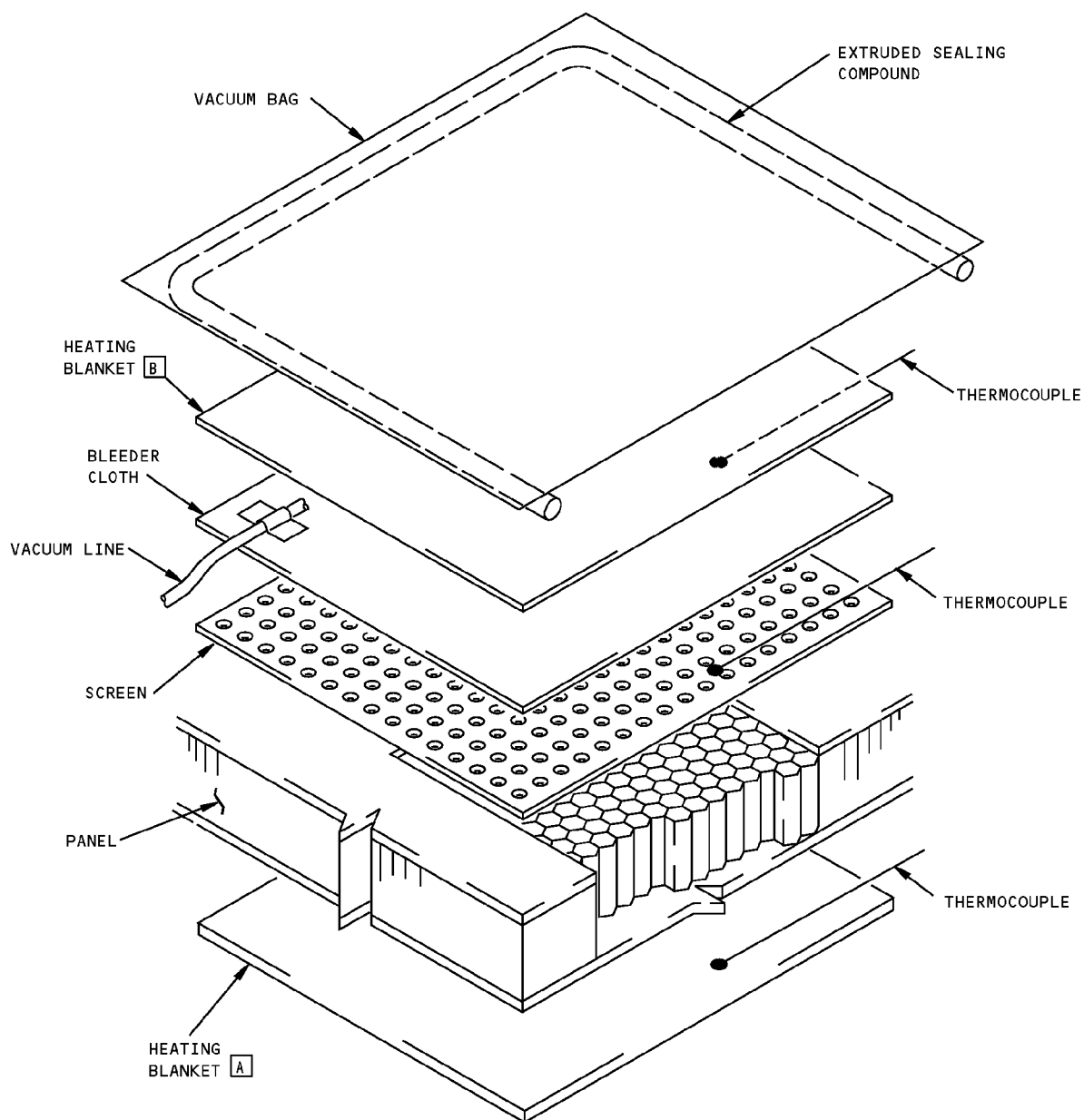
Repair of Damaged Panel Attach Hole - 350 Degrees F (177 Degrees C) Cure
Figure 10 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



Repair of Damaged Panel Attach Hole - 350 Degrees F (177 Degrees C) Cure
Figure 10 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL



NOTES

- [A] PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B] ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

Water Removal From Honeycomb Sandwich
Figure 11



757-200

STRUCTURAL REPAIR MANUAL

BMS 8-139 STYLE	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS
120 A	BLUE	0.004-0.006	—
1581 A C	BLUE	0.008-0.012	BMS 8-139, TYPE 120 A

BMS 8-139 GLASS FABRIC PREPREG DATA

BMS 8-218 STYLE	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS
120 B	WHITE	0.0041	BMS 8-139, TYPE 120 B
285 B	RED	0.010	BMS 8-139, TYPE 1581 B

BMS 8-218 ARAMID FABRIC PREPREG DATA

CAUTION: GLASS FABRIC MUST NOT BE SUBSTITUTED FOR GRAPHITE PREPREG REPAIR PLIES.

ORIGINAL MATERIAL	SUBSTITUTE MATERIAL
BMS 8-212, CLASS 1, GRADE 95 TAPE	1 PLY BMS 8-212, CLASS 2, STYLE 3K-70-PW FABRIC
BMS 8-212, CLASS 1, GRADE 145 AND GRADE 95 TAPE	2 PLIES BMS 8-212, CLASS 1, GRADE 90 TAPE OR 2 PLIES BMS 8-212, CLASS 2, STYLE 3K-70-PW FABRIC
BMS 8-212, CLASS 2, STYLE 3K-135-8H FABRIC	2 PLIES BMS 8-212, CLASS 2, STYLE 3K-70-PW FABRIC
BMS 8-256, CLASS 1, GRADE 95 TAPE	1 PLY BMS 8-256, CLASS 2, STYLE 3K-70-PW FABRIC
BMS 8-256, CLASS 1, GRADE 145 AND GRADE 190 TAPE	2 PLIES CLASS 1, GRADE 95 TAPE OR 2 PLIES CLASS 2, STYLE 3K-70-PW FABRIC
BMS 8-256, CLASS 2, STYLE 3K-135-8H FABRIC	2 PLIES BMS 8-256, CLASS 2, STYLE 3K-70-PW FABRIC

BMS 8-212 AND BMS 8-256 GRAPHITE TAPE AND GRAPHITE FABRIC

NOTES

- 2 PLIES OF BMS 5-154, TYPE II, CLASS 1, GRADE 03 MAY BE SUBSTITUTED FOR EACH PLY OF BMS 5-154, TYPE II, CLASS 1, GRADE 05.

A STYLE 1581 IS PREFERRED FOR USE AS REPAIR PLIES. THREE PLIES OF STYLE 120 MAY BE SUBSTITUTED FOR EACH PLY OF STYLE 1581.

B ONE PLY OF BMS 8-139, STYLE 120 MAY BE USED FOR EACH PLY OF BMS 8-218, STYLE 120 AND ONE PLY OF BMS 8-139, STYLE 1581 MAY BE USED FOR EACH PLY OF BMS 8-218, STYLE 285.

C STYLE 1581 WAS FORMERLY KNOWN AS TYPE 181.

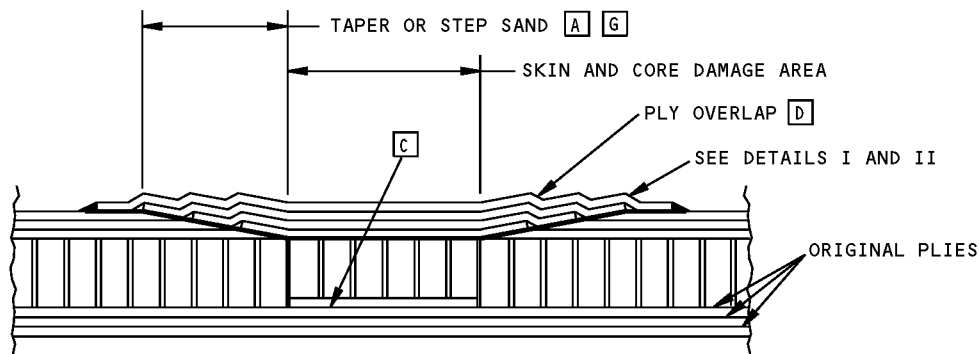
Prepreg Fabric Ply Substitution Data Figure 12

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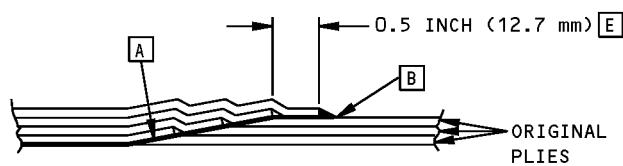
51-70-04

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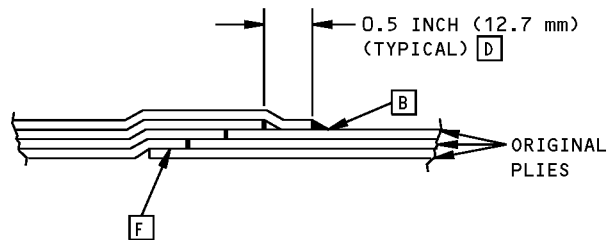
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(PREPREG LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



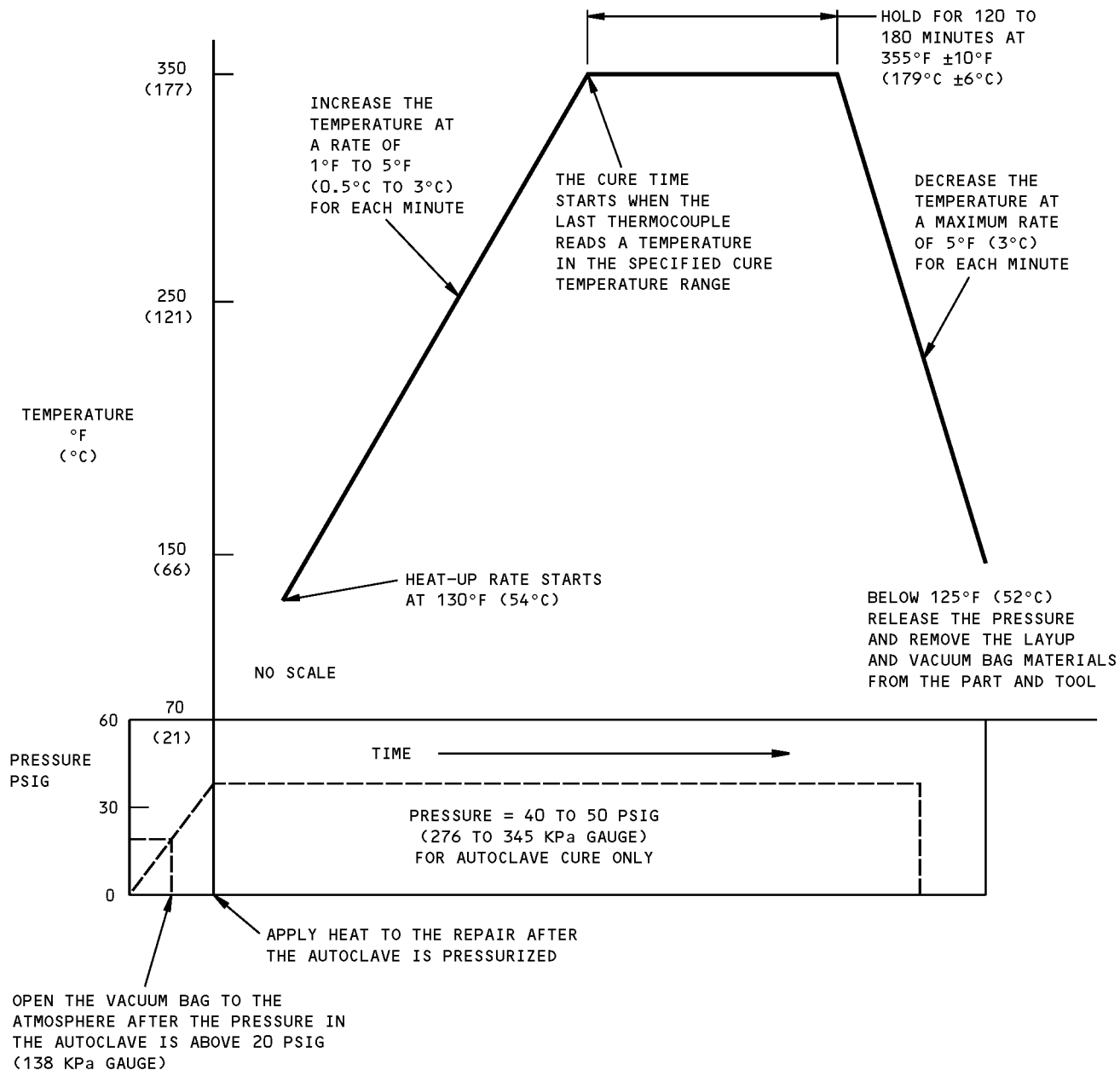
STEP SANDED SKIN
DETAIL II

NOTES

- | | |
|---|--|
| <p>A TAPER SAND AROUND REPAIR AREA OVER DISTANCE OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>B DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING</p> <p>C SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)</p> <p>D EXTRA PLY MUST OVERLAP AT LEAST 0.5 INCH (12.7 mm). EACH SUCCEEDING PLY MUST OVERLAP AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF PRECEEDING PLY PRECEEDING PLY</p> | <p>E SURFACE PLY FAYING SURFACE MUST BE AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF TAPER</p> <p>F REMOVE DAMAGED PLIES IN STEPS OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>G TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO SRM 51-10-01</p> |
|---|--|

Sanding and Overlap Requirements
Figure 13

757-200 STRUCTURAL REPAIR MANUAL



NOTES

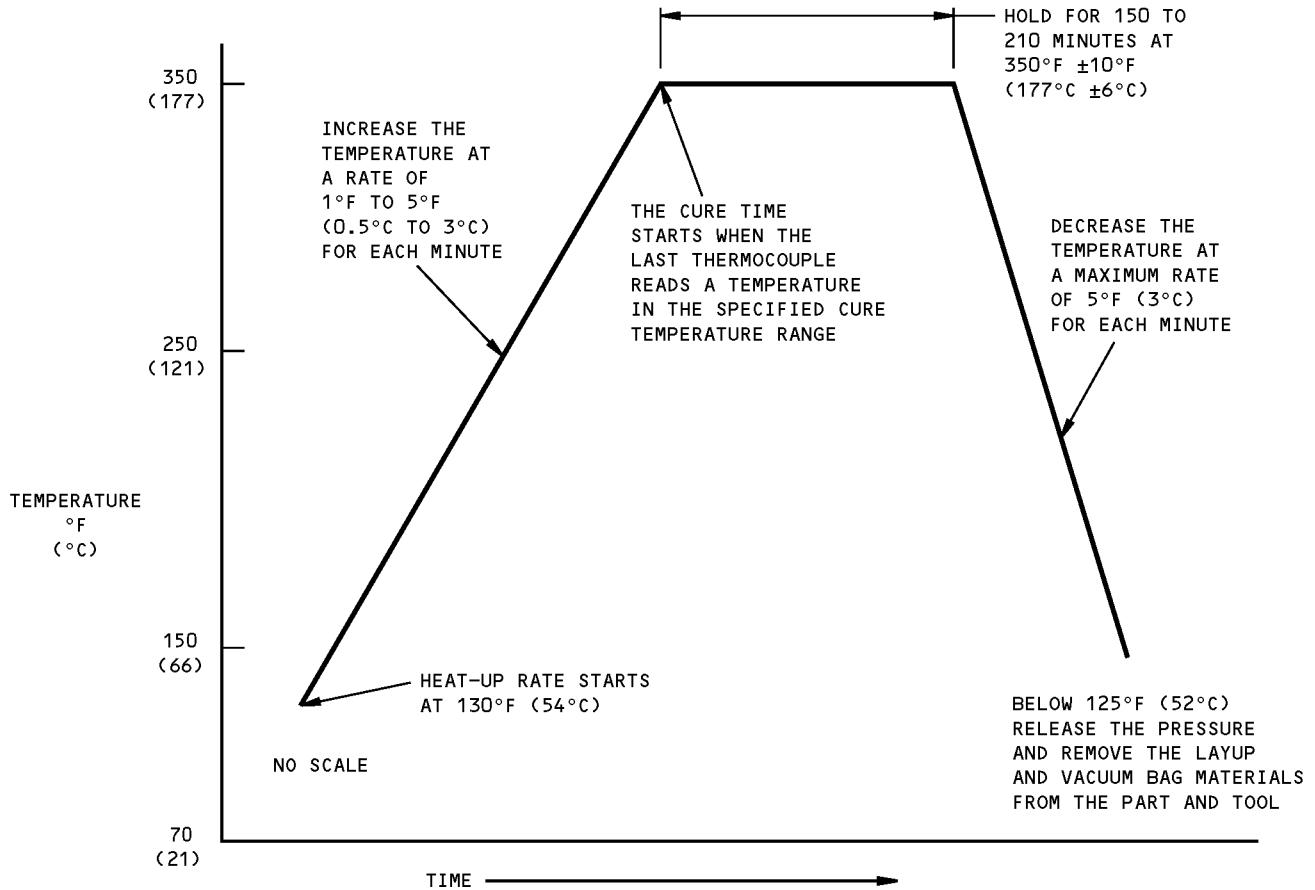
- FOR THE OVEN CURE, KEEP A MINIMUM VACUUM OF 22 INCHES OF MERCURY (75 kPa) DURING THE FULL CURE CYCLE.

350°F (177°C) AUTOCLAVE OR OVEN CURE CYCLE

DETAIL I

Repair Cure Cycles
Figure 14 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- KEEP A MINIMUM VACUUM OF 22 INCHES OF MERCURY (75 kPa) DURING THE FULL CURE CYCLE.

350°F (177°C) HEAT BLANKET CURE CYCLE
DETAIL II

Repair Cure Cycles
Figure 14 (Sheet 2 of 2)

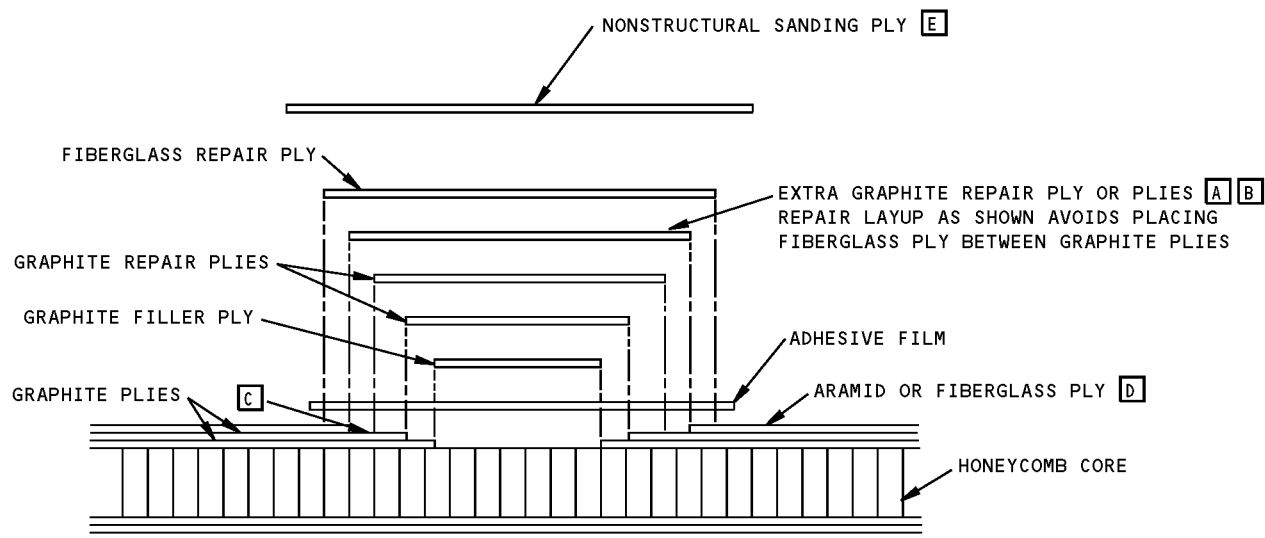
STRUCTURAL REPAIR MANUAL

COMPONENT MATERIAL	EXTRA PLY MATERIAL
GRAPHITE	GRAPHITE FABRIC, STYLE 3K-70-PW B
GRAPHITE/ARAMID/FIBERGLASS HYBRID	GRAPHITE FABRIC, STYLE 3K-70-PW A B
ARAMID	GLASS FABRIC, STYLE 120 OR 1581

NOTES

- A** ON HYBRID PANELS, GRAPHITE EXTRA PLIES MUST BE BONDED TO GRAPHITE PLY. SEE DETAIL I.
- B** WHEN MORE THAN ONE EXTRA REPAIR PLY IS REQUIRED, THE ORIENTATIONS OF THE EXTRA REPAIR PLIES MUST REPEAT THE ORIENTATIONS OF THE EXISTING PLIES IN THE ORIGINAL LAMINATE STARTING WITH THE OUTERMOST PLY.

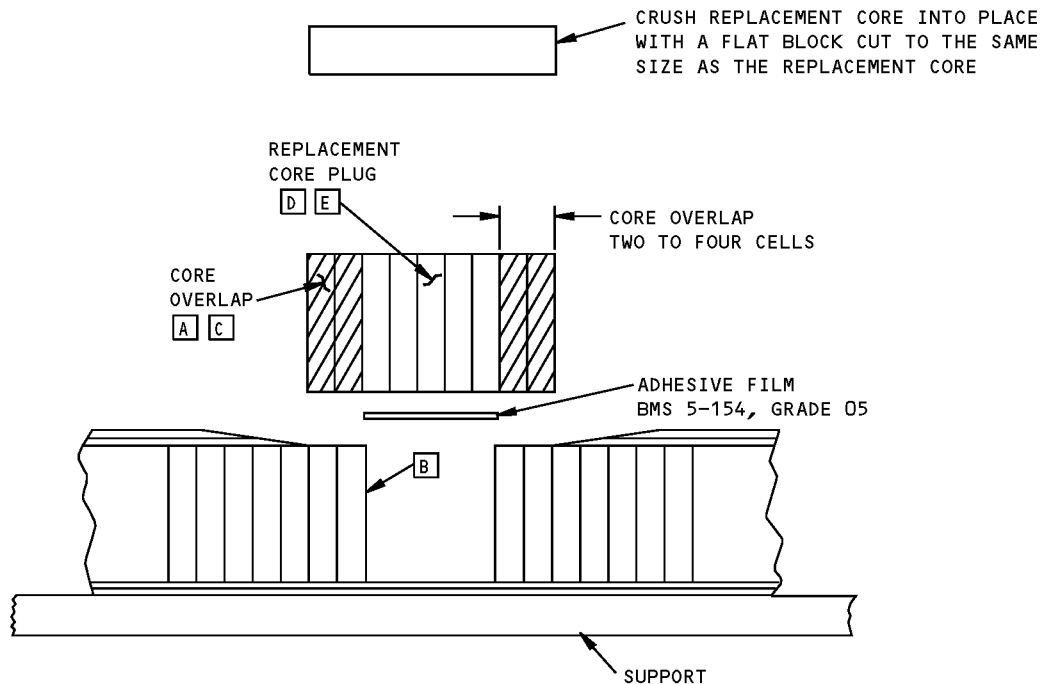
- C** WHEN EXTRA GRAPHITE REPAIR PLY OR PLIES ARE REQUIRED, THE EXISTING OUTER PLY OF ARAMID, ALUMINUM COATED FIBERGLASS OR FIBERGLASS MUST BE SANDED TO ALLOW AN ADDITIONAL OVERLAP OF 0.5 INCH (12.7 mm) EACH EXTRA REPAIR PLY.
- D** IF OUTER PLY CONSISTS OF ALUMINUM COATED FIBERGLASS OR OTHER, CONDUCTIVE COATING, REFER TO SRM 51-70-14, SRM 51-70-05 OR FIG. 17 AS APPLICABLE FOR REPAIR OF THE CONDUCTIVE COATING.
- E** ADHESIVE FILM BMS 8-145 OR FIBERGLASS PREPREG BMS 8-139. SEE TEXT PARAGRAPH 4.E.(4)(b).



SECTION THRU HYBRID HONEYCOMB SANDWICH
DETAIL I

Extra Repair Ply Materials
Figure 15

757-200 STRUCTURAL REPAIR MANUAL

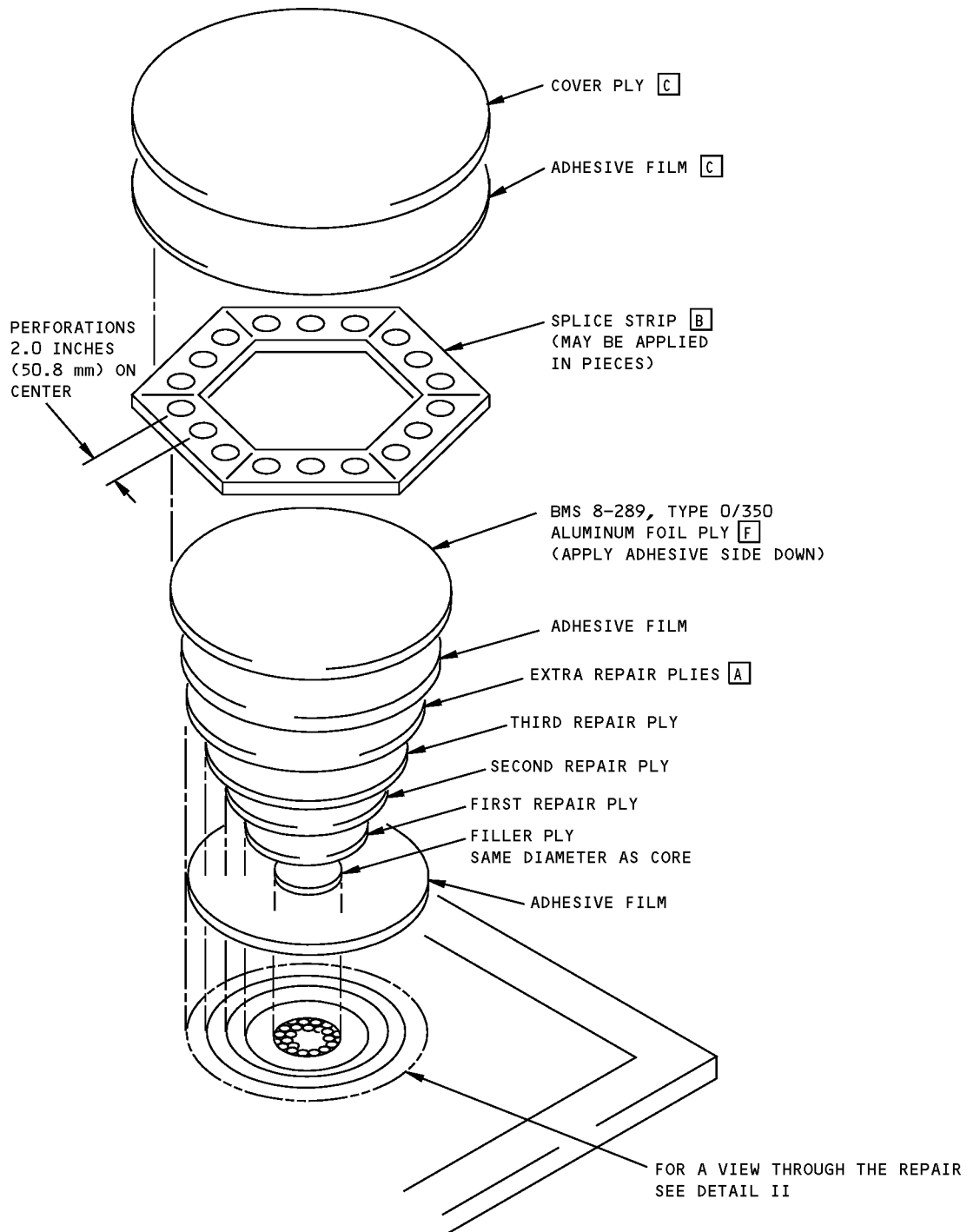


NOTES

- [A] WHEN CRUSH SPLICING CORE 1.0 INCH (25.4 mm) OR THICKER THE JOINT MAY BE CHAMFERED.
- [B] PRIOR TO SPLICING CORE MAY BE STABILIZED WITH SC1008 PHENOLIC RESIN. LIMIT RESIN APPLICATION TO A MAXIMUM OF 1.0 INCH (25.4 mm) BEYOND THE EDGE CORE THAT IS TO BE SPLICED. THINNING RESIN WITH ACETONE IS PERMITTED.
- [C] USE BMS 8-301 CLASS 2 OR BMS 8-214 EPOXY RESIN AFTER SPLICING TO KEEP THE SPLICE FROM SEPERATING.
- [D] ALIGN HONEYCOMB CELLS OF REPAIR PLUG WITH ORIGINAL CORE.
- [E] REPLACEMENT CORE PLUG MUST BE MADE FROM CORE MATERIAL A MAXIMUM OF TWO GRADES DENSER THAN THE ORIGINAL CORE.

**Core Crush Splicing Requirements
Figure 16**

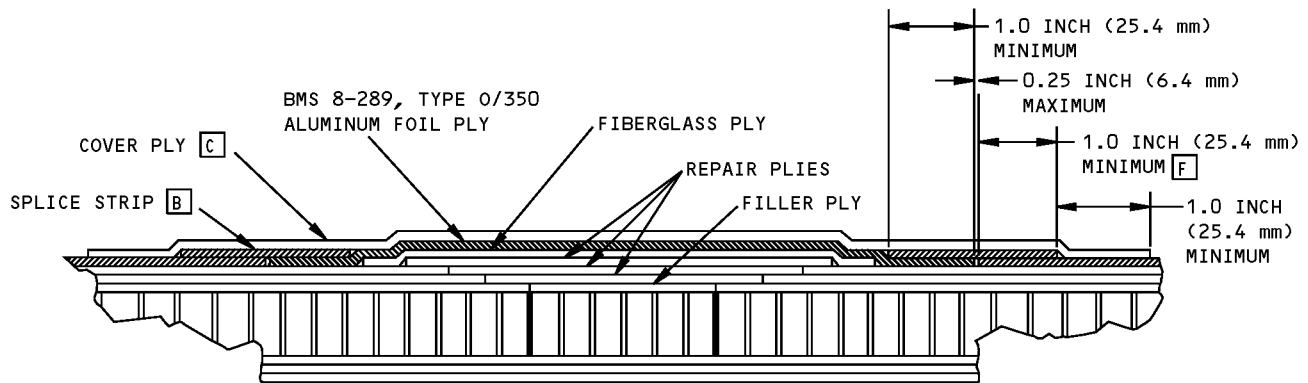
757-200
STRUCTURAL REPAIR MANUAL



REPAIR PLY LAYUP
DETAIL I

Repairs to Aluminum Foil
Figure 17 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



VIEW THRU REPAIR
DETAIL II

MATERIAL	SHIPPING AND STORAGE LIFE		SHELF LIFE [D]	
	MAXIMUM TEMPERATURE [E]	DURATION (DAYS)	MAXIMUM TEMPERATURE	DURATION (HOURS)
BMS 8-289 TYPE O/350 GRADE A	10 (-12°C)	180 DAYS	95°F (35°C)	240
BMS 8-289 TYPE O/350 GRADE B	95°F (35°C)	5 YEARS	95°F (35°C)	NO LIMIT

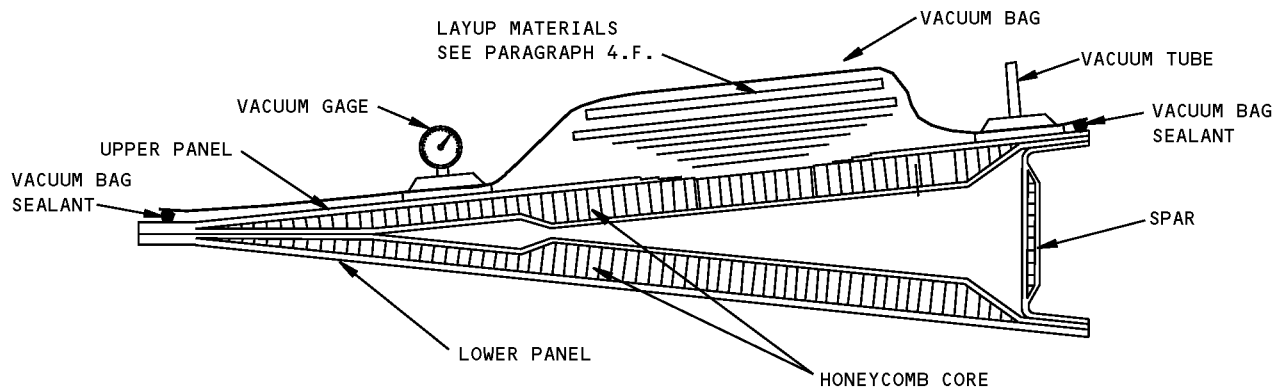
STORAGE AND SHELF LIFE OF BMS 8-289
TABLE I

NOTES

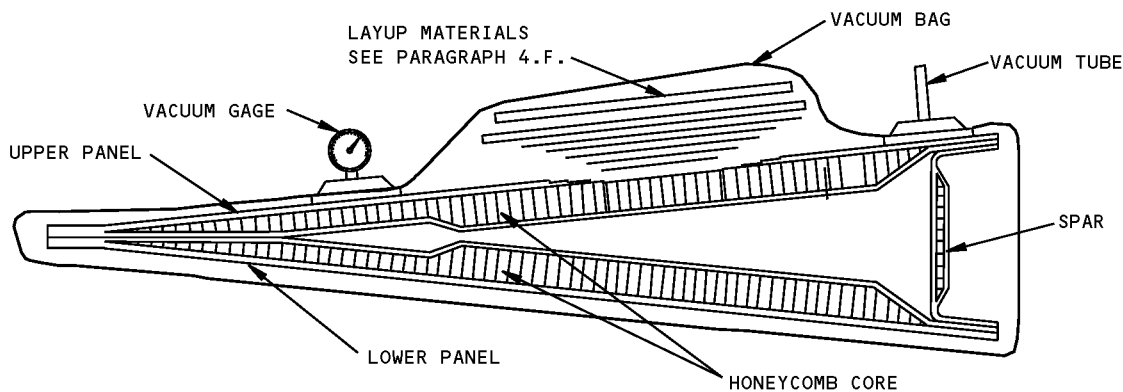
- [A] SEE INDIVIDUAL COMPONENT REPAIR SECTION FOR EXTRA REPAIR PLY REQUIREMENTS. ALL STRUCTURE HAVING AN ALUMINUM FOIL LAYER MUST HAVE A FIBERGLASS PLY TO WHICH THE FOIL IS BONDED. IF A FIBERGLASS EXTRA REPAIR PLY IS NOT REQUIRED BY THE INDIVIDUAL COMPONENT REPAIR SECTION, ONE MUST BE INSTALLED AS THE OUTERMOST PLY.
- [B] BMS 8-289, TYPE O/350, FORM II APPLIED ADHESIVE SIDE UP OR FORM I CHEMICAL CONVERSION COATED ON THE NONADHESIVE SIDE. PERFORATE FORM I WITH 0.5 INCH (12.7 mm) DIAMETER HOLES ON 2.0 INCHES (50.8 mm) CENTERS.
- [C] BMS 8-139, STYLE 120 OR 1581 GLASS FABRIC WITH BMS 5-154, TYPE II, CLASS 1, GRADE O3 OR O5 ADHESIVE FILM UNDERNEATH.
- [D] SHELF LIFE HOURS ACCUMULATE FROM THE DATE OF REMOVAL FROM REFRIGERATION UNTIL START OF THE REPAIR CURE CYCLE.
- [E] STORAGE LIFE AND OUT TIME SHALL BE AS SHOWN IN TABLE 1 EXCEPT ON PRODUCTS GUARANTEED BY THE SUPPLIER AT 95°F (35°C).
- [F] APPLY A CHEMICAL CONVERSION COATING

Repairs to Aluminum Foil
Figure 17 (Sheet 2 of 2)

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ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



NOT ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART
MAY CAUSE ASSEMBLY DISTORTION DURING CURE CYCLE

PARTS CONSISTING OF UPPER AND LOWER PANELS **A**

NOTES

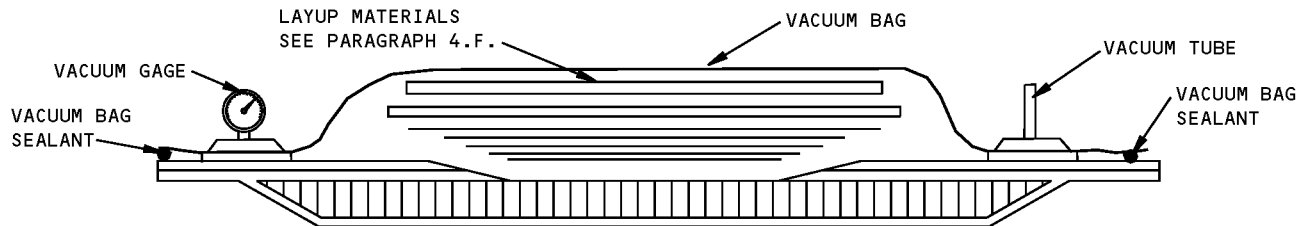
- REFER TO PARAGRAPH 4.F. FOR LAYUP AND BAGGING PROCEDURES

A THIS TYPE OF COMPONENT MUST NOT BE COMPLETELY SEALED IN A VACUUM BAG. DAMAGE TO PART WILL OCCUR. VACUUM BAG ONE SIDE OF COMPONENT ONLY

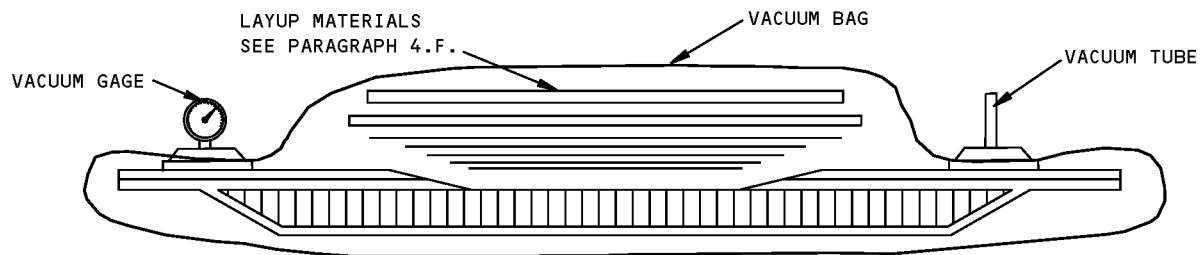
B THIS TYPE OF COMPONENT MAY BE COMPLETELY SEALED IN A VACUUM BAG OR MAY BE SEALED ON ONE SIDE ONLY

Vacuum Bagging Restrictions Figure 18 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**



ACCEPTABLE - VACUUM BAG SEALED TO ONE SIDE ONLY



ACCEPTABLE - VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

**Vacuum Bagging Restrictions
Figure 18 (Sheet 2 of 2)**



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - GRAPHITE/ARAMID/HYBRID REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH REPAIRS - 250°F (121°C) CURE

1. Applicability

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of graphite, aramid or hybrid fabrics. A hybrid can contain layers of graphite, aramid and glass fabrics. The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Glass fabric is also known as fiberglass cloth. Solid laminate is used for small components, honeycomb panel edgebands, and at fitting locations. This section describes repair modes using 250°F (121°C) cure materials (prepreg layup).

WARNING: DO NOT BREATHE CARBON FIBER DUST. MAKE SURE THAT THERE IS A GOOD FLOW OF AIR WHERE YOU DO THE WORK. USE EQUIPMENT TO HELP YOU BREATHE WHEN YOU WORK IN A CONFINED SPACE. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY.

CAUTION: TO GET AN ACCEPTABLE QUALITY REPAIR, DO AS FOLLOWS:



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(CAUTION PRECEDES)

- REFER TO THE APPLICABLE COMPONENT WHICH YOU ARE GOING TO REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE YOU USE THESE REPAIR INSTRUCTIONS.

- USE THE CORRECT MATERIALS FOR THE TYPE OF COMPONENT AND REPAIR THAT IS MADE.

- USE THE MATERIALS THAT AGREE WITH THE SPECIFICATIONS IN THE SRM.

- ACCURATELY FOLLOW THE SRM PROCEDURES AT EACH STEP OF THE REPAIR. IF YOU DO NOT DO THIS, IT CAN CAUSE A REPAIR THAT IS NOT SATISFACTORY AND IS NOT APPROVED.

250°F (121°C) CURE REPAIRS ARE RESTRICTED TO SPECIFIC AREAS AND COMPONENTS AS SHOWN IN THE INDIVIDUAL COMPONENT REPAIR SECTION IN THE MANUAL. THESE REPAIRS ARE PERMANENT WHEN APPLIED USING THE REPAIR MANUAL PROCEDURES TO COMPONENTS ORIGINALLY MADE FROM 250°F (121°C) CURE MATERIALS.

250°F (121°C) CURE REPAIRS MAY NOT RESTORE THE STRENGTH OR DURABILITY OF COMPONENTS ORIGINALLY MADE USING 350°F (177°C) CURE MATERIALS. THEIR USE IS RESTRICTED TO SPECIFIC AREAS OF COMPONENTS AS SHOWN IN THE INDIVIDUAL COMPONENT REPAIR SECTION OF THE MANUAL.

REPAIRS TO DAMAGE CONTAINED HEREIN, SPECIFY MATERIALS QUALIFIED FOR 250°F (121°C) CURE. 350°F (177°C) CURE MATERIALS WILL NOT CURE AT 250°F (121°C) TEMPERATURES AND MUST NOT BE USED TO ATTEMPT REPAIR OF 250°F (121°C) COMPONENTS.

CAUTION: DO NOT LET CARBON FIBER DUST GO INTO ELECTRICAL EQUIPMENT. CARBON FIBER DUST IS ELECTRICALLY CONDUCTIVE AND IT CAN CAUSE SHORT CIRCUITS IF IT GOES INTO ELECTRICAL EQUIPMENT. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE ELECTRICAL EQUIPMENT.

B. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage
Paragraph 4.B./GENERAL	Remove Water from Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedures

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Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater Than 0.50 in. (12.7 mm) Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 5.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.H./GENERAL	Repair of Punctures and Damage in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Laminated Panels
Paragraph 5.L./GENERAL	Repair of Surface Dents
Paragraph 5.M./GENERAL	Repair to Aluminum Foil

2. General

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR RUBBER GLOVES, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE BARE OR ALUMINUM COATED TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY ALSO BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.



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(CAUTION PRECEDES)

WHEN REINSTALLING ALUMINUM FITTINGS ON GRAPHITE COMPOSITE STRUCTURE, ENSURE THAT THE ORIGINAL CORROSION PROTECTIVE TREATMENT IS MAINTAINED. INSTALL FITTINGS WITH FAYING SURFACE SEAL USING BMS 5-26 IN FUEL TANK AREAS OR BMS 5-95 IN ALL OTHER AREAS.

- A. Use suitable holding fixtures per Paragraph 4.F./GENERAL to prevent distortion and delamination of the structure.
- B. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust or other particulate matter are specifically prohibited.
- C. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- D. Store rolls or precut kits of prepreg and adhesive material below 10°F (-12°C) in sealed moisture-proof bags. An identification label must accompany the material inside the bag, with the following information:

BMS Type, Class, Grade, Style, supplier name, batch number, roll number, prepreg lot number and date of kit preparation. Record storage time in and out of refrigeration.
- E. Refer to 51-70-02, GENERAL for the locations of principal composite components.
- F. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- G. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
- H. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- I. Refer to 51-70-14, GENERAL for repair of flame spray.
- J. Refer to 51-70-16, GENERAL for drilling and machining of composite structures.
- K. Refer to 51-30-06, GENERAL for composite repair material ordering data.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-05, GENERAL	Repair Sealing
51-30	REPAIR MATERIALS
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-60	CONTROL SURFACE BALANCING
51-70-02, GENERAL	Locations of the Principal Composite Components
51-70-03, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
51-70-17, GENERAL	Repairs to 250°F (121°C) and 350°F (177°C) Cured Graphite/Aramid/Fiberglass Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Structure - 200°F (93°C) to 230°F (110°C) Wet Layup Repair Method
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
DOCUMENT D6-49327	Certification of Autoclaves for Metal Bonding and Curing of Composite Structure

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(Continued)

Reference	Title
DOCUMENT D6-56273	Qualification of Heat Blankets for Hot Bonding
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Repair Procedures Common to Various Repairs

A. Determine Damage.

CAUTION: DO NOT USE CHEMICAL PAINT STRIPPERS TO REMOVE THE PAINT. CHEMICAL PAINT STRIPPERS WILL CAUSE DAMAGE TO THE RESIN SYSTEMS.

- (1) Examine visually for extent of damage.
- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic or thermography methods. Remove contaminants. Refer to Paragraph 4.B./GENERAL for water removal instructions.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental nondestructive inspection (NDI) methods or by tap test. For the tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will give a dull sound. Solid bonded areas will give a sharp ring. Refer to NDT Part 1, 51-05-01.

B. Remove Water From Damaged Area.

- (1) Remove water from honeycomb sandwich (Figure 11/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum and oil-free compressed air.
 - (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
 - (c) Apply a fiberglass or metal fine mesh screen over the exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
 - (g) If the far side is accessible, apply thermocouple and heating blanket to the far side of the honeycomb sandwich panel.

NOTE: If the far side is accessible, it is acceptable to heat the area using a heating blanket only on the far side. An additional heating blanket and vacuum application may be used on the near side at the location shown in Figure 11/GENERAL to accelerate water removal. If the far side is inaccessible, use of a heating blanket on the near side is required.

- (h) When the far side is inaccessible or when using additional heating blanket, place the heating blanket over the bleeder cloth on the near side.
- (i) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
- (j) Evacuate the layup to a minimum of 22 in/Hg (75 kPa) vacuum.

STRUCTURAL REPAIR MANUAL

- (k) Heat the area for 1 hour minimum at 150°F to 170°F (66°C to 77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
- (l) Remove layup materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
 - (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
 - (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

CAUTION: REMOVE (FOR ALL TYPES OF CURE) OR ISOLATE (HEAT BLANKET ONLY) ALUMINUM STRUCTURE TO PREVENT LOSS OF STRENGTH IN THE ALUMINUM PARTS. ALL ALUMINUM ALLOYS, EXCEPT 2219, MUST BE KEPT BELOW 200°F (93°C). ALUMINUM 2219 CAN BE KEPT UP TO 400°F (204°C). REMOVE SEALANTS, PAINTS AND PRIMERS IN THOSE AREAS WHERE THE TEMPERATURE COULD REACH ABOVE THE MAXIMUM ALLOWABLE TEMPERATURE. REFER TO SRM 51-20-01 FOR THE MAXIMUM ALLOWABLE TEMPERATURES.

C. Remove Damage and Prepare Damaged Area.

- (1) Damage removal.
 - (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.

- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. For crush splice repairs (Paragraph 4.D./GENERAL) leave one to three core cells (0.4 in. (10.2 mm) maximum) visible between core cavity and skin (Figure 16/GENERAL). The core area removed should extend at least 0.5 in. (12.7 mm) further than the visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side. In cores greater than 1.0 in. (25.4 mm) thick, partially remove core (at least 0.5 in. (12.7 mm) deep) sufficient to clean up damage.

NOTE: When a potted core repair is to be made, removal of damaged core is not required.

- (c) In areas where contamination cannot be removed by cleaning or drying per Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 4.C.(1)(a)/GENERAL.
- (e) When core is removed from the inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.



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(CAUTION PRECEDES)

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 9/GENERAL AND FIGURE 13/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(2) Preparation of damaged area (Figure 13/GENERAL).

- (a) Determine the number of plies that have been cut. Mask off the area around the cleaned up damage allowing 0.5 in. (12.7 mm) overlap for each ply replacement, plus 0.5 in. (12.7 mm) extra for the extra ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the applicable component section.

If the damaged area has a layer of aluminum foil, cut back the foil enough to allow a new foil layer to have a 1.0 in. (25.4 mm) minimum overlap beyond the outermost repair ply (Figure 17/GENERAL).

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
- 1) Remove the paint finish or Tedlar film using No. 240 or finer Scotch-Brite abrasive or No. 150 or finer sandpaper in the masked off area.
 - 2) If the damage area has a layer of aluminum foil, cut back the foil enough to allow a new foil layer to be at least 1.0 in. (25.4 mm) larger all around than the largest repair ply (Figure 17/GENERAL).
 - a) Strip the aluminum foil by peeling or abrading. Do not damage the underlying composite fibers.
 - b) Carefully abrade to remove the primer on the aluminum foil to a border 1.0 in. (25.4 mm) larger all around than the repair area that was just stripped of foil.
 - c) Taper sand or step sand each ply per Paragraph 4.C.(2)(b)3)/GENERAL below.
 - d) Lightly abrade and solvent wipe the primer on the aluminum foil to a border 1.0 in. (25.4 mm) larger all around than the band of foil exposed by primer removal in Paragraph 4.C.(2)(b)2b)/GENERAL.
 - e) Apply a chemical conversion coating to the foil exposed by primer removal in Paragraph 4.C.(2)(b)2b)/GENERAL.

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- 3) Taper sand each ply or simply abrade the surface around the cleaned up damage a minimum of 0.5 in. (12.7 mm) per ply. Refer to Figure 13/GENERAL.
 - 4) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
 - 5) Abrade surfaces around repair using No. 150 or finer Scotch-Brite abrasive.
- (c) External surface of panel (critical aerodynamic surfaces).
- 1) Taper sand a uniform taper around the cleaned up damage using No. 180 sandpaper. The taper is to be over a minimum distance of 0.5 in. (12.7 mm) for each existing ply of the laminate. Step sanding is optional to taper sanding on honeycomb sandwich structure in areas of noncritical aerodynamic smoothness. Refer to 51-10-01, GENERAL for locations of areas of critical aerodynamic smoothness. Always taper sand on solid laminate structures.
- NOTE:** For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.
- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 0.5 in. (12.7 mm) border using No. 150 or finer sandpaper.
- (d) Edgeband of panel.
- 1) Taper sand panel edgeband according to Paragraph 4.C.(2)(c)1)/GENERAL.
- NOTE:** Edgeband is the solid laminate around the outer periphery of the honeycomb panel.
- (e) Cleaning of repair area.
- 1) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PART. DAMAGE TO PART WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/ SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

- (1) Fabricate core plug.
 - (a) Fabricate core plug from core called out on engineering drawing. Refer to specific component structural identification section to determine type of core called out on engineering drawing.

STRUCTURAL REPAIR MANUAL

- (b) For butt splicing, the honeycomb core should fit flush with the original core and with the ribbon direction aligned. Trim the core plug no more than 0.05 in. (1.3 mm) smaller than the cut out. The core plug is to have a tight interference fit in the core cavity after it is wrapped with the foaming adhesive.
- (c) For crush splicing, the honeycomb core plug should be made two to four cells larger than the repair cavity and be made from core material which is a maximum of two grades denser than the original core (Figure 16/GENERAL).

NOTE: Crash splicing applies to fiberglass core (BMS 8-124, Class I) only.

- (d) Trim core plug to full or partial depth of original core as given in Paragraph 4.C.(1)(b)/GENERAL and shown in Figure 2/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive film between core plug and undamaged core or skin (Figure 2/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL).

- (2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED IMMERSION CRITERIA GIVEN IN PARAGRAPH 4.D.(2)(A)/GENERAL. DAMAGE TO CORE MATERIAL WILL OCCUR.

DO NOT IMMERSE PARTS IN TRICHLOROETHANE SOLVENT OR ALLOW STANDING SOLVENT ON PART. DAMAGE TO PART WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99) bath for 60 seconds.
- (b) Locally contaminated areas can be washed with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
- (c) The core must be completely dry, clean and free of evidence of solvents before installation.

CAUTION: WHEN HANDLING ADHESIVE FILM WEAR CLEAN WHITE GLOVES TO PREVENT CONTAMINATION.



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(CAUTION PRECEDES)

DO NOT TOUCH THE ADHESIVE FILM WITH BARE HANDS OR OTHER PARTS OF THE BODY.

DO NOT FOLD, STRETCH OR OTHERWISE THIN THE ADHESIVE FILM.

- (3) Install core plug (Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL, typical).

NOTE: Most of the materials used in this procedure have limited life and require controlled storage conditions. Refer to the applicable material specifications for the maximum time out of the controlled storage and for the uncontrolled storage conditions.

Before opening the adhesive film wrapper, condition refrigerated adhesives to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of adhesive horizontally through its axis free from other rolls or objects.

- (a) For partial core replacement, cut two pieces of BMS 5-129, Type 2 or 4, Grade 10 adhesive film and one piece of BMS 8-79, Style 120, fiberglass prepreg fabric to fit the repair hole. Place in position as shown in Figure 2/GENERAL, Section A-A.
- (b) For full depth core replacement, where damage does not extend through both skins, trim a piece of BMS 5-129, Type 2 or 4, Grade 10 adhesive film to fit repair hole and place on the inside surface of the undamaged skin (Figure 2/GENERAL, Figure 3/GENERAL, Figure 7/GENERAL, and Figure 13/GENERAL).
- (c) If both skins are damaged, tape a metal caul plate (such as 0.04 in. (1.02 mm) thick aluminum) against the exterior surface of the far side skin and repair as for damage to one skin only. Repair far side skin in a subsequent cure cycle.
- (d) For butt splicing, wrap the edges of the core plug with BMS 5-90, Type III or Type IV, Class 250/350, Grade 100, or two layers of Grade 50 foaming adhesive and install in the repair cavity. Align the honeycomb ribbon with the original core ribbon direction.
- (e) For crush splicing, prepare and install the core plug per Figure 16/GENERAL. Align the honeycomb core ribbon with the original core ribbon direction.
- (f) Put the layup materials and equipment in place per Figure 3 (Sheet 2).
 - 1) If the damage extends through both face skins, vacuum bag both sides of the panel (or the entire part) using the layup shown in Figure 3 (Sheet 2).
 - 2) If the replacement core plug is less than or equal to 0.5 in. (12.7 mm) thick, use the heating blanket on the near side and locate at least two separate thermocouples on the panel surface at the bondline.
 - 3) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and both sides are accessible, use heating blankets on both sides. Locate at least two separate thermocouples on the near side at the bondline and one on the far side corresponding to the center of the repair.

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- 4) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and only one side is accessible, use the heating blanket on the near side and put at least two separate thermocouples into the repair hole so the thermocouples touch the repair materials at the bottom of the repair hole.

NOTE: The ends of these thermocouples will be cured into the adhesive. Cut the thermocouples leaving the embedded ends behind before applying the repair plies. Only the portion of the thermocouple embedded in the core can be left in the repair. The thermocouples cannot come between the repair plies and the sanded surfaces of the original plies.

- (g) Evacuate the repair area to a vacuum of 22 in/Hg (75 kPa) minimum.
- (h) Cure a minimum of 90 minutes at 250 to 270°F (121 to 132°C)(Figure 14/GENERAL).
- (i) Allow the repair area to cool under vacuum until the temperature of the repair area is 125°F (52°C) or less. Then release restraints (if applicable) and remove layup materials and equipment.
- (j) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (k) Vacuum to remove sanding residue from core cells.

NOTE: The core plug and the repair plies can be cured at the same time if the temperature can be adequately monitored by thermocouples placed on the outside surfaces of the panel (refer to Paragraph 4.D.(3)(f)2)/GENERAL, Paragraph 4.D.(3)(f)3)/GENERAL, and Paragraph 4.D.(3)(f)4)/GENERAL). If the thermocouples must be embedded in the repair core adhesive, then the core plug must be cured separately to avoid curing the thermocouple between the repair plies and the sanded surface of the original plies.

CAUTION: DO NOT CURE MORE THAN TEN (10) PLIES DURING ONE CURE CYCLE FOR HEAT BLANKET AND OVEN CURES. IF THE REPAIR HAS MORE THAN 10 PLIES, DIVIDE THE REPAIR PLIES EVENLY INTO MULTIPLE CURE CYCLES. IF YOU DO NOT OBEY, POROSITY AND BULGES CAN OCCUR AND THE SUBSEQUENT REPAIR WILL BE UNSATISFACTORY.

E. Prepare and Apply Preimpregnated (Prepreg) Repair Plies.

NOTE: Refer to applicable paragraphs for preparation of prepreg glass, aramid and graphite fabrics. For hybrid components, refer to relevant material paragraphs for each individual ply.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

- (1) Prepare prepreg glass fabric repair plies (BMS 8-79).

CAUTION: THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

- (a) Refer to the specific component structural identification to determine type and orientation of glass fabric used in original structure. Repair existing plies of original structure with BMS 8-79, Class III, Style 1581 or Style 7781 (Figure 12/GENERAL).

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- (b) From BMS 8-79, Class III, Style 1581 or Style 7781 preimpregnated material, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(1)(c)/GENERAL, for substitution of prepreg glass fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 15/GENERAL for extra repair ply material and orientation.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) Substitution of prepreg glass fabric plies (Figure 12/GENERAL).
- 1) If BMS 8-79, Style 1581 or Style 7781 prepreg material is not available, three plies of BMS 8-79, Style 120 prepreg material may be substituted for each ply of Style 1581 or Style 7781 prepreg material required (Figure 12/GENERAL).
- (d) Substitution of prepreg glass fabric plies (Figure 12/GENERAL).
- 1) If BMS 8-79, Style 1581 or Style 7781 prepreg material is not available, three plies of BMS 8-79, Style 120 prepreg material may be substituted for each ply of Style 1581 or Style 7781 prepreg material required (Figure 12/GENERAL).
- (2) Prepare prepreg aramid fabric repair plies (BMS 8-219).

CAUTION: THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

- (a) Refer to the specific component structural identification to determine number, style, and orientation of aramid fabric used in original structure, see Figure 12/GENERAL.
- (b) From each type of material required, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(2)(c)/GENERAL for the substitution for prepreg aramid fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 15/GENERAL for extra repair ply material and orientation.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) Substitution for prepreg aramid fabric plies (Figure 12/GENERAL).
- 1) Prepreg glass fabric material, BMS 8-79, may be used to substitute for prepreg aramid fabric per table shown in Figure 12/GENERAL.
- (3) Prepare prepreg graphite or tape repair plies (BMS 8-168).

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CAUTION: TAPE IS A UNIDIRECTIONAL FIBER. WHEN USED IN A LAYUP, THE PREDOMINATE STIFFNESS IS IN THE DIRECTION OF THE FIBER. TAPE HAS LITTLE OR NO STIFFNESS IN THE TRANSVERSE DIRECTION.

FABRIC HAS BIDIRECTIONAL PROPERTIES. WHEN SUBSTITUTED FOR TAPE, FABRIC ADDS STIFFNESS IN THE TRANSVERSE DIRECTION. THE EFFECTS OF THIS ADDITIONAL TRANSVERSE STIFFNESS ON THE COMPONENT AND SUBSTRUCTURE MUST BE CONSIDERED PRIOR TO COMMITTING A MAJOR SUBSTITUTION IN A REPAIR.

THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

- (a) Refer to the specific component structural identification to determine number, style, and orientation of graphite fabric used in original structure, see Figure 12/GENERAL.
- (b) From each type of material required, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(3)(c)/GENERAL for the substitution of prepreg tape plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 15/GENERAL for extra repair ply material and orientation.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) No substitutes are permitted for graphite fabric repair plies. However, graphite fabric may be used as a substitute for graphite tape (Figure 12/GENERAL).
- (4) Apply the repair plies (Figure 2/GENERAL, Typical Repair, and Figure 13/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with strips of preimpregnated material before application of the repair plies. Use the same material as used in the repair plies.

CAUTION: ENSURE THAT PARTING FILM AND POLYETHYLENE SEPARATOR ARE REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Make a temporary vacuum bag system.

NOTE: This vacuum bag is used to compact the repair plies and prevent contamination of the repair. Do not use this vacuum bag system for the repair cure.

- 1) Put one layer of perforated parting film above the repair.
- 2) Apply the vacuum sealing compound around the repair area.
- 3) Put the vacuum bag material over the repair area. Seal the edges with the vacuum sealing compound.

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- 4) Attach a vacuum line above the surface breather.
- (b) Cut two plies of BMS 5-129, Type 2 or 4, Grade 10, adhesive film, 0.125 in. (3.2 mm) larger than the largest patch ply which also covers the entire repair area.

NOTE: After curing, the repair will need to be sanded in preparation for refinishing. An additional nonstructural ply covering the entire repair is added which may be sanded as required to obtain a smooth surface for refinishing. Be careful not to sand through this nonstructural sanding ply into the structural plies below it.

The second adhesive film ply will be used as a sanding ply. As an option, substitute a ply of BMS 8-79 fiberglass prepreg cut to the same size as the adhesive ply. The fiberglass is less likely to entrap air during the cure.

Repairs to aluminum foil will require one ply of adhesive film and one ply of BMS 8-79, Style 120 fiberglass prepreg.

- (c) Place one layer of adhesive film over the entire repair area.
- (d) Install the repair plies and if necessary the sanding ply also.

NOTE: Add filler plies as necessary to get a smooth repair. Do not use more than four filler plies on one repair area.

- 1) Install the smallest repair ply first.
- 2) Make sure that the warp direction of each repair ply that you put in the repair is correct and that the overlap is correct.
- 3) Install the next ply. Make sure that it is smooth with no wrinkles.
- 4) Remove the separator sheet.
- 5) You must do the steps that follow for repairs that have one or more graphite (Carbon Fiber Reinforced Plastic (CFRP)) repair plies.

NOTE: Although it is only necessary to compact repairs containing CFRP repair plies, Boeing recommends that you compact all repairs.

- a) Compact each ply (or plies) with the temporary vacuum system as follows:

- 1-minute for each ply (one ply at a time), or
- 2-minutes for each two plies (two plies at a time), or
- 6-minutes for each three plies (three plies at a time)

NOTE: Do not compact more than three plies at a time. An adhesive ply counts the same as a repair ply.

- b) Do Paragraph 4.E.(4)(d2)/GENERAL, Paragraph 4.E.(4)(d3)/GENERAL, Paragraph 4.E.(4)(d4)/GENERAL, and Paragraph 4.E.(4)(d5)/GENERAL again for all of the repair plies as necessary to complete the layup.
- (e) Apply a cover ply of BMS 8-79 fiberglass prepreg or the second ply of adhesive film over the replaced plies. If the repair includes repair to aluminum foil, skip this step.
- (f) If the repair area has a layer of aluminum foil, repair the foil per Paragraph 5.M./GENERAL before proceeding with the next step.

F. Layup/Bagging Procedure

- (1) Place one layer of perforated FEP parting film over the replacement plies and extending at least 1.0 in. (25.4 mm) beyond the largest patch ply.

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- (2) Put on the thermocouples.

(a) If you use an autoclave or an oven, then do the step that follows:

- 1) Put one or more thermocouples at the location where the temperature will increase the fastest and one or more thermocouples where the temperature will increase the slowest.

NOTE: Boeing recommends that you put one or more thermocouples at the thick areas of the part and tool and the thin area of the part and tool. Use more than two thermocouples when more than 900 in² (5806 cm²) of a panel surface is repaired. Insulation is not necessary in the repair area for autoclave or oven cures.

(b) If you use a heat blanket, then do the step that follows:

- 1) Secure three thermocouples (spaced evenly around the repair) to the panel at the edge of the repair and secure them to the temperature recording device.

- (3) Place a layer of dry peel ply over the perforated FEP.

NOTE: The peel ply must be cut large enough to make contact with the surface breather.

- (4) Place one layer of solid FEP parting film over the layup extending to 0.5 in. (12.7 mm) short of the edge of the dry peel ply.

- (5) If you use a heat blanket, then place it over the repair area.

NOTE: The heat blanket must extend a minimum of 2 in. (5.1 cm) beyond the edge of the patch.

When you use a heat blanket that is longer than 12 in. (30.5 cm) on one side, it is recommended that you use an aluminum pressure plate (0.04 in. (1.0 mm) thick max) to minimize localized heating.

If you use two or more pads then you must also use a pressure plate.

- (a) If the area to be repaired is near or attached to aluminum structure that was not removed in Paragraph 4.C./GENERAL, do the steps that follow:

- 1) Isolate the aluminum structure from the area that will get hot.
- 2) Add one or more thermocouples to put on the aluminum structure. Make sure that the temperature does not go above 200°F (93°C).
- 3) You can put insulation around all other metals to prevent cold locations in the repair.

- (6) Place a layer of Airweave SS or Style 120 glass fabric over the solid FEP as a surface breather, or, if heat blanket is used, place four to six layers of breather material over the heat blanket to act as an insulator and a surface breather.

NOTE: The surface breather material and the dry peel ply must make contact.

- (7) Lay the vacuum line over the edge of the breather material.

- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.

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CAUTION: HOLLOW COMPOSITE COMPONENTS SUCH AS RUDDERS, ELEVATORS, AND AILERONS MUST NOT BE COMPLETELY BAGGED BECAUSE THEY MAY COLLAPSE UNDER 22 IN/HG (75 KPA) VACUUM. ATTACH VACUUM BAG TO ONE SIDE OF COMPONENT ONLY OR ATTACH SEPARATE VACUUM BAGS TO EACH SIDE TO ENSURE THAT ATMOSPHERIC PRESSURE IS MAINTAINED INSIDE OF COMPONENT DURING REPAIR. COMPONENTS CONSISTING OF A SINGLE PANEL MADE OF FULL DEPTH HONEYCOMB CORE WITH LAMINATE FACE SHEETS AND EDGE BANDS MAY BE COMPLETELY BAGGED (FIGURE 18/GENERAL).

- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. In some cases it is optional to vacuum bag the entire part.

NOTE: The entire repair surface must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts where sagging and distortion could occur due to the weight of the part.

- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
- (11) Check the vacuum bag for leak paths.
- G. Cure the repair. Do Paragraph 4.G.(1)/GENERAL for the autoclave procedure, Paragraph 4.G.(2)/GENERAL for the oven cure procedure, or do Paragraph 4.G.(3)/GENERAL for the heat blanket/heat lamp cure procedure.

- (1) For an autoclave cure, see Figure 14/GENERAL, Detail I and do the steps that follow:

NOTE: Boeing recommends that you use a certified autoclave when you do the procedure that follows. DOCUMENT D6-49327, Certification of Autoclaves, is a procedure that Boeing uses, and you can use this as a guide to certify your autoclave.

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. This must be done for all parts that were initially made at a cure temperature of 250°F (121°C). Boeing also recommends that you hold the part in the specified part tool, if the part was initially made at a cure temperature of 350°F (177°C). The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Pressurize the autoclave to 40 to 50 psig (276 to 345 kPa gauge). Open the vacuum bag to the atmosphere when the autoclave pressure is above 20 psig (138 kPa gauge).
- (c) Increase the temperature of the autoclave until it is at 130°C (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 2°F to 8°F (1°C to 5°C) for each minute until all thermocouples are in the cure temperature range.

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- (d) Hold the cure temperature for the specified time as given in Figure 14/GENERAL, Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature range during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (e) Keep the vacuum bag connection to the atmosphere open and the autoclave pressurized until after the cure is complete and the temperature of the part has decreased to 125°F (52°C).
- (f) Decrease the autoclave temperature at a maximum rate of 5°F (3°C) for each minute.
- (g) When the temperature is less than 125°F (52°C), release the autoclave pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONS.

- (2) For an oven cure, see Figure 14/GENERAL, Detail I and do the steps that follow:

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. This must be done for all parts that were initially made at a cure temperature of 250°F (121°C). Boeing also recommends that you hold the part in the specified part tool, if the part was initially made at a cure temperature of 350°F (177°C). The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum vacuum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the oven until it is at 130°F (54°C). When the temperature is at 150°F (66°C), increase the temperatures at a rate of 2°F to 8°F (1°C to 5°C) for each minute until all thermocouples are in the cure temperature range.
- (d) Hold the cure temperature for the specified time as given in Figure 14/GENERAL, Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (e) Decrease the oven temperature at a maximum rate of 5°F (3°C) for each minute.
- (f) When the temperature is less than 125°F (52°C), remove the vacuum pressure.
- (g) Remove the vacuum bag equipment from the part and tool.

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WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONNEL.

(3) For heat blanket cure, see Figure 14/GENERAL, Detail II and do the steps that follow:

NOTE: Boeing recommends that you use a qualified heat blanket when you do the procedure that follows. DOCUMENT D6-56273, Qualification of Heat Blankets for Hot Bonding, is a procedure that Boeing uses, and can be used as a guide to qualify your heat blanket.

- (a) Make sure there is a minimum of three thermocouples for each heat blanket used. Refer to Paragraph 4.F./GENERAL.
- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum vacuum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the heat source until the temperature of the repair is at 130°F (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 2°F to 8°F (1°C to 5°C) for each minute until all thermocouples are at the cure temperature.

NOTE: When you use a hot bond console, obey the manufacturer's operation instructions.

- (d) If necessary, put insulation on the cooler areas of the repair area, opposite of the heat source.
- (e) Hold the cure temperature for the specified time as given in Figure 14/GENERAL, Detail II.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (f) Decrease the temperature at a rate maximum of 5°F (3°C) for each minute.
- (g) When the temperature decreases to less than 120°F (52°C), release the vacuum pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

H. Refinish After Repair.

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of top most repair ply as necessary to fair the edge. Do not sand through the nonstructural sanding ply into the structural repair plies below it.
- (2) Apply finish to the repaired surface using the following applicable methods.
 - (a) Where clear Tedlar film surfaces have been removed, seal with a brush coat of Resin Mix 3 (Figure 1/GENERAL). Cure for 6 to 8 hours at room temperature or at elevated temperature per Figure 4/GENERAL.
 - (b) Where gray or white Tedlar film surfaces have been removed, seal with Resin Mix 3 (Figure 1/GENERAL). Cure 6 to 8 hours at room temperature (or per Figure 4/GENERAL) and apply one coat of BMS 10-79, Type II primer and one coat of BMS 10-60, Type II enamel (gray, BAC 705; white, BAC 7106).
 - (c) Where the conductive coating BMS 10-21 has been removed, reapply per AMM 51-24-02.

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- (d) Where the abrasion resistant Teflon finish has been removed from the internal surface of the panel edgeband, reapply the finish per AMM 51-24-13.
- (e) Where the original painted surfaces have been removed, restore original finish per AMM 51-21-00/701.
- (f) Where sealant has been removed from around fittings or fay surfaces to facilitate repairs, reapply BMS 5-95 sealant per 51-20-05, GENERAL.
- (g) Where permanent fasteners have been removed from aluminum fittings common to graphite, reinstall bolts wet with BMS 5-95 sealant and fillet seal around bolt heads and nuts.

I. Perform Post-Repair Requirements.

- (1) Make an inspection of the repair that was done to make sure that the repair is satisfactory. The inspection must include these areas:
 - The area that was hot.
 - A minimum width of 2 in. (5 cm) all around the area that was hot.

If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: Post repair inspection is recommended. Examples of inspection procedures are given in NDT Part 1, 51-01-01. Other inspection methods that have been examined and found satisfactory by the airlines can be used.

WARNING: FLIGHT SAFETY DEMANDS THAT THE CONTROL SURFACES BE PROPERLY BALANCED AT ALL TIMES.

- (2) Following repair of control surface, balance must be checked to determine whether or not rebalancing is required. Rebalance as necessary per CONTROL SURFACE BALANCING, SECTION/51-60.

CAUTION: REPAIRS MADE TO CONTROL SURFACES AND/OR ADJACENT STRUCTURE MUST NOT INTERFERE WITH THE DESIGNED OPERATION OF THE CONTROL SURFACES. DAMAGE TO AIRPLANE STRUCTURE MAY OCCUR.

- (3) Check all repairs for clearance and noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

CAUTION: REPAIRS MUST NOT COVER EXISTING DRAIN HOLES IN PANELS. WATER WILL ACCUMULATE IF DRAIN HOLES ARE COVERED.

- (4) If repair covers the drain hole, drill through the repair at existing location.

NOTE: Drain holes are usually 0.375 in. (9.52 mm) diameter. Refer to AMM 51-41-01.

5. **Typical Repairs**

NOTE: These repairs apply to all graphite/aramid/glass fabric reinforced honeycomb components, except radomes, when called out in applicable repair index of specific structure.

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR FOR THE REPAIR LIMITS AND MATERIAL FOR THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

A. Repair of Delaminations Between Plies.

- (1) Delamination of plies over core area of panel (Figure 5/GENERAL).

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- (a) Determine damage per Paragraph 4.A./GENERAL. Ensure that water and other contamination are removed as given in Paragraph 4.B./GENERAL.
 - (b) Cut away delaminated plies per Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area per Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband.
- (a) Repair this type of damage per 51-70-17, GENERAL.
- B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel.
- (1) Repair this type of damage per 51-70-17, GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Figure 2/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from damaged area (Paragraph 4.B./GENERAL).
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
 - (5) Sand core plug approximately flush with surrounding material making allowance for film adhesive and slight core crush during cure.
 - (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Figure 6/GENERAL).

NOTE: For repair where access to inner surface is limited, refer to Paragraph 5.F./GENERAL.

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area. Refer to Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL, except do not perform Paragraph 4.D.(3)(e)/GENERAL, Paragraph 4.D.(3)(f)/GENERAL, Paragraph 4.D.(3)(g)/GENERAL, Paragraph 4.D.(3)(h)/GENERAL, Paragraph 4.D.(3)(i)/GENERAL, Paragraph 4.D.(3)(j)/GENERAL, and Paragraph 4.D.(3)(k)/GENERAL.
- (5) Prepare and apply repair plies to one surface of the panel according to Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
- (6) Apply vacuum pressure and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
- (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (8) Prepare and apply repair plies to the other surface of the panel according to Paragraph 4.E./GENERAL.

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- (9) Apply vacuum and cure per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (10) Refinish the repair according to Paragraph 4.H./GENERAL.
- (11) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

E. Replacement of Honeycomb Core on Damaged Edge of Panel (Figure 7/GENERAL).

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area (Ref Paragraph 4.B./GENERAL).
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
- (5) Sand core plug approximately flush with surrounding core material, making allowance for film adhesive and slight core crush during cure.
- (6) Clean surfaces according to Paragraph 4.C.(2)(e)/GENERAL.
- (7) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side Only (Figure 8/GENERAL).

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side, and the repair is accomplished in one operation, i.e. core repair and patch overlay repair cured together. Refer to Figure 8/GENERAL when making this repair.

- (1) Determine extent of damage.
- (2) Ensure that all contamination and water is removed from damaged area.
- (3) Remove damage and prepare area per Paragraph 4.C./GENERAL and the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + \{N \times [1.0 \text{ in. (25.4 mm) for each ply}]\} + 1.0 \text{ in. (25.4 mm)}$

d = major diameter of oval hole in inner skin and is limited to 1.5 in. (38.1 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole. Taper sand the outer skin plies per Paragraph 4.C.(2)/GENERAL.
- (4) Fabricate an airtight patch, Figure 8/GENERAL, (Details II thru V) to cover the oval hole from the inaccessible side as follows:
 - (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.

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- (b) Cover the mold with parting film or release agent.
- (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 4.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D diameter.
- (d) Bag and cure the patch per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Place thermocouples at the edge of the patch before cure.
- (e) Remove the patch from the mold.
- (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
- (g) Drill a 0.125 in. (3.175 mm) diameter hole in the center of the patch for a Cleco fastener.
- (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
- (i) Fabricate a strip of spring steel 1.0 in. (25 mm) X 10.0 in. (254 mm) and drill a 0.125 in. (3.175 mm) diameter hole in the center for the Cleco fastener.

NOTE: This repair illustrates the use of a spring steel clamp. However, any suitable retaining device may be used.

- (j) Assemble the patch and spring steel together with a 0.125 in. (3.175 mm) diameter Cleco fastener. See Figure 8 (Sheet 2), Detail II.
- (5) Remove Tedlar, if required and abrade the underside of the inner skin to a distance of 0.4 in. (10.2 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean out the repair area with oil-free compressed air. Wipe the surface with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
- (7) Bend up both ends of the spring steel and apply BMS 5-109, Type II adhesive paste to the precured patch.
- (8) Holding the spring steel up - insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
- (9) Cure the adhesive per Figure 1/GENERAL. When cure is complete, remove the Cleco fastener and spring. Fill hole for Cleco fastener with BMS 5-109, Type II adhesive paste or BMS 5-95, Class B 1/2 sealant and let it cure.

NOTE: Cure BMS 5-109 adhesive paste as given in Figure 1/GENERAL. Cure BMS 5-95 sealant as given in 51-20-05, GENERAL.

- (10) Clean out the repair area per Paragraph 5.F.(6)/GENERAL.
- (11) Apply adhesive film BMS 5-129, Type 2 or 4, Grade 10, 0.10 in. (2.5 mm) bigger than diameter D to the surface of the inner skin which faces with the inner skin repair plies.
- (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin.
- (13) Fabricate and clean core plug per Paragraph 4.D.(1)/GENERAL and Paragraph 4.D.(2)/GENERAL.

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- (14) Complete the installation of the core plug per Paragraph 4.D.(3)(b)/GENERAL, Paragraph 4.D.(3)(c)/GENERAL, Paragraph 4.D.(3)(d)/GENERAL, Paragraph 4.D.(3)(e)/GENERAL, Paragraph 4.D.(3)(f)/GENERAL, Paragraph 4.D.(3)(g)/GENERAL, Paragraph 4.D.(3)(h)/GENERAL, Paragraph 4.D.(3)(i)/GENERAL, Paragraph 4.D.(3)(j)/GENERAL, and Paragraph 4.D.(3)(k)/GENERAL.
 - (15) Prepare and apply repair plies to the outer skin surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Figure 9/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from damaged area. Area must be completely dried out.
- CAUTION:** DO NOT SAND INTO BOND PLY OR CORE (FIGURE 9/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THIS CAUTION IS NOT OBSERVED. BOND PLY IS PLY ADJACENT TO CORE.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- CAUTION:** ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURES.
- (4) Prepare and apply repair plies and complete the repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- H. Repair of Damage and Punctures in Solid Laminate Panels.
- NOTE:** This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with other damage.
 - (3) Remove all damage and prepare area per Paragraph 4.C./GENERAL.
- NOTE:** Taper sand edges of plies around repair on damaged side of panel.
- (4) Prepare and apply repair plies and complete the repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- NOTE:** If cleaned up damage penetrates solid laminate, secure a metal caul plate (such as 0.016 in. (0.4 mm) thick aluminum) to far side of panel to support repair plies.
- I. Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels.
- NOTE:** This repair applies to components made from laminated graphite/aramid/glass fabric or tape plies and epoxy resin without a honeycomb core.
- (1) Check for delamination per Paragraph 4.A./GENERAL.
 - (2) If no delamination is found, clean up damage to a smooth, rounded shape. Then repair per Paragraph 4.B./GENERAL.

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- (3) If delamination is found, repair per Paragraph 5.B./GENERAL.

J. Repair of Delaminations Between Plies in Solid Laminate Panels

NOTE: This repair applies to components made from laminated graphite/aramid/glass fabric or tape plies and epoxy resin without a honeycomb core.

- (1) Repair delaminations using methods described in Paragraph 5.H./GENERAL.

K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels (Figure 10/GENERAL).

- (1) Determine the extent of damage according to Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage according to Figure 10/GENERAL and Paragraph 4.C.(2)(d)/GENERAL.
- (4) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.

CAUTION: ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURE.

- (5) Prepare and apply repair plies according to Paragraph 4.E./GENERAL and Figure 10/GENERAL.
- (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (7) Refinish the repair according to Paragraph 4.H./GENERAL.
- (8) Drill and countersink fastener holes.
- (9) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.

L. Repair of Surface Dents

- (1) Check for delamination and broken fibers per Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair per Paragraph 5.A./GENERAL.
- (3) If broken fibers are found, repair per Paragraph 5.B./GENERAL or Paragraph 5.C./GENERAL.
- (4) If no delamination or broken fibers are found, repair per 51-70-03, GENERAL.

M. Repair of BMS 8-289 Aluminum Foil (Figure 17/GENERAL and Paragraph 4.C.(2)(b2)/GENERAL).

NOTE: Do this repair in addition to the applicable repair of the underlying plies.

- (1) Determine extent of and remove damage. Apply repair materials to the underlying composite structure per Paragraph 5.A./GENERAL, Paragraph 5.B./GENERAL, Paragraph 5.C./GENERAL, Paragraph 5.D./GENERAL, Paragraph 5.E./GENERAL, and Paragraph 5.F./GENERAL up to and including the step for applying the repair plies to the surface that had aluminum foil.
- (2) Apply a chemical conversion coating to the nonadhesive side of the splice strip, cover ply, and aluminum surfaces that will contact the splice strip and cover ply.
- (3) Butt-splice a ply of BMS 8-289, Type 0/250/x/x/x over the repair area, adhesive side down, with a 0.25 in. (6.4 mm) maximum gap and no overlap allowance.



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- (4) Lay up splice strips of BMS 8-289, Type 0/250/x/x/x Form II, adhesive side up, so that they overlap each side of the splice line by about 1.25 in. (31.8 mm). Form I foil is optional, but requires a chemical conversion coating on the nonadhesive side and 0.5 in. (12.7 mm) diameter holes on 2.0 in. (50.8 mm) centers.

NOTE: Do not allow the cover ply or splice strip to extend into the edgeband area of the panel. Electrical splicing is not allowed on the laminated edgeband faying surface.

- (5) Apply a layer of BMS 5-129, Type 2 or 4, Grade 10, adhesive film then a cover ply of BMS 8-79 Style 120, Style 1581, or Style 7781 prepreg over the repair so that both plies overlap the outer edge of the splice strip by 1.0 in. (25.4 mm).
- (6) Vacuum bag and cure the repair per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.



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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
(CONTINUED) BMS 8-79 (PREPREG) CLASS III, GRADE B, STYLE 7781	NOT APPLICABLE			
BMS 8-168 (250°F/121°C GRAPHITE PREPREG) TYPE II CLASS 1 (TAPE) GRADE 95 <				

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 2 of 4)

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
BMS 8-219 (250°F PREPREG) STYLE 285	NOT APPLICABLE		A	250°F TO 270°F FOR 90 MINUTES
BMS 8-219 (250°F PREPREG) STYLE 120	NOT APPLICABLE		A	250°F TO 270°F FOR 90 MINUTES
RESIN MIX 3 (SEALER RESIN)	EPIBOND 156A EPIBOND 156B HARDENER	98 TO 102 4.7 TO 5.3	12 TO 25 MINUTES AT 77°F (25°C)	12 HOURS AT 70°F (21°C) OR 1 TO 3 HOURS AT 150°F (66°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE	FIBER-RESIN 5318S FIBER-RESIN 5318C	98 TO 102 49 TO 51	45 TO 60 MINUTES AT 70°F (21°C)	REFER TO FIG. 4 OR 24 HOURS MINIMUM 70°F (21°C)
RESIN MIX 3 EPOX-O WELD (SEALER RESIN) ALTERNATE	TWO COMPONENT KIT	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT		
			45 TO 60 MINUTES AT 70°F (21°C)	REFER TO FIG. 4 OR 24 HOURS MINIMUM AT 70°F (21°C)
RESIN MIX 3 (SEALER RESIN)	EPIBOND 156A EPIBOND 941 HARDENER	98 TO 102 12 TO 15	45 TO 60 MINUTES AT 70°F (21°C)	12 HOURS AT 70°F (21°C) OR 1 TO 3 HOURS AT 150°F (66°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE BMS 8-207, TYPE 1, CLASS I (250°F)	EC1838A EC1838B HARDENER	50 50	20 MINUTES	12 HOURS MINIMUM AT 105°F (41°C) TO 125°F (52°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE BMS 8-207, TYPE 1, CLASS II (350°F)	FR-40 5413C HARDENER	99 TO 101 14.5 TO 15.5	20 MINUTES AT 75°F (24°C) TO 79°F (26°C)	12 HOURS MINIMUM AT ROOM TEMPERATURE (65°F MINIMUM)(18°C) 1 HR MINIMUM AT 150°F TO 170°F (66°C TO 77°C)
BMS 8-301 CLASS 2 LAMINATING RESIN	FR 7020 PART A RESIN BASE PART B HARDENER EY3804 PART A RESIN BASE PART B HARDENER	100 ±2 58 ±0.5	30 MINUTES AT 75°F	180 MINUTES AT 150°F (67°C) 5 DAY AT ROOM TEMP 68°F (20°C)
BMS 5-109, TYPE II (ADHESIVE PASTE)	EA 9394 PART A EA 9394 PART B OR EA 934 NA PART A EA 934 NA PART B	REFER TO MANUFACTURERS' DATA	30 MINUTES	130 MINUTES± 10 MINUTES AT 150°F (66°C) ±20°F (7°C)

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures Figure 1 (Sheet 3 of 4)



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	RESIN MIXING AND ADHESIVE PREPARATION PROCEDURES
RESIN MIX 1 RESIN MIX 3 BMS 8-301	ADD HARDENER TO RESIN AND MIX THOROUGHLY
BMS 5-90 BMS 5-129 BMS 8-219	REMOVE WRAPPER FILM BEFORE USE

NOTES

- REFER TO SRM 51-30-00 FOR SOURCES OF MATERIALS.
- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

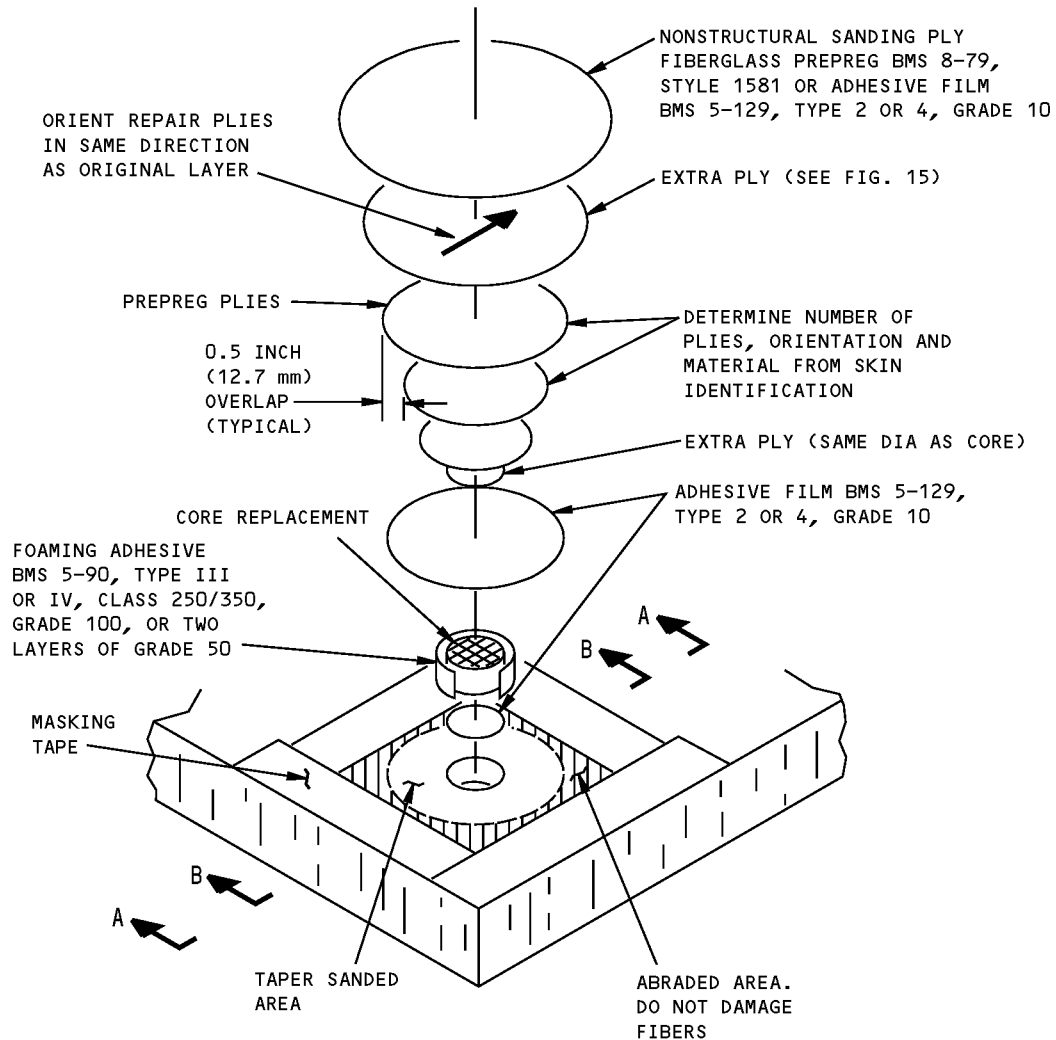
- A** OUT-TIME OF THIS MATERIAL IS 200 EXPOSURE UNITS. ONE EXPOSURE UNIT IS ACCUMULATED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 10°F (-12°C) AND 80°F (27°C). THREE EXPOSURE UNITS ARE ACCUMULATED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 81°F (27°C) AND 100°F (38°C). MATERIALS EXPOSED TO TEMPERATURES ABOVE 100°F (38°C) ARE TO BE REJECTED.
- B** REMOVE THE MATERIAL FROM REFRIGERATION AND KEEP IT SEALED AT 65°F (18°C) TO 90°F (32°C) FOR A MINIMUM OF 8 HOURS FOR A FULL ROLL BEFORE IT IS USED.

- C** THE MATERIAL MAY BE PUT BACK INTO REFRIGERATION ONE OR MORE TIMES WHEN THE CUMULATIVE OUT-TIME IS NOT MORE THAN 10 DAYS.

- D** THE MATERIAL MAY BE PUT BACK INTO REFRIGERATION ONE OR MORE TIMES WHEN THE CUMULATIVE OUT-TIME IS NOT MORE THAN 5 DAYS.

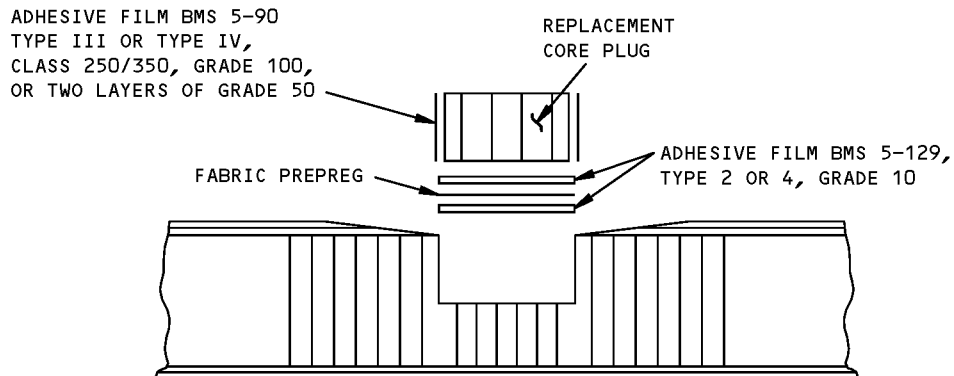
Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 4 of 4)

757-200 STRUCTURAL REPAIR MANUAL

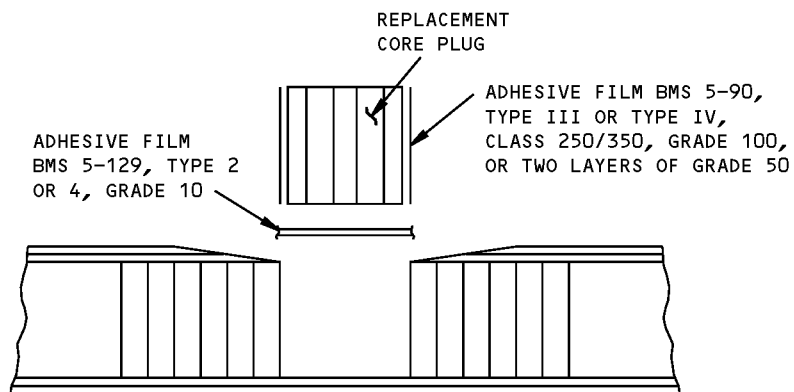


Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 250 Degrees F (121 Degrees C) Cure
Figure 2 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



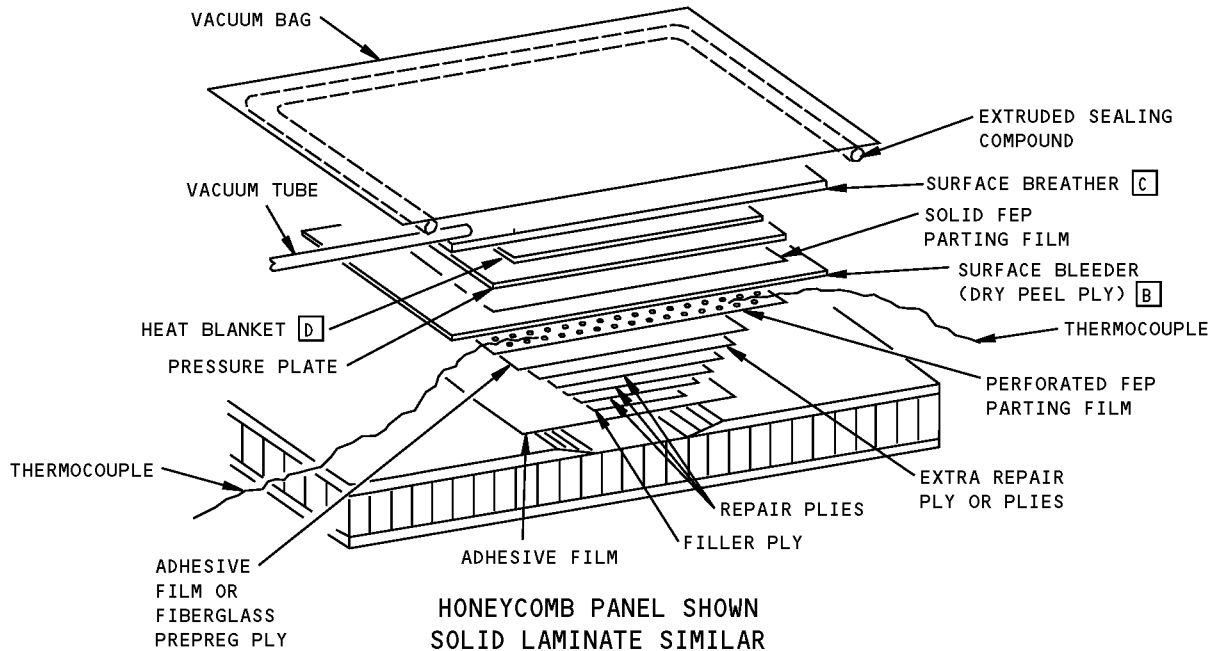
SECTION THRU REPAIR AREA -
PARTIAL DEPTH CORE REPLACEMENT
SECTION A-A



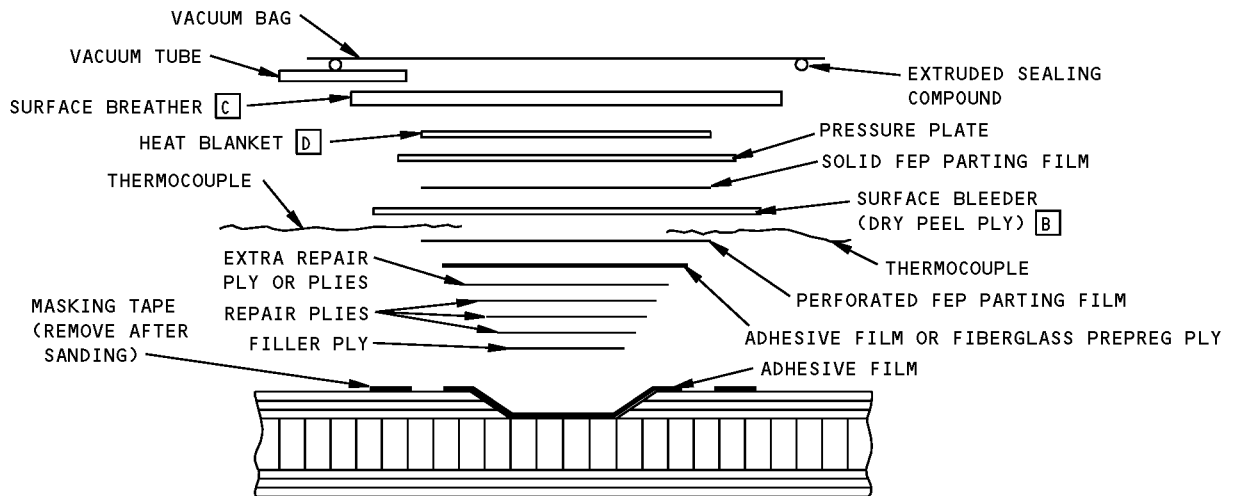
SECTION THRU REPAIR AREA -
FULL DEPTH CORE REPLACEMENT
SECTION B-B

Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 250 Degrees F (121 Degrees C) Cure
Figure 2 (Sheet 2 of 2)

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BAGGING SEQUENCE FOR SKIN PLY REPAIR



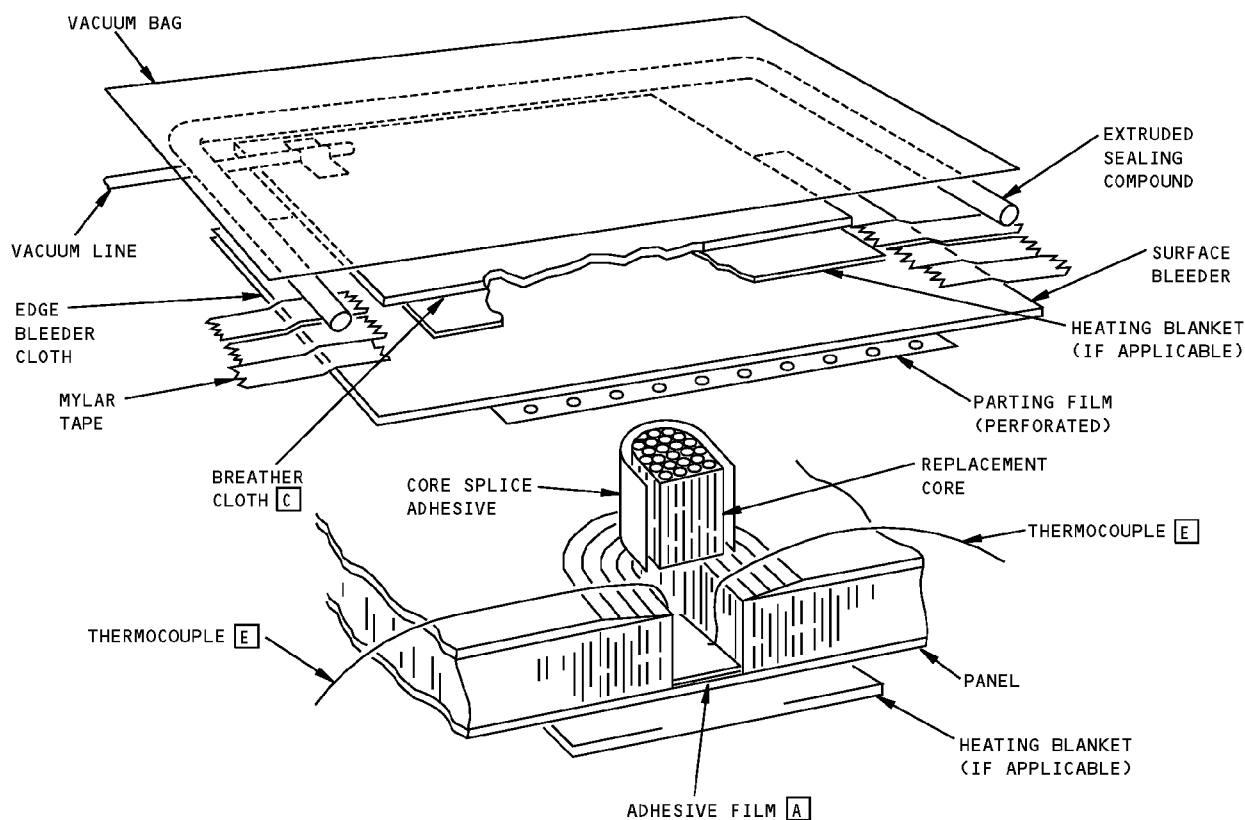
SECTION THRU SKIN PLY REPAIR

NOTES

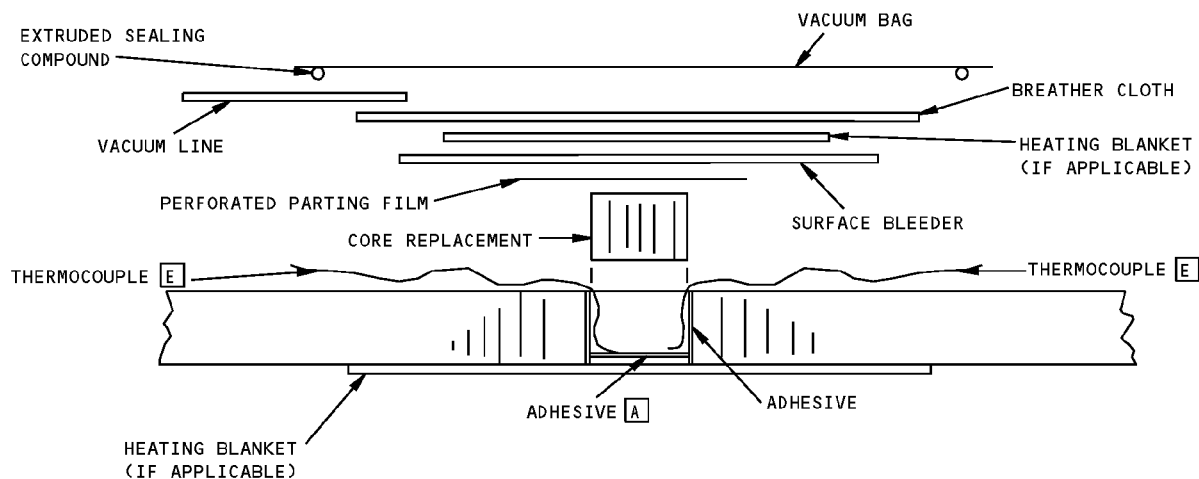
- | | |
|---|---|
| <p>[A] ONE PLY OF ADHESIVE FILM (FOR FULL DEPTH CORE REPLACEMENT, WHERE DAMAGE DOES NOT EXTEND THROUGH BOTH SKINS). FOR PARTIAL CORE REPLACEMENT USE TWO PLIES OF ADHESIVE FILM WITH ONE PLY OF BMS 8-168, CLASS 2 GRAPHITE BETWEEN THEM.</p> <p>[B] DRY PEEL PLY MUST MAKE CONTACT WITH THE SURFACE BREATHER MATERIAL.</p> | <p>[C] WHEN USING A HEATING BLANKET, USE 4 TO 6 LAYERS OF BREATHER MATERIAL TO PREVENT DAMAGE TO VACUUM BAG.</p> <p>[D] HEATING BLANKET MUST EXTEND A MINIMUM OF 2 INCHES (50 mm) BEYOND EDGE OF REPAIR PATCH.</p> <p>[E] FOR THERMOCOUPLE PLACEMENT, REFER TO PARAGRAPH 4.D.(3)(f).</p> |
|---|---|

**Application of Pressure During Cure - 250 Degrees F (121 Degrees C) Cure
Figure 3 (Sheet 1 of 2)**

757-200 STRUCTURAL REPAIR MANUAL



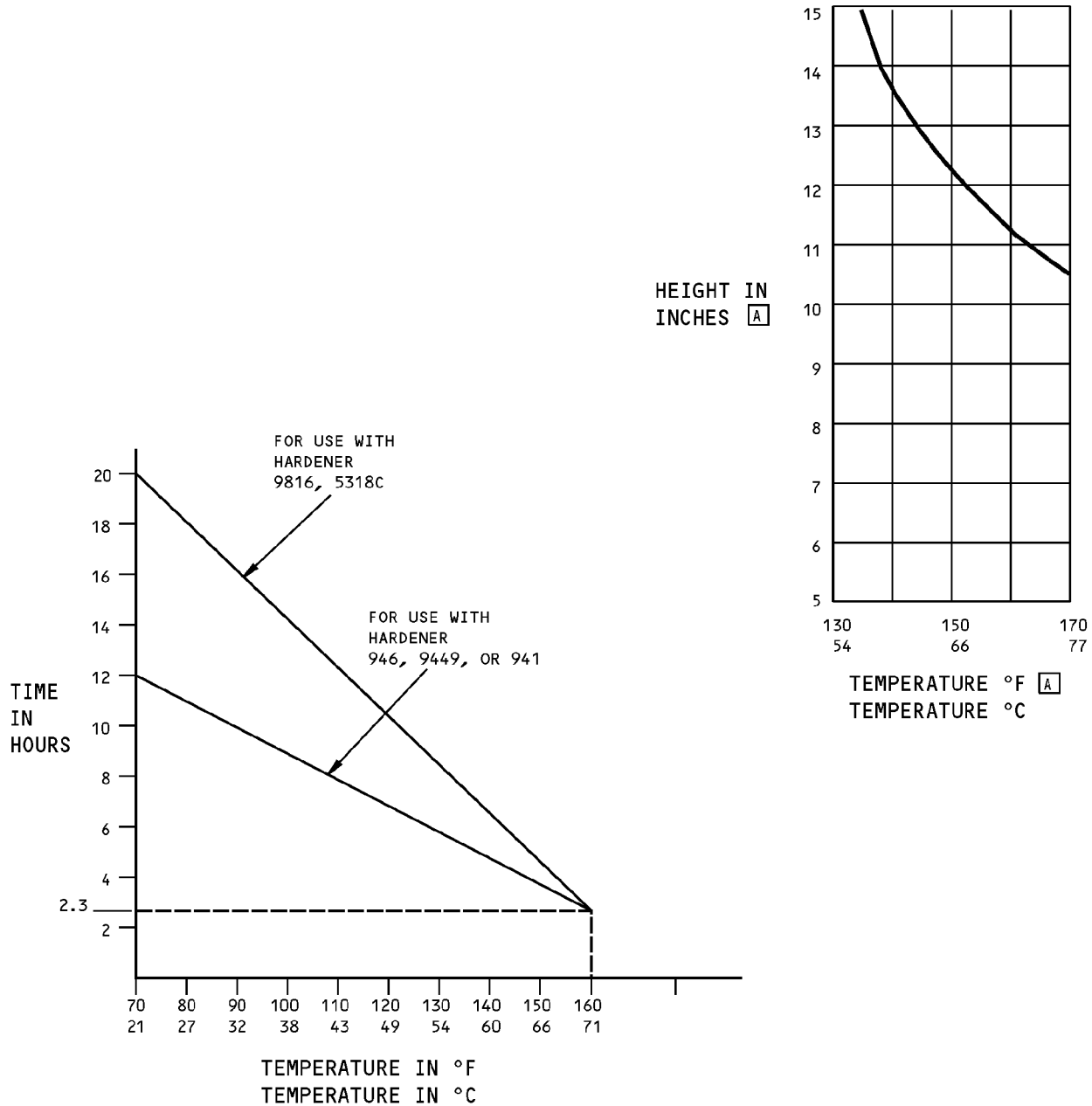
BAGGING SEQUENCE
FOR CORE REPLACEMENT



SECTION THRU LAYUP
FOR CORE REPLACEMENT

Application of Pressure During Cure - 250 Degrees F (121 Degrees C) Cure
Figure 3 (Sheet 2 of 2)

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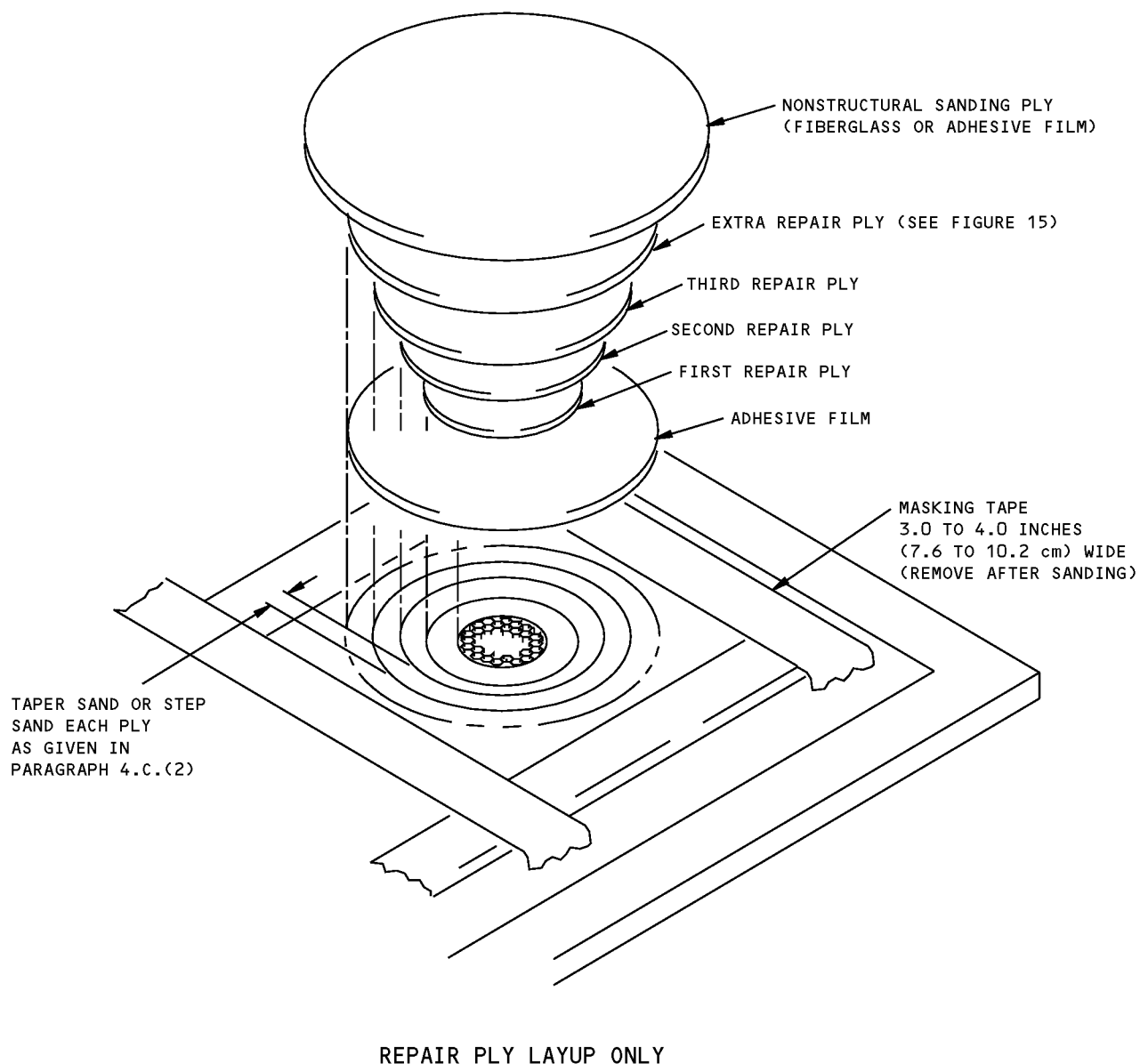


NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE
- [A] THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

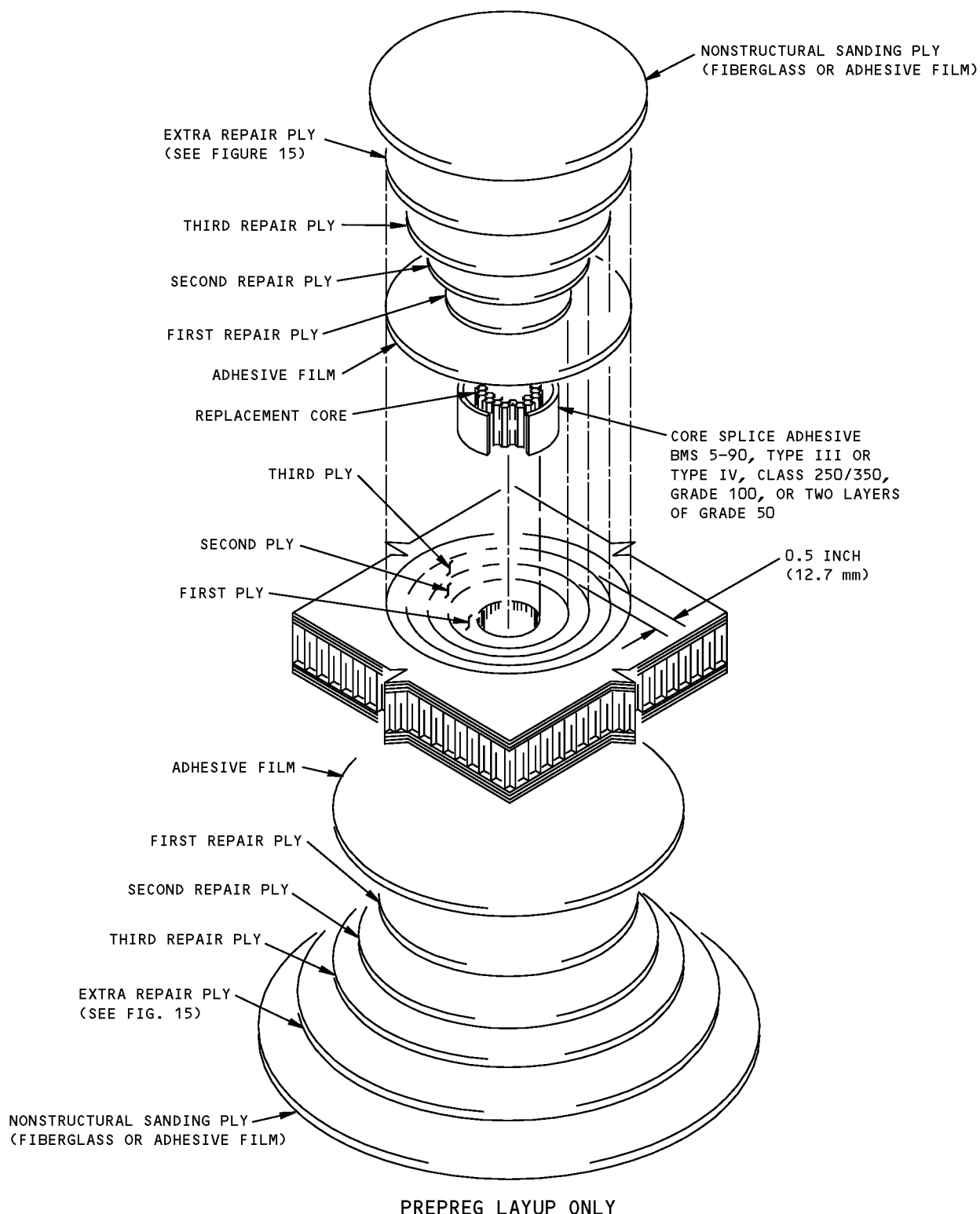
**Potting and Laminating Resin Cure Temperature
Figure 4**

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STRUCTURAL REPAIR MANUAL



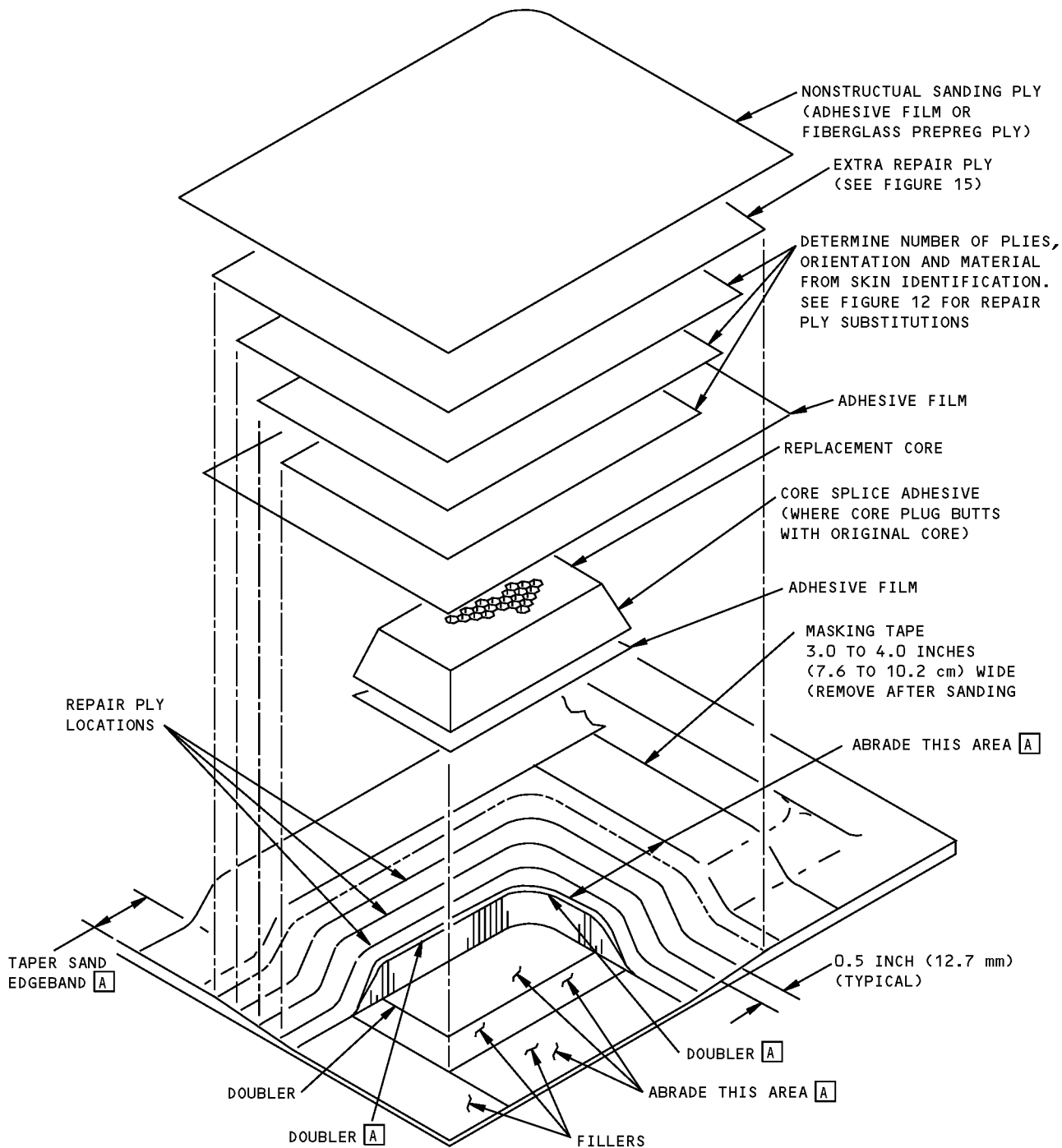
Repair of Damaged External or Internal Skins of a Sandwich Panel - 250 Degrees F (121 Degrees C) Cure
Figure 5

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STRUCTURAL REPAIR MANUAL**



**Repair of Large Punctures Thru Both Skins of a Sandwich Panel Including Core Damage - 250 Degrees F (121 Degrees C) Cure
Figure 6**

757-200 STRUCTURAL REPAIR MANUAL



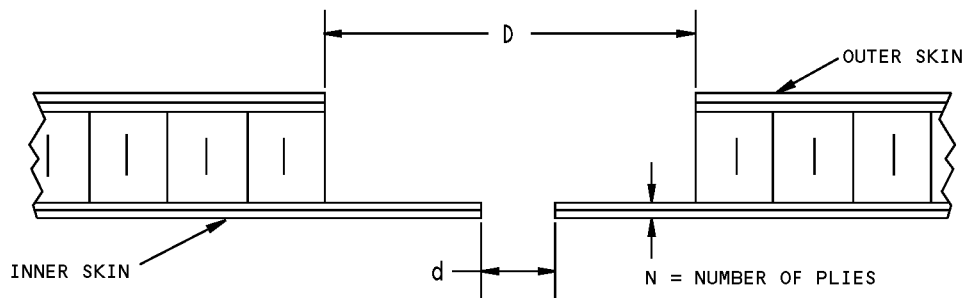
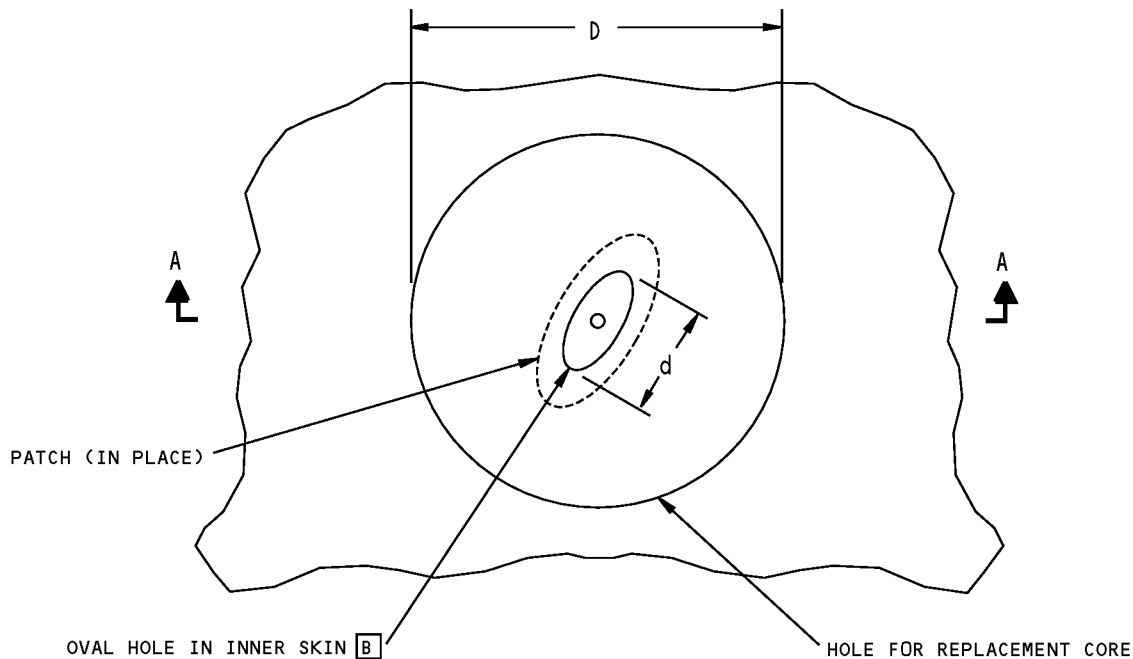
NOTES

PREPREG LAYUP ONLY

- [A] TAPER SANDING IS OPTIONAL TO JUST ABRADING THE SURFACE OF THE SKIN AND DOUBLER PLIES ABOVE AND BELOW THE HONEYCOMB CORE. HOWEVER, TAPER SANDING IS REQUIRED ON THE EDGE BAND

**Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel - 250 Degrees F (121 Degrees C) Cure
Figure 7**

757-200 STRUCTURAL REPAIR MANUAL



SECTION A-A
(PATCH NOT SHOWN)

DETAIL I

NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
- $D = d + \{N \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}]\} + 1.0 \text{ INCH (25.4 mm)}$
- d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN. SIZE LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR
- N = NUMBER OF PLIES
- D = DIAMETER OF HOLE FOR REPLACEMENT CORE

EXAMPLE:

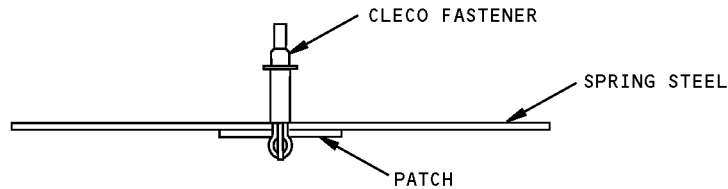
IF $d = 0.5 \text{ INCH (12.7 mm)}$
 THEN, $D = 0.5 \text{ INCH (12.7 mm)} + \{[2 \text{ PLIES}] \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}]\} + 1.0 \text{ INCH (25.4 mm)}$
 $D = 3.50 \text{ INCHES (88.9 mm) DIAMETER}$

- A** MAKE TAPER AND OVERLAP PER FIGURE 13
- B** MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR

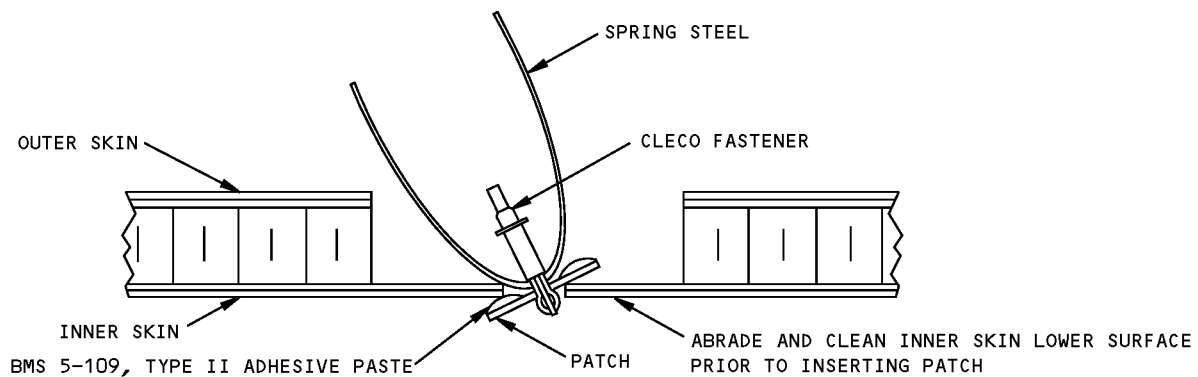
Repair of Damage to External and Internal Skins with Access Limited to One Side - 250 Degrees F (121 Degrees C) Cure

Figure 8 (Sheet 1 of 3)

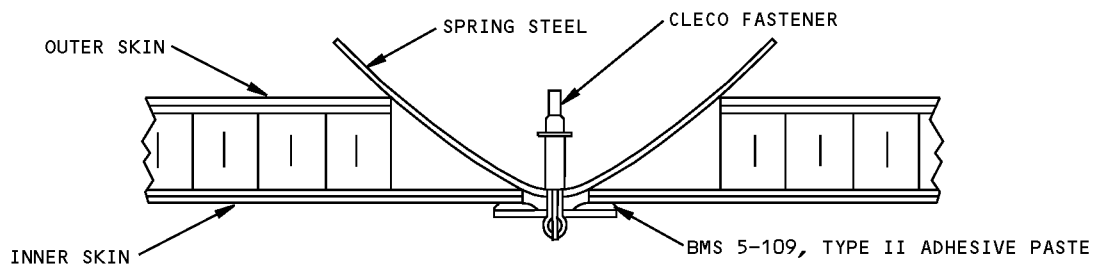
757-200 STRUCTURAL REPAIR MANUAL



ASSEMBLE PATCH AND SPRING STEEL
DETAIL II



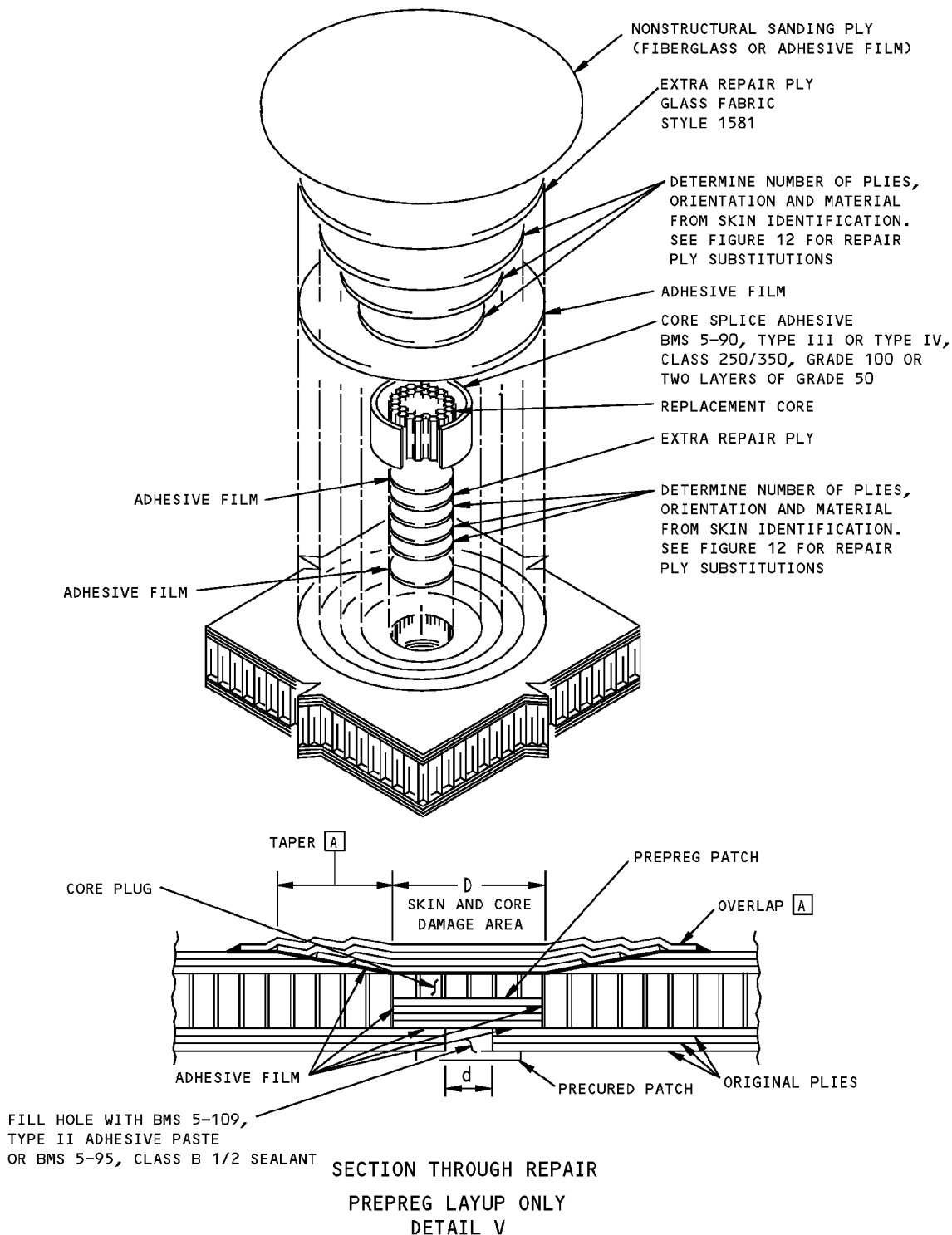
INSERT PATCH INTO OVAL HOLE
DETAIL III



HOLD PATCH IN PLACE WHILE CURING
DETAIL IV

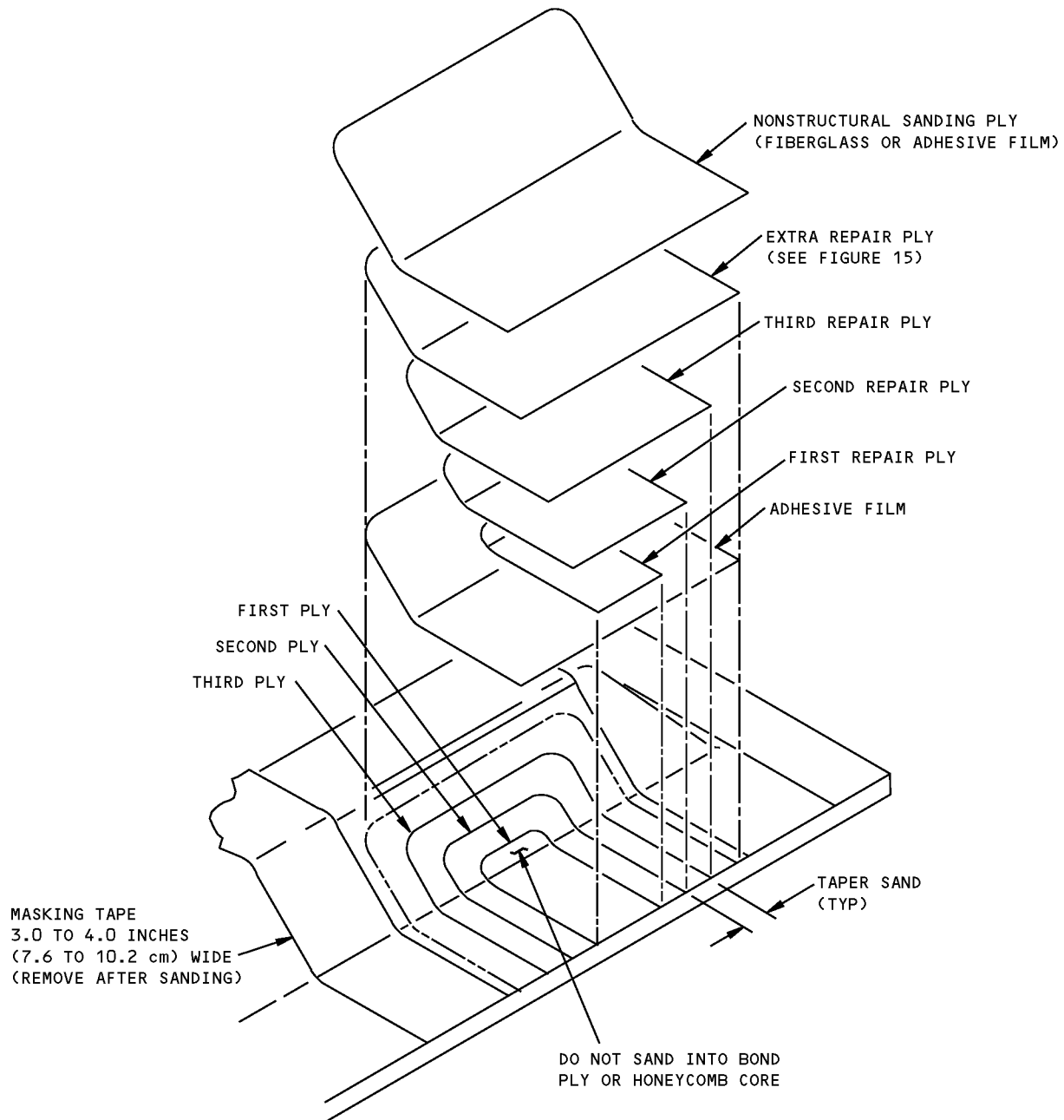
Repair of Damage to External and Internal Skins with Access Limited to One Side - 250 Degrees F (121 Degrees C) Cure
Figure 8 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



Repair of Damage to External and Internal Skins with Access Limited to One Side - 250 Degrees F (121 Degrees
C) Cure
Figure 8 (Sheet 3 of 3)

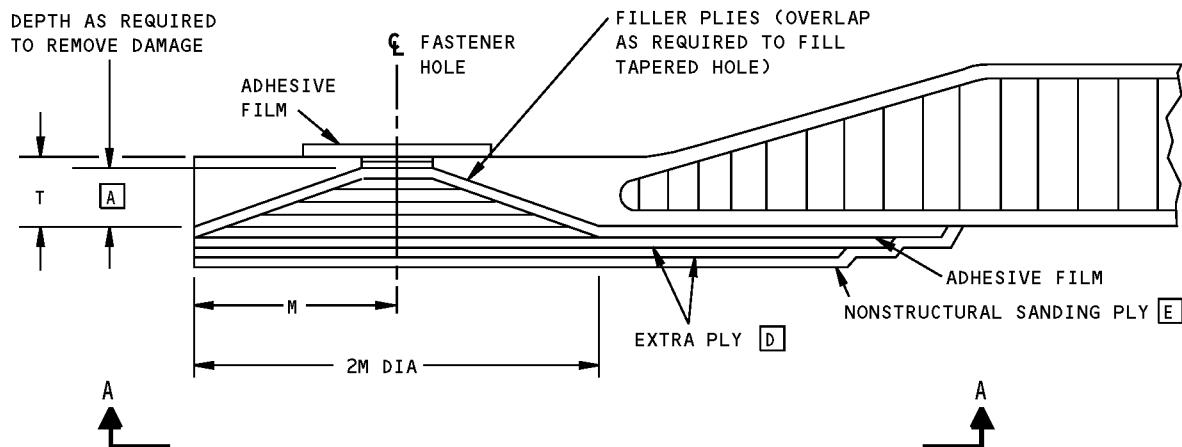
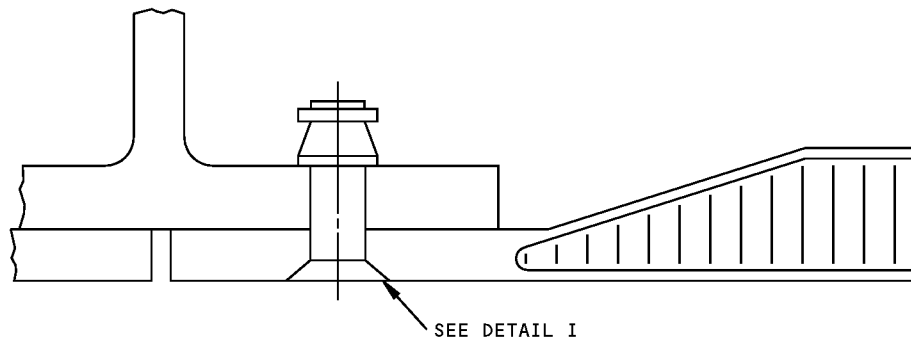
757-200
STRUCTURAL REPAIR MANUAL



PREPREG LAYUP ONLY

Repair of Damaged Skin Plies On A Panel Edge - 250 Degrees F (121 Degrees C) Cure
Figure 9

757-200 STRUCTURAL REPAIR MANUAL



DETAIL I

NOTES

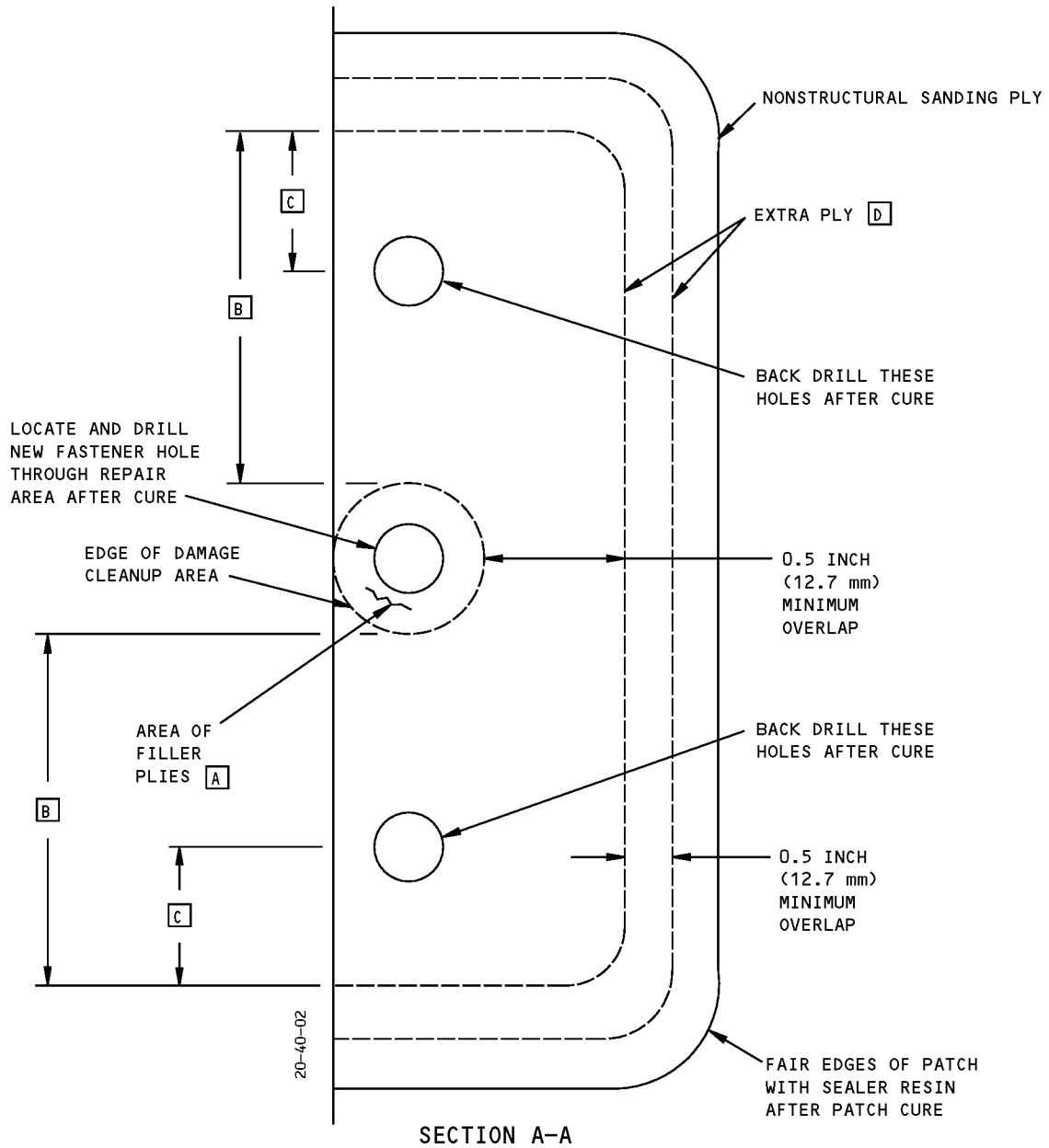
- D EQUALS FASTENER DIAMETER
- $M = 5T$ MAXIMUM AS SHOWN WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE.
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES.

[A] APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA.

- [B]** EXTEND FIRST EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF DAMAGED AREA.
- [C]** EXTEND FIRST EXTRA PLY FAR ENOUGH TO PROVIDE AT LEAST 2D EDGE MARGIN.
- [D]** ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER (SEE FIG. 15).
- [E]** FIBERGLASS PREPREG BMS 8-79 OR ADHESIVE FILM BMS 5-129, TYPE 2 OR 4, GRADE 10.

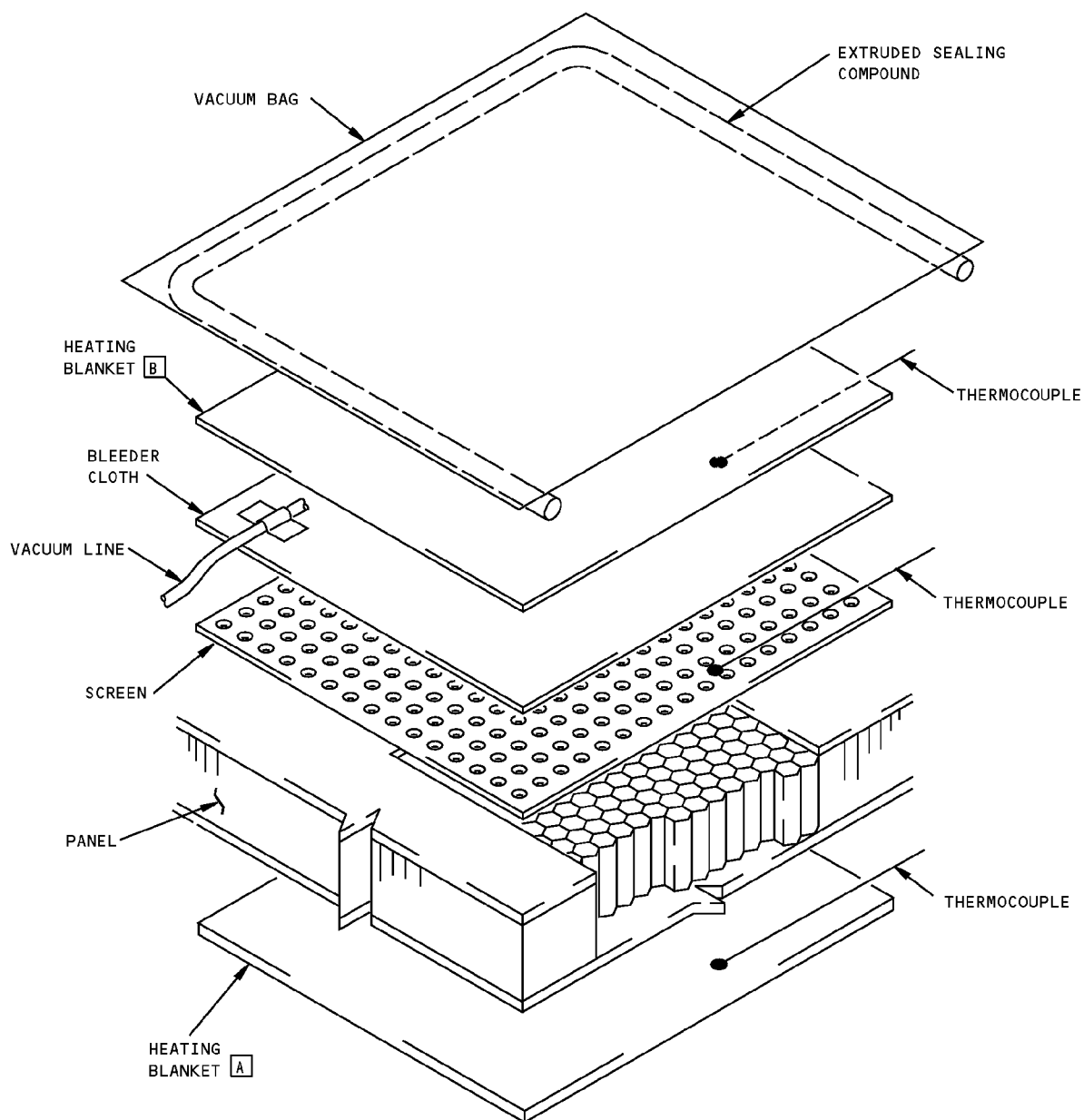
Repair of Damaged Panel Attach Hole - 250 Degrees F (121 Degrees C) Cure
Figure 10 (Sheet 1 of 2)

757-200
STRUCTURAL REPAIR MANUAL



Repair of Damaged Panel Attach Hole - 250 Degrees F (121 Degrees C) Cure
Figure 10 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL



NOTES

- [A]** PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B]** ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

Water Removal From Honeycomb Sandwich
Figure 11



757-200
STRUCTURAL REPAIR MANUAL

BMS 8-79 TYPE	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS
120 A	RED	0.004-0.006	_____
1581 A	RED	0.008-0.012	BMS 8-79, TYPE 120 A
7781 A	RED	0.008-0.011	BMS 8-79, TYPE 120 A

BMS 8-79 GLASS FABRIC PREPREG DATA

BMS 8-219 TYPE	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS
120 B	LT BLUE	0.0041	BMS 8-79, TYPE 120 B
285 B	GREEN	0.010	BMS 8-79, TYPE 1581 OR BMS 8-79, TYPE 7781 B

BMS 8-219 ARAMID FABRIC PREPREG DATA

NOTES:

- A** TYPE 1581 AND 7781 ARE PREFERRED FOR USE AS REPAIR PLIES. THREE PLIES OF TYPE 120 MAY BE SUBSTITUTED FOR EACH PLY OF TYPE 1581 OR 7781
- B** ONE PLY OF BMS 8-79, TYPE 120 MAY BE USED FOR EACH PLY OF BMS 8-219, STYLE 120 AND ONE PLY OF BMS 8-79, TYPE 1581 OR 7781 MAY BE USED FOR EACH PLY OF BMS 8-219, STYLE 285

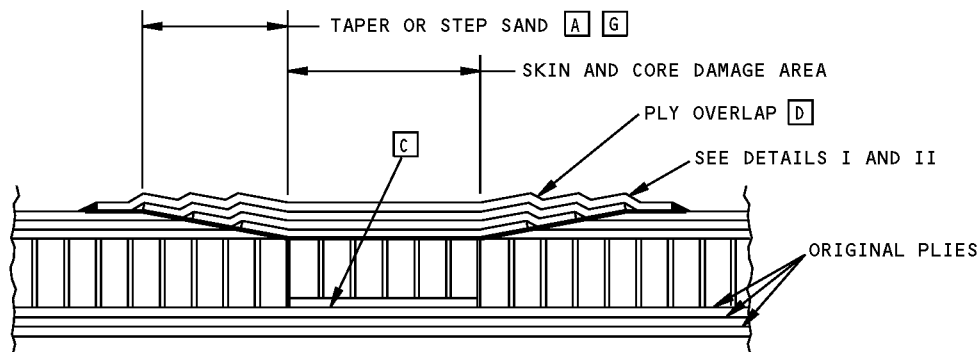
CAUTION: GLASS FABRIC MUST NOT BE SUBSTITUTED
FOR GRAPHITE PREPREG REPAIR PLIES.

ORIGINAL MATERIAL	SUBSTITUTE MATERIAL
CLASS 1, GRADE 95 TAPE	1 PLY CLASS 2, STYLE 3K-70-PW FABRIC
CLASS 1, GRADE 145 AND GRADE 190 TAPE	2 PLIES GRADE 95 TAPE OR 2 PLIES CLASS 2, STYLE 3K-70-PW FABRIC
CLASS 2, STYLE 3K-135-8H FABRIC	2 PLIES 3K-70-PW FABRIC

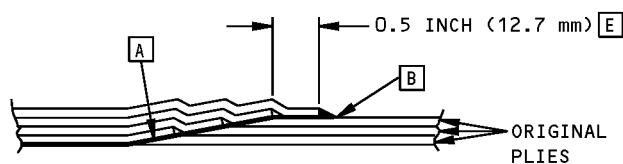
BMS 8-168 GRAPHITE SUBSTITUTION DATA

Prepreg Fabric Ply Substitution Data
Figure 12

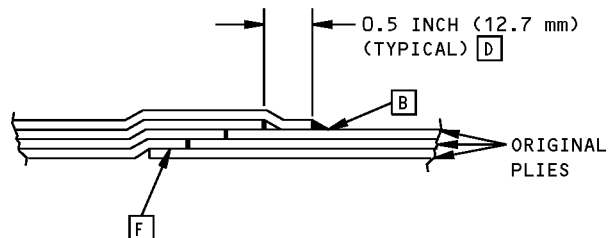
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(PREPREG LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



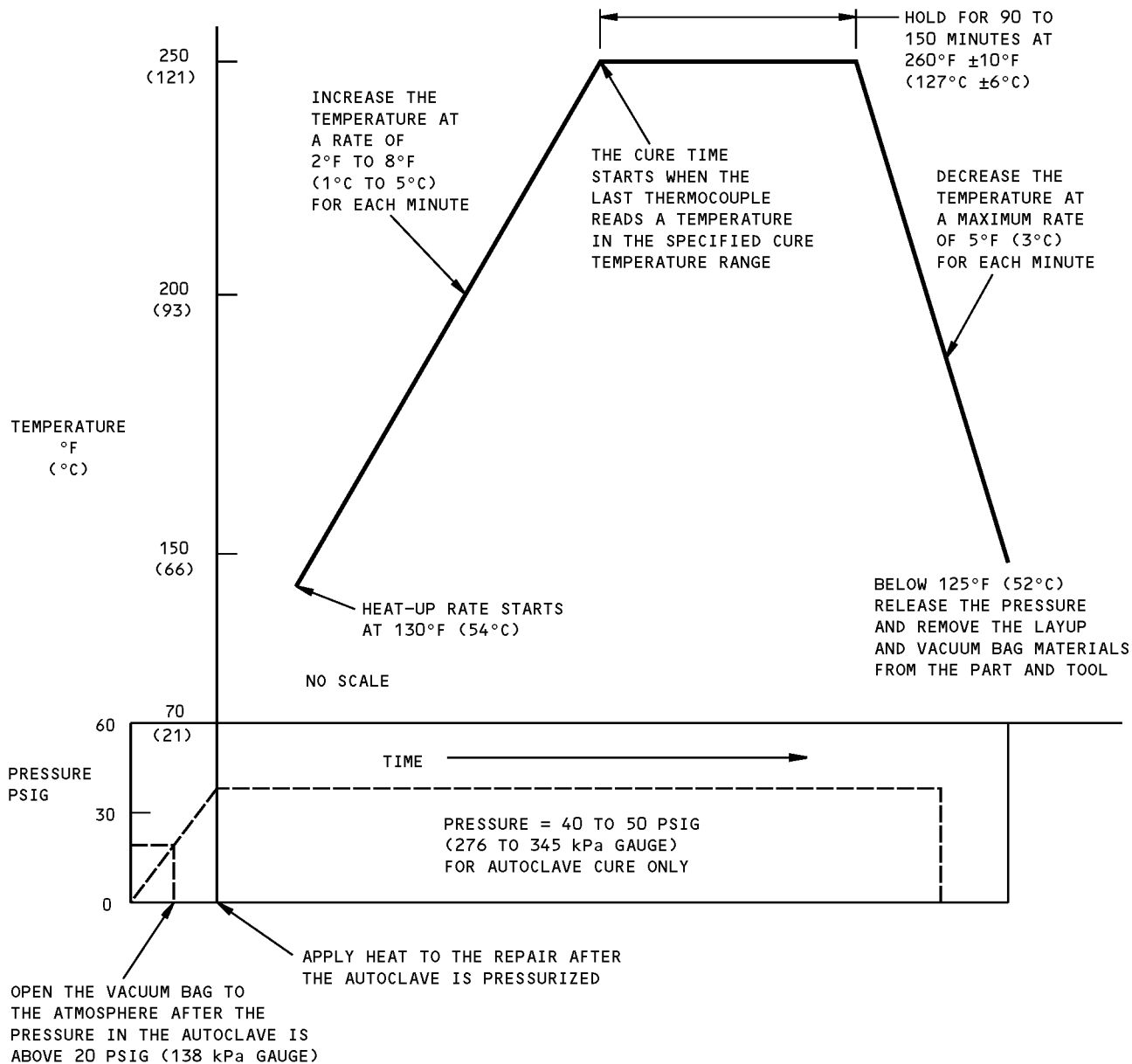
STEP SANDED SKIN
DETAIL II

NOTES

- | | |
|---|--|
| <p>A TAPER SAND AROUND REPAIR AREA OVER DISTANCE OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>B DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING</p> <p>C SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)</p> <p>D EXTRA PLY MUST OVERLAP AT LEAST 0.5 INCH (12.7 mm). EACH SUCCEEDING PLY MUST OVERLAP AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF PRECEEDING PLY PRECEEDING PLY</p> | <p>E SURFACE PLY FAYING SURFACE MUST BE AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF TAPER</p> <p>F REMOVE DAMAGED PLIES IN STEPS OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>G TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO SRM 51-10-01</p> |
|---|--|

Sanding and Overlap Requirements
Figure 13

757-200 STRUCTURAL REPAIR MANUAL



NOTES

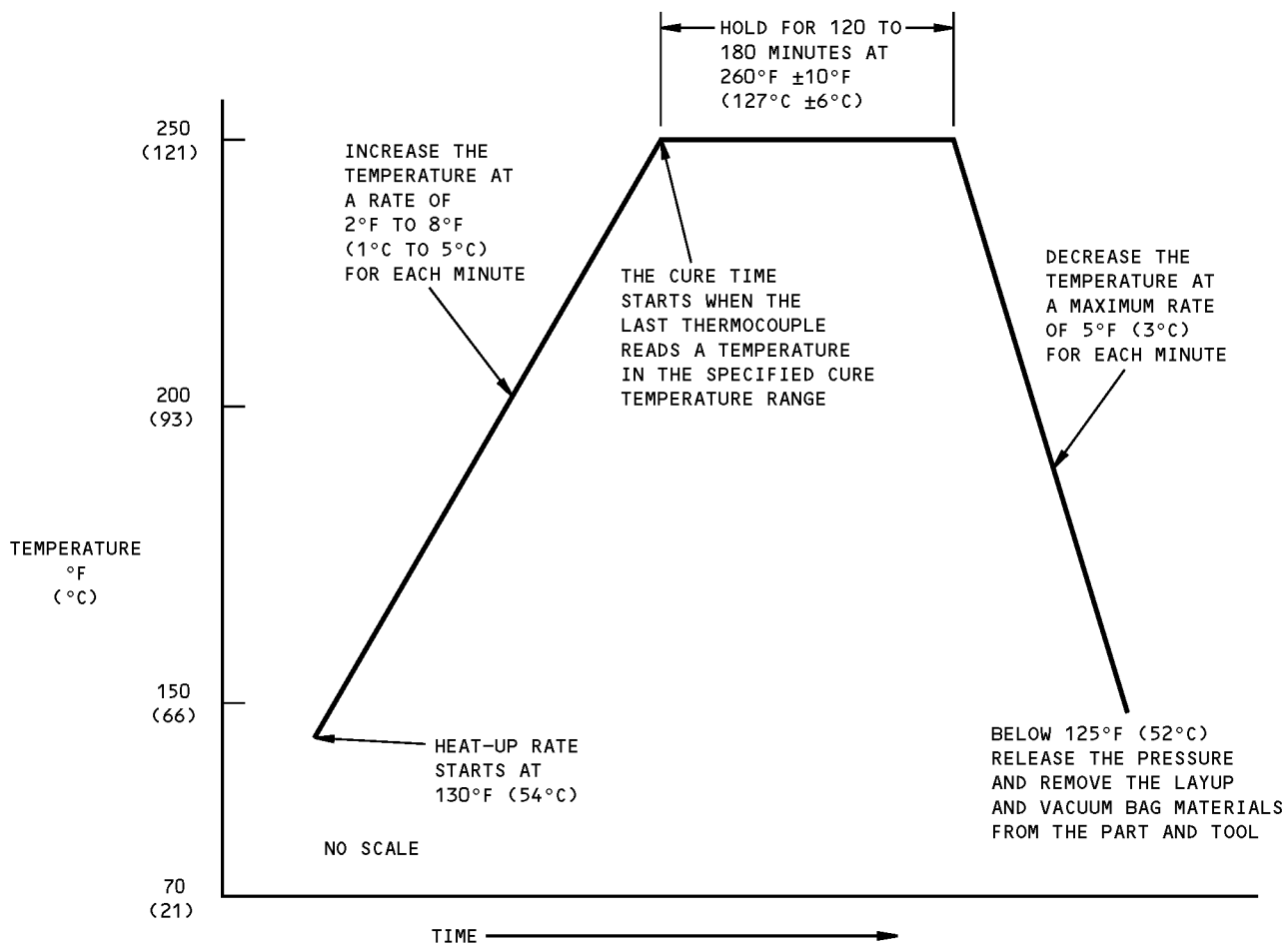
- FOR THE OVEN CURE, KEEP A MINIMUM VACUUM OF 22 INCHES OF MERCURY (75 kPa) DURING THE FULL CURE CYCLE.

250°F (121°C) AUTOCLAVE OR OVEN CURE CYCLE

DETAIL I

Repair Cure Cycles
Figure 14 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- KEEP A MINIMUM VACUUM OF 22 INCHES OF MERCURY (75 kPa) DURING THE FULL CURE CYCLE.

250°F (121°C) HEAT BLANKET CURE CYCLE

DETAIL II

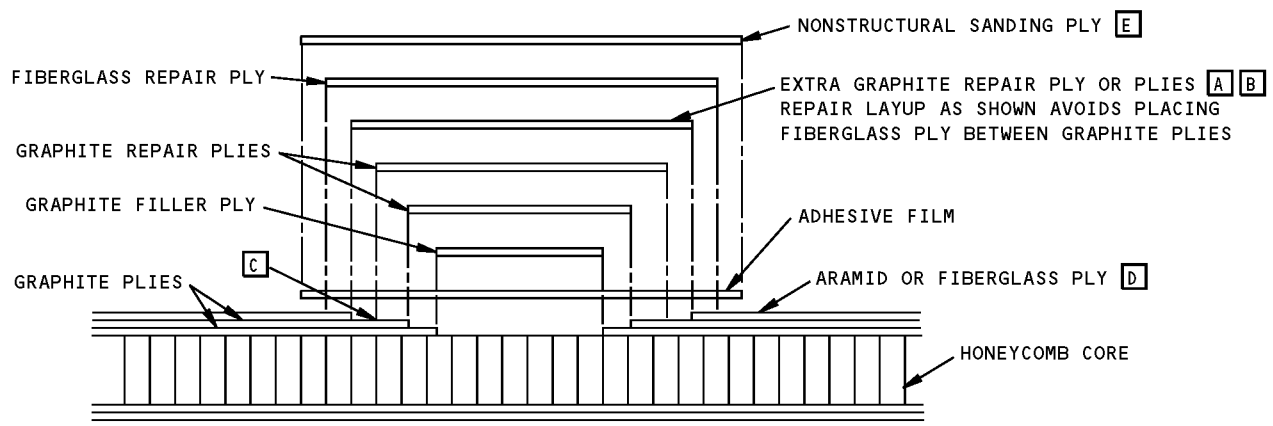
Repair Cure Cycles
Figure 14 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL

COMPONENT MATERIAL	EXTRA PLY MATERIAL B
GRAPHITE	GRAPHITE FABRIC, STYLE 3K-70-PW
GRAPHITE/ARAMID/GLASS	GRAPHITE FABRIC, STYLE 3K-70-PW A
ARAMID	GLASS FABRIC, STYLE 120 OR 1581
FIBERGLASS	GLASS FABRIC, STYLE 120 OR 1581

NOTES

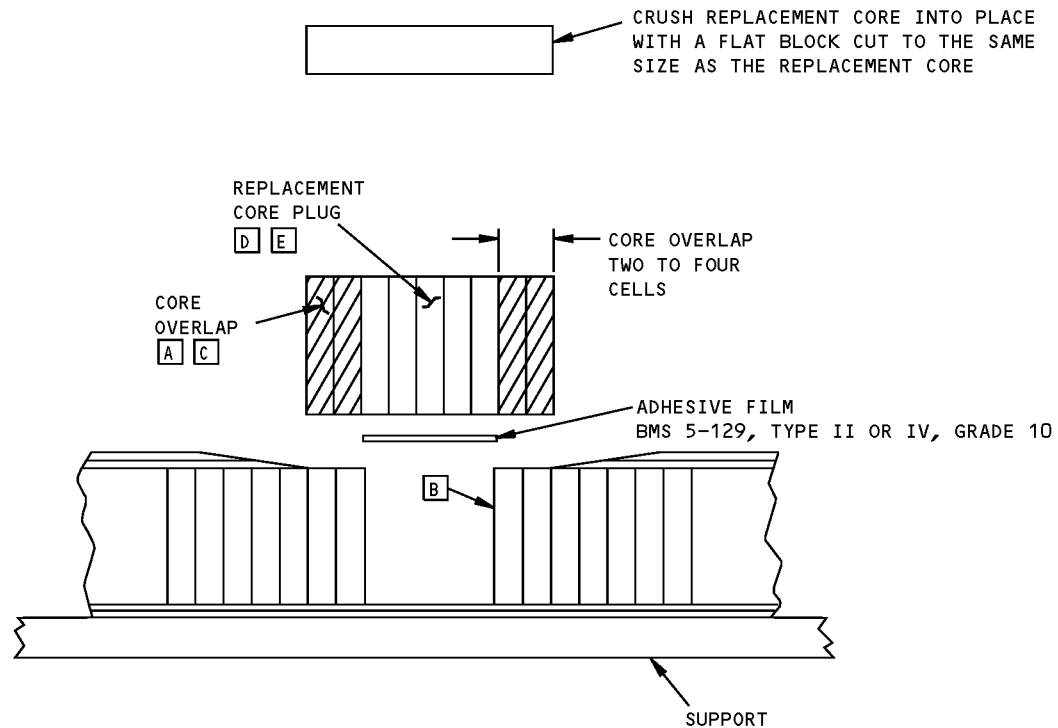
- | | |
|---|--|
| <p>A ON HYBRID PANELS, GRAPHITE EXTRA PLIES MUST BE BONDED TO GRAPHITE PLY. SEE DETAIL I.</p> <p>B THE ORIENTATIONS OF THE EXTRA REPAIR PLIES MUST REPEAT THE ORIENTATIONS OF THE EXISTING PLIES IN THE ORIGINAL LAMINATE, STARTING WITH THE OUTERMOST PLY.</p> | <p>C WHEN EXTRA GRAPHITE REPAIR PLY OR PLIES ARE REQUIRED, THE EXISTING OUTER PLY OF ARAMID, ALUMINUM COATED FIBERGLASS OR FIBERGLASS MUST BE SANDED TO ALLOW AN ADDITIONAL OVERLAP OF 0.5 INCH (12.7 mm) EACH EXTRA REPAIR PLY.</p> <p>D IF OUTER PLY CONSISTS OF ALUMINUM COATED FIBERGLASS OR OTHER CONDUCTIVE COATING, REFER TO SRM 51-70-14, SRM 51-70-04 OR FIG. 17 AS APPLICABLE FOR REPAIR OF THE CONDUCTIVE COATING.</p> <p>E FIBERGLASS PREPREG BMS 8-79 OR ADHESIVE FILM BMS 5-129, TYPE 2 OR 4, GRADE 10. SEE TEXT PAR. 4.E.(4)(b).</p> |
|---|--|



SECTION THRU HYBRID HONEYCOMB SANDWICH
DETAIL I

Extra Repair Ply Material
Figure 15

757-200 STRUCTURAL REPAIR MANUAL

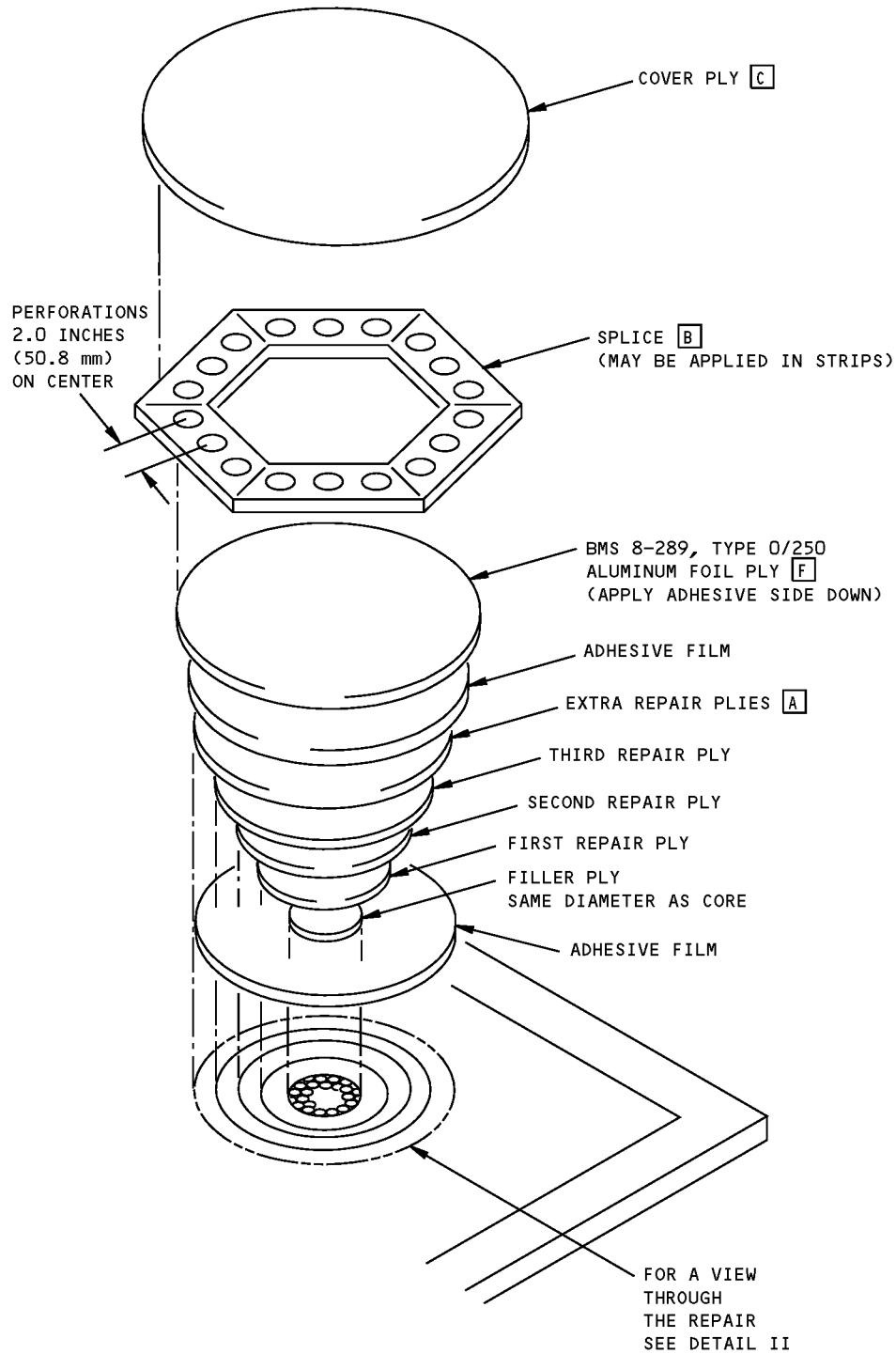


NOTES

- [A] WHEN CRUSH SPLICING CORE 1.0 INCH (25.4 mm) OR THICKER, THE JOINT MAY BE CHAMFERED.
- [B] PRIOR TO SPLICING, CORE MAY BE STABILIZED WITH SC1008 PHENOLIC RESIN. LIMIT RESIN APPLICATION TO A MAXIMUM OF 1.0 INCH (25.4 mm) BEYOND THE EDGE CORE THAT IS TO BE SPLICED. THINNING RESIN WITH ACETONE IS PERMITTED.
- [C] USE BMS 8-301, CLASS 2 OR BMS 8-214 EPOXY RESIN AFTER SPLICING TO KEEP THE SPLICE FROM SEPERATING.
- [D] ALIGN HONEYCOMB CELLS OF REPAIR PLUG WITH ORIGINAL CORE.
- [E] REPLACEMENT CORE PLUG MUST BE MADE FROM CORE MATERIAL A MAXIMUM OF TWO GRADES DENSER THAN THE ORIGINAL CORE.

**Core Crush Splicing Requirements - 250 Degrees F (121 Degrees C) Core
Figure 16**

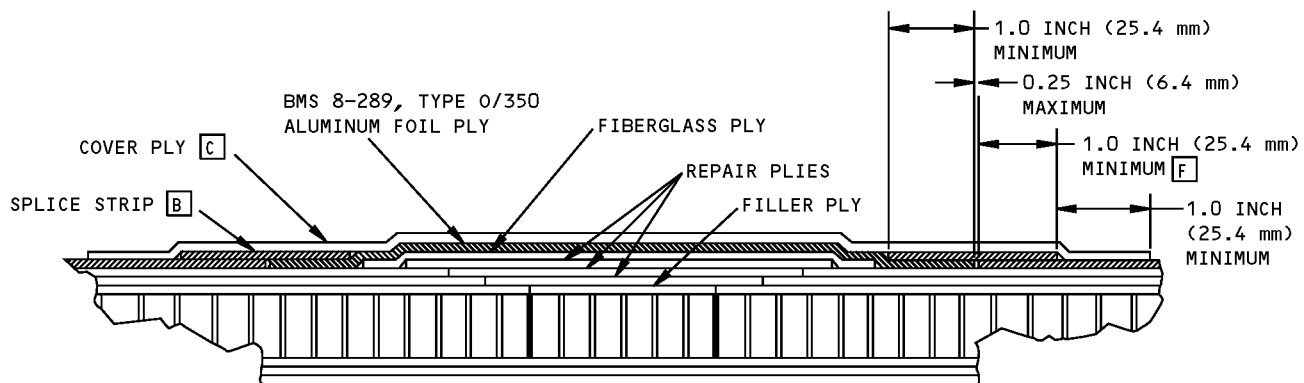
757-200
STRUCTURAL REPAIR MANUAL



**REPAIR PLY LAYUP
DETAIL I**

**Repairs to Aluminum Foil
Figure 17 (Sheet 1 of 2)**

757-200 STRUCTURAL REPAIR MANUAL



VIEW THRU REPAIR
DETAIL II

MATERIAL	SHIPPING AND STORAGE LIFE		SHELF LIFE [D]	
	MAXIMUM TEMPERATURE [E]	DURATION	MAXIMUM TEMPERATURE	DURATION HOURS
BMS 8-289 TYPE 0/250 GRADE A	10 (-12°C)	180 DAYS	95°F (35°C)	240
BMS 8-289 TYPE 0/250 GRADE B	95°F (35°C)	5 YEARS	95°F (35°C)	NO LIMIT

STORAGE AND SHELF LIFE OF BMS 8-289
TABLE I

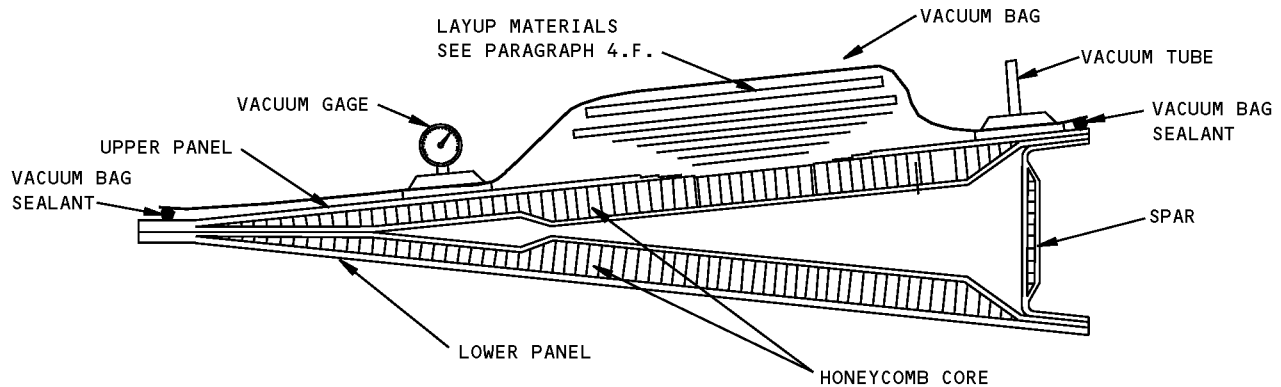
NOTES

- [A] SEE INDIVIDUAL COMPONENT REPAIR SECTION FOR EXTRA REPAIR PLY REQUIREMENTS. ALL STRUCTURE HAVING AN ALUMINUM FOIL LAYER MUST HAVE A FIBERGLASS PLY TO WHICH THE FOIL IS BONDED. IF A FIBERGLASS EXTRA REPAIR PLY IS NOT REQUIRED BY THE INDIVIDUAL COMPONENT REPAIR SECTION, ONE MUST BE INSTALLED AS THE OUTERMOST PLY.
- [B] BMS 8-289, TYPE 0/250, FORM II APPLIED ADHESIVE SIDE UP OR FORM I CHEMICAL CONVERSION COATED ON THE NONADHESIVE SIDE. PERFORATE FORM I WITH 0.5 INCH (12.7 mm) DIAMETER HOLES ON 2.0 INCH (50.8 mm) CENTERS.

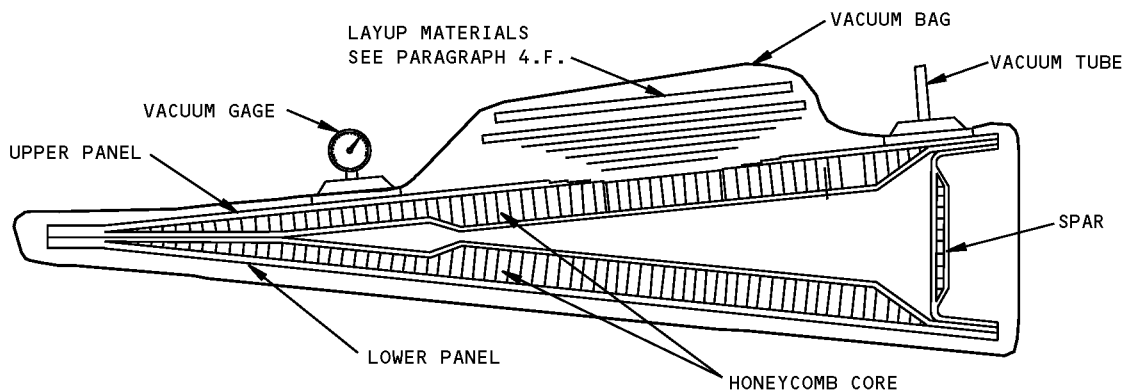
- [C] BMS 8-79, STYLE 120,1581, OR 7781 GLASS FABRIC WITH BMS 5-129, TYPE 2 OR 4, GRADE 10 ADHESIVE FILM UNDERNEATH.
- [D] SHELF LIFE HOURS ACCUMULATE FROM THE DATE OF REMOVAL FROM REFRIGERATION UNTIL START OF THE REPAIR CURE CYCLE.
- [E] STORAGE LIFE SHALL BE AS SHOWN IN TABLE I UNLESS PRODUCT IS GUARANTEED BY THE SUPPLIER FOR 360 DAYS STORAGE AT 95°F (35°C).
- [F] CHEMICAL CONVERSION COAT THE EXISTING ALUMINUM FOIL.

Repairs to Aluminum Foil
Figure 17 (Sheet 2 of 2)

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ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



NOT ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART
MAY CAUSE ASSEMBLY DISTORTION DURING CURE CYCLE

PARTS CONSISTING OF UPPER AND LOWER PANELS A

NOTES

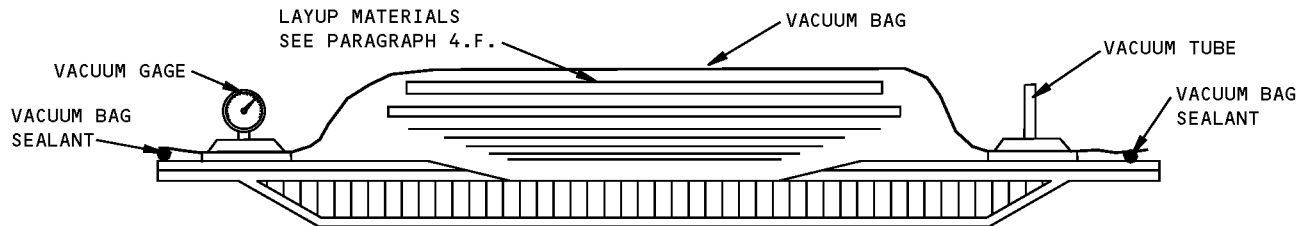
- REFER TO PARAGRAPH 4.F. FOR LAYUP AND BAGGING PROCEDURES

A THIS TYPE OF COMPONENT MUST NOT BE COMPLETELY SEALED IN A VACUUM BAG. DAMAGE TO PART WILL OCCUR. VACUUM BAG ONE SIDE OF COMPONENT ONLY

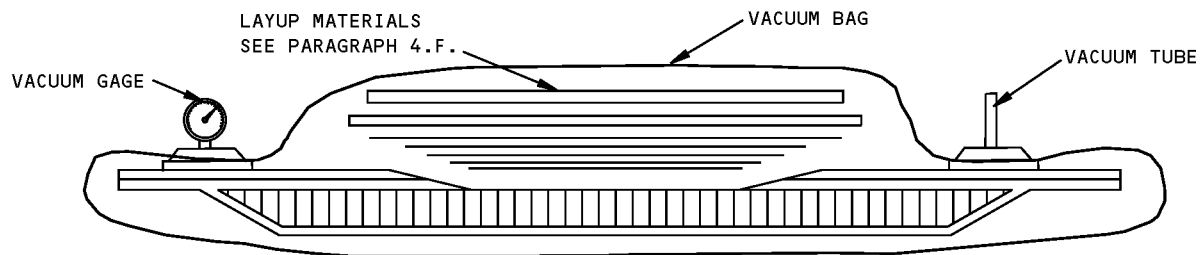
B THIS TYPE OF COMPONENT MAY BE COMPLETELY SEALED IN A VACUUM BAG OR MAY BE SEALED ON ONE SIDE ONLY

Vacuum Bagging Restrictions Figure 18 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**



ACCEPTABLE - VACUUM BAG SEALED TO ONE SIDE ONLY



ACCEPTABLE - VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

**Vacuum Bagging Restrictions
Figure 18 (Sheet 2 of 2)**



757-200

STRUCTURAL REPAIR MANUAL

GENERAL - GLASS FABRIC REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH REPAIRS - ROOM TEMPERATURE/150°F (66°C) CURE (WET LAYUP)

1. Applicability

CAUTION: TO GET AN ACCEPTABLE QUALITY REPAIR, DO AS FOLLOWS:

- REFER TO THE APPLICABLE COMPONENT WHICH YOU ARE GOING TO REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE YOU USE THESE REPAIR INSTRUCTIONS.
- USE THE CORRECT MATERIALS FOR THE TYPE OF COMPONENT AND REPAIR THAT IS MADE.
- USE THE MATERIALS THAT AGREE WITH THE SPECIFICATIONS IN THE SRM.
- ACCURATELY FOLLOW THE SRM PROCEDURES AT EACH STEP OF THE REPAIR. IF YOU DO NOT DO THIS, IT CAN CAUSE A REPAIR THAT IS NOT SATISFACTORY AND IS NOT APPROVED.

ROOM TEMPERATURE/150°F (66°C) CURE REPAIRS WILL NOT RESTORE EITHER THE STRENGTH OR THE DURABILITY OF THE ORIGINAL 250°F (121°C) OR 350°F (177°C) CURE COMPONENTS. FOR SIZE AND LIMITS OF SUCH REPAIRS, SEE APPLICABLE REPAIR.

ROOM TEMPERATURE/150°F (66°C) REPAIRS MUST NOT BE USED IN STRESS CRITICAL AREAS OF PRIMARY STRUCTURE COMPONENTS. FAILURE TO COMPLY WOULD RESULT IN AN INADEQUATE REPAIR.

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of fiberglass fabric. The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands and at fitting locations. Glass fabric is also known as fiberglass cloth. This section describes repairs made using room temperature/150°F (66°C) cure materials (wet layup).

NOTE: The repairs called for herein are wet layup repairs. Wet layup repairs require rapid use of catalyzed resin materials. Wet layup will not return the structure to its original strength or durability. A periodic inspection plan for the repaired area may be required. For size and limits of such repairs, see applicable repair.

The repairs in this subject are room temperature/150°F (66°C) repairs, the cure of which maybe accelerated by the application of heat as specified herein. To obtain maximum properties, cure repair at 150°F (66°C).

- B. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage
Paragraph 4.B./GENERAL	Remove Water From Damaged Area and Dry Out Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area

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Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedures
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 5.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.H./GENERAL	Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Punctures, 0.50 in. (12.7 mm) Diameter or Less, in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Laminated Panels
Paragraph 5.L./GENERAL	Repair of Surface Dents
Paragraph 5.M./GENERAL	Repair of Lightning Strike Damage
Paragraph 5.N./GENERAL	Repair of Small Damage to One Skin
Paragraph 5.O./GENERAL	Repair of Erosion Damage to Panel Edges

2. General

WARNING: KEEP THE SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS. IF YOU DO NOT, AN EXPLOSION CAN OCCUR.

DO NOT PERMIT THE SOLVENTS TO TOUCH YOUR SKIN, EYES OR CLOTHING. DO NOT BREATHE THE VAPORS. WEAR PROTECTIVE CLOTHING AND EYE PROTECTION. MAKE SURE THERE IS A GOOD FLOW OF CLEAN AIR. IN A CONFINED SPACE, USE MECHANICAL VENTILATION FOR RESPIRATORY PROTECTION. INJURY TO PERSONS CAN OCCUR.

- A. Specific allowable damage, repair limitations, and repair data, can be found in the chapter/section/subject associated with each structural component.
- B. Use suitable holding fixtures for large repairs to prevent distortion of the structure.
- C. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.



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- D. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- E. Store resin and/or adhesive material at 40° to 80°F (4° to 27°C) in sealed containers. An identification label must accompany the material inside the bag, with the following information: BMS Type, Class, Grade, supplier name, batch number, and date of preparation.
- F. Refer to 51-70-02, GENERAL for the locations of principal composite components.
- G. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- H. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
- I. Refer to 51-30-06, GENERAL for composite repair material ordering data.
- J. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- K. Restore aluminum flame spray per 51-70-14, GENERAL.
- L. Repair damage to aluminum foil per 51-70-14, GENERAL.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-05, GENERAL	Repair Sealing
51-30	REPAIR MATERIALS
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-60	CONTROL SURFACE BALANCING
51-70-02, GENERAL	Locations of the Principal Composite Components
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Repair Procedures Common to Various Repairs

- A. Determine Damage.

CAUTION: DO NOT USE CHEMICAL PAINT STRIPPERS TO REMOVE PAINT BEFORE YOU FIND THE RANGE OF THE DAMAGE. CHEMICAL PAINT STRIPPERS WILL CAUSE DAMAGE TO THE RESIN SYSTEM.

- (1) Examine the area visually to find the range of the damage.
- (2) Examine the area around the damage for the entry of water, oil, fuel, dirt or other unwanted material. You can find if there is water in the damaged area with radiographic or thermographic inspection procedures. Remove the unwanted material from the damaged area.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental nondestructive inspection (NDI) methods or by tap test. For the tap test, use a solid metal disk and tap the repair area lightly, but firmly. Void areas will give a dull sound. Solidly bonded areas will give a sharp ring. Refer to NDT Part 1, 51-05-01.

- B. Remove Water From Damaged Area and Dry Out Damaged Area.

STRUCTURAL REPAIR MANUAL

- (1) Remove water from honeycomb sandwich (Figure 11/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum or oil-free compressed air.
 - (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
 - (c) Apply a fiberglass or metal fine mesh screen over exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
 - (g) If the far side is accessible, apply thermocouple and heating blanket to the far side of the honeycomb sandwich panel.

NOTE: If the far side is accessible, it is acceptable to heat the area using a heating blanket only on the far side. An additional heating blanket may be used on the near side at the location shown in Figure 11/GENERAL to accelerate water removal. If the far side is inaccessible, use of a heating blanket on the near side is required.

- (h) When the far side is inaccessible or when using an additional heating blanket, place the heating blanket over the bleeder cloth on the near side.
 - (i) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
 - (j) Evacuate the layup to a minimum 22 in/Hg (75 kPa) vacuum.
 - (k) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
 - (l) Remove layup materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
 - (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
 - (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

C. Remove Damage and Prepare Damaged Area

- (1) Damage removal
 - (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.
- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. For crush splice repairs (Paragraph 4.D./GENERAL) leave one to three core cells (0.4 in. (10.2 mm) maximum) visible between core cavity and skin (Figure 18/GENERAL). The core area removed should extend at least 0.5 in. (12.7 mm) further than the visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side. In cores greater than 1.0 in. (25.4 mm) thick, partially remove core (at least 0.5 in. (12.7 mm) deep) sufficient to clean up damage.

NOTE: When a potted core repair is to be made, removal of damaged core is not required.

STRUCTURAL REPAIR MANUAL

- (c) In areas, where contamination cannot be removed by cleaning or drying per Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 4.C.(1)(a)/GENERAL.
- (e) When core is removed from the inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 9/GENERAL AND FIGURE 14/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(2) Preparation of damaged area (Figure 14/GENERAL).

- (a) Determine the number and orientation of plies that have been cut. Mask off the area around the cleaned up damage allowing 1.0 in. (25.4 mm) overlap for each ply replacement, plus 1.0 in. (25.4 mm) extra for each extra ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the applicable structure identification or engineering drawing.

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
 - 1) Remove the paint finish or Tedlar film using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper in the masked off area.
 - 2) Taper sand each ply or simply abrade the surface around the cleaned up damage a minimum of 1.0 in. (25.4 mm) per ply. Refer to Figure 14/GENERAL.
 - 3) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
 - 4) Abrade surfaces around repair using No. 240 or finer Scotch-Brite abrasive.
- (c) External surface of panel (critical aerodynamic surfaces).

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- 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over an approximate distance of 1.0 in. (25.4 mm) for each existing ply of the laminate. Step sanding is optional to taper sanding on honeycomb sandwich structure in areas of noncritical aerodynamic smoothness. Refer to 51-10-01, GENERAL for locations of areas of critical aerodynamic smoothness. Always taper sand on solid laminate structures.

NOTE: For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.

- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 1.0 in. (25.4 mm) border using No. 150 or finer sandpaper.

(d) Edgeband of panel.

- 1) Taper sand panel edgeband according to Paragraph 4.C.(2)(c)/GENERAL.

NOTE: Edgeband is the solid laminate around the outer periphery of the honeycomb panel.

(e) Cleaning of repair area.

- 1) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/ SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

(1) Fabricate core plug.

- (a) Fabricate core plug. Refer to specific component structural identification section to determine type, class, and grade of the original core.
- (b) For butt splicing, the honeycomb core, plug should fit flush with original core and with ribbon direction the same as in original core. The replacement core must overlap enough to make contact with the cell walls of surrounding core material.
- (c) For crush splicing, the honeycomb core plug should be made two to four cells larger than the repair cavity and be made from core material which is a maximum of two grades denser than the original core (Figure 18/GENERAL).

NOTE: Crush splicing applies to fiberglass core (BMS 8-124, Class I) only.

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- (d) Trim core plug to full or partial depth of original core as given in Paragraph 4.C.(1)(b)/GENERAL and shown in Figure 2/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive between core plug and undamaged core or skin (Figure 2/GENERAL, Figure 3/GENERAL, Figure 8/GENERAL, Figure 14/GENERAL).

- (2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED THE IMMERSION CRITERIA THAT FOLLOWS. DAMAGE TO CORE MATERIAL WILL OCCUR.

DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99) bath for 60 seconds.
- (b) Locally contaminated areas can be wiped with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
- (c) The core must be completely dry, clean and free of evidence of solvents before installation.
- (3) Install core plug (Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, Figure 8/GENERAL).
- (a) If one skin is undamaged, cut two plies of BMS 9-3, Type H-2 or H-3 fiberglass fabric or four plies of BMS 9-3, Type D fiberglass fabric that will fit on the inside surface of the undamaged skin (Figure 2/GENERAL and Figure 14/GENERAL). Saturate the plies with Resin Mix 1, prepared as shown in Figure 1/GENERAL, then position in core cavity.
- (b) If both skins are damaged, tape a caul plate against the exterior surface of farside skin and repair as for damage to one skin only. Repair the far side skin in a subsequent repair cycle.
- (c) For butt splicing, spread Resin Mix 7, BMS 5-25, or BMS 5-92 on the edges of the replacement core and the undamaged core that will mate when the plug is installed. Orient ribbon in the direction of original core ribbon.
- (d) For crush splicing, prepare and install the core plug per Figure 18/GENERAL. Orient ribbon in the direction of original core ribbon.
- (e) Put the layup materials and equipment in place per Figure 3 (Sheet 2).
- (f) Evacuate the repair area to a minimum of 22 in/Hg (75 kPa) vacuum.
- (g) Cure per Figure 1/GENERAL.
- (h) Sand repair core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.

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- (i) Vacuum to remove sanding residue from core cells.

NOTE: The above procedure is based on the core plug installation being cured separately from the repair plies. As an option, core plug installation and repair plies may be cured at the same time.

E. Prepare and Apply Repair Plies.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

(1) Prepare glass fabric repair plies (BMS 9-3).

- (a) Refer to the component structure identification or engineering drawing to determine number, style, and orientation of glass fabric used in original structure. Repair existing Type 120 plies with Type D plies. Repair existing Type 1581 or 181 plies with Type H-2 plies. Repair existing Type 7781 plies with Type H-3 plies (Figure 13/GENERAL).
- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: Refer to Paragraph 4.E.(1)(c)/GENERAL below for substitution of repair ply fabrics.

Use one ply of glass fabric in the patch for each damaged ply of the original laminate, plus extra repair plies as required for specific repairs. Refer to specific structural component repair. If extra repair plies are not indicated by individual repair one extra ply is required and is to have the same orientation as the original surface ply.

- (c) Substitution of repair ply fabrics (Figure 13/GENERAL).
 - 1) Three plies of Type D glass fabric can be used for each ply of Type H-2 or Type H-3 required.
 - 2) One ply of Type H-3 can be used for each ply of Type H-2 required, and vice versa.
 - 3) One ply of Type H-2 or Type H-3 can be used for every two plies of Type D required.
- (d) Cut two pieces of parting film approximately 3.0 in. (7.6 cm) larger all around than the fabric and tape down one piece to a smooth surface.

NOTE: Use Teflon film or other parting films.

- (e) Spread Resin Mix 1, prepared as shown in Figure 1/GENERAL, over parting film and place the fabric over the resin mix.

NOTE: Weight of resin approximately equal to the weight of the dry fabric is required to impregnate the cloth.

- (f) Cover the fabric on the parting film with the second piece of parting film.
- (g) Press the resin through the fabric by working over the parting film with a squeegee or roller, in order to impregnate the fabric and to remove entrapped air.

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- (h) Cut the impregnated fabric to the required sizes for each individual ply of the patch. The parting film on both sides of the fabric decreases fraying of the edges while cutting the fabric.

NOTE: The total number of repair plies is to be in accordance with Paragraph 4.E.(1)/GENERAL. Refer to Figure 14/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired. The extra repair ply must be installed with the same orientation as the original surface ply. Other extra repair plies must be installed as specified in individual structural component repair sections.

- (2) Apply repair plies (Figure 2/GENERAL and Figure 14/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with filler plies before application of the repair plies.

CAUTION: ENSURE THAT PARTING FILM IS REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Apply a coat of Resin Mix 1, prepared as shown in Figure 1/GENERAL, over the repair area, both the sanded laminate and the exposed core.
- (b) Remove parting film from one side of the smallest ply of the patch and place the exposed face against the repair area with orientation as in original structure.
- (c) Use a squeegee over the parting film that covers the patch to remove wrinkles and entrapped air. Do not apply excessive pressure. Excessive pressure will produce a patch deficient in resin.
- (d) After removing parting film from the contact faces, place the next larger size ply of the impregnated patch over the ply on the repair area with proper orientation and with overlap all around per Figure 14/GENERAL.
- (e) Place succeeding plies of the patch as described in Paragraph 4.E.(2)(c)/GENERAL and Paragraph 4.E.(2)(d)/GENERAL.
- (f) After placing the last ply, cover the entire layup with a piece of perforated parting film extending about 0.5 in. (12.7 mm) over edges of the patch.
- (g) Sweep excess resin to edges of parting film thereby fairing the edges of the patch to the contour of the repair surface. All loose threads must be embedded in the resin.
- (h) Wipe off any excess resin that has been squeezed out at the edges of the parting film.
- (i) Remove parting film.

F. Layup/Bagging Procedure (Figure 3/GENERAL).

- (1) Place a layer of perforated FEP parting film (1 mil (0.025 mm) thick) over the repair. Cut the FEP so that the edges extend 3 in. (7.6 cm) beyond the edge of the repair patch.
- (2) Secure three thermocouples (spaced evenly around repair) to the panel at the edge of the repair and secure them to the appropriate recorders.
- (3) Place a layer of dry peel ply or Style 120 glass fabric (or equivalent thickness glass fabric) over the perforated FEP as a surface bleeder. Cut the surface bleeder so that the edges extend 2 in. (5 cm) beyond the edge of the perforated FEP.

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- (4) Place a layer of solid FEP parting film (2 mils (0.051 mm) thick) over the surface bleeder. Cut the solid FEP so that the edges are even with the edge of the perforated FEP.
- (5) Place a layer of Airweave SS or Style 120 glass fabric over the solid FEP as a surface breather. Cut the surface breather so that the edges extend to the edge of the surface bleeder. Make certain the surface breather makes contact with the surface bleeder along the edges.
- (6) Secure a vacuum line on the edge of the surface breather.

WARNING: FOR ACCELERATED CURE, USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- (7) If a heat blanket is used as a heat source, perform the following steps:

NOTE: A heat blanket, infrared heat lamp, or equivalent heat source may be used to accelerate the cure.

If the repair is made on a structure too small to allow the heat blanket to be vacuum bagged, proceed to Paragraph 4.F.(8)/GENERAL and place heat blanket over the vacuum bag. A second vacuum bag may then be placed over the part to hold the heat blanket in place.

- (a) Place a heat blanket over the surface breather. The heat blanket must extend a minimum of 2 in. (5 cm) beyond the repair patch edges.

NOTE: When using a heat blanket larger than 12 in. (30.5 cm) on one side, an aluminum caul plate (0.016 in. (0.4 mm) thick) can be used under the heat blanket to minimize localized heating. Make the caul plate slightly smaller than the surface breather.

- (b) Place controlling thermocouple over the center of the heat blanket.
- (c) Place 4 to 6 layers of glass fabric over the heat blanket. The glass fabric will insulate the heat blanket and prevent damage to the bagging film.
- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.

CAUTION: HOLLOW COMPOSITE COMPONENTS SUCH AS RUDDERS, ELEVATORS, AND AILERONS MUST NOT BE COMPLETELY VACUUM BAGGED BECAUSE THEY MAY COLLAPSE UNDER 22 IN/HG (75 KPA) VACUUM. ATTACH THE VACUUM BAG TO ONE SIDE OF COMPONENT ONLY OR ATTACH SEPARATE VACUUM BAGS TO EACH SIDE TO ENSURE THAT ATMOSPHERIC PRESSURE INSIDE OF THE COMPONENT IS MAINTAINED DURING REPAIR. COMPONENTS CONSISTING OF A SINGLE PANEL MADE OF FULL DEPTH HONEYCOMB CORE WITH LAMINATE FACESHEETS AND EDGE BANDS MAY BE COMPLETELY VACUUM BAGGED. SEE FIGURE 23/GENERAL.

- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. It is optional to vacuum bag the entire part.

NOTE: The entire part must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts where sagging and distortion could occur due to the weight of the part.

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- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum.

NOTE: Maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.

- (11) Check the vacuum bag for leak paths.
(12) Cure the repair per Paragraph 4.G./GENERAL.

G. Cure the Repair.

WARNING: USE EXPLOSIONPROOF HEAT LAMP OR HEAT BLANKETS FOR ACCELERATED CURE. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

CAUTION: SURFACE TEMPERATURE MUST NOT EXCEED 170°F (77°C). DAMAGE OR DISTORTION OF STRUCTURE MAY OCCUR IF TEMPERATURE EXCEEDS 170°F (77°C).

- (1) Cure of wet layup.

NOTE: Determination of the temperature must be made by using thermocouples placed at edge of patch.

The gel and cure times of the potting and laminating resins are based on ambient temperature (70 to 80°F; 21 to 27°C); elevated temperatures will advance the reactions and lower temperatures will retard the reactions.

An infrared heat lamp (250 watt), heating blankets or equivalent source may be used to accelerate the cure. The graph shown in Figure 4/GENERAL indicates the temperature obtained on the patch surface when the heat lamp is a certain height. Monitor temperature with thermocouples.

- (a) Cure of the repair may be accomplished at room temperature (70 to 80°F; 21 to 27°C) or can be accelerated by the use of heat. See Figure 1/GENERAL and graph in Figure 4/GENERAL for time at temperature requirements.

NOTE: Cure time does not include the time required for the mold and part to heat up to temperature. Cure time is the period after the part has reached that temperature.

- (b) Maintain vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
(c) Remove bagging and parting film after curing.
(d) The patch should be free from pits, blisters, starved areas, and excess resin deposits.

H. Refinish After Repair.

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of topmost repair ply as necessary to fair the edge. Sand surface of repair to produce a smooth finish without damaging fibers.
(2) Apply finish to the repaired surface using the following applicable methods.
(a) Where clear Tedlar film surfaces have been removed, seal with a brush coat of Resin Mix 1 or 3 (Figure 1/GENERAL). Cure per Figure 1/GENERAL.
(b) Where grey or white Tedlar film surfaces have been removed, seal with Resin Mix 3 (Figure 1/GENERAL). Cure per Figure 1/GENERAL and apply one coat of BMS 10-11 primer and one coat of BMS 10-60 enamel (grey, BAC705; white, BAC7106).



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- (c) Where the conductive coating BMS 10-21 has been removed, reapply per AMM 51-24-02.
- (d) Where the abrasion resistant Teflon finish has been removed from the internal surface of the panel edgeband, reapply the finish per AMM 51-24-13.
- (e) Where the original painted surfaces have been removed, restore original finish per AMM 51-21-00/701.
- (f) Where sealant has been removed from around fittings or fay surfaces to facilitate repairs, reapply BMS 5-95 sealant per drawing requirements or 51-20-05, GENERAL.

I. Perform Post Repair Requirements

- (1) Make an inspection of the repair that was done to make sure that the repair is satisfactory. The inspection must include these areas:
 - The area that was hot.
 - A minimum width of 2 in. (5 cm) all around the area that was hot.

If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: Post repair inspection is recommended. Examples of inspection procedures are given in NDT Part 1, 51-01-01. Other inspection methods that have been examined and found satisfactory by the airline can be used.

WARNING: FLIGHT SAFETY DEMANDS THAT CERTAIN CONTROL SURFACES BE PROPERLY BALANCED AT ALL TIMES.

- (2) Following repair of control surface, balance must be checked to determine whether or not rebalancing is required. Rebalance as necessary per CONTROL SURFACE BALANCING, SECTION/51-60.

CAUTION: REPAIRS MADE TO CONTROL SURFACES AND/OR ADJACENT STRUCTURE MUST NOT INTERFERE WITH THE DESIGNED OPERATION OF THE CONTROL SURFACES. DAMAGE TO AIRPLANE STRUCTURE MAY OCCUR.

- (3) Check all repairs for noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

CAUTION: REPAIRS MUST NOT COVER EXISTING DRAIN HOLES IN PANELS. WATER WILL ACCUMULATE IF DRAIN HOLES ARE COVERED.

- (4) If the repair covers a drain hole, drill through the repair at existing location.

NOTE: Drain holes are usually 0.375 in. (9.52 mm) diameter. Refer to AMM 51-41-01.

5. Typical Repairs

NOTE: These repairs apply to all fiberglass fabric reinforced honeycomb and laminate components except radomes and floor panels.

CAUTION: TO GET AN ACCEPTABLE QUALITY REPAIR, DO AS FOLLOWS:



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(CAUTION PRECEDES)

- REFER TO THE APPLICABLE COMPONENT WHICH YOU ARE GOING TO REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE YOU USE THESE REPAIR INSTRUCTIONS.
- USE THE CORRECT MATERIALS FOR THE TYPE OF COMPONENT AND REPAIR THAT IS MADE.
- USE THE MATERIALS THAT AGREE WITH THE SPECIFICATIONS IN THE SRM.
- ACCURATELY FOLLOW THE SRM PROCEDURES AT EACH STEP OF THE REPAIR. IF YOU DO NOT DO THIS, IT CAN CAUSE A REPAIR THAT IS NOT SATISFACTORY AND IS NOT APPROVED.

A. Repair of Delaminations Between Plies.

- (1) Delamination of plies over core area of panel (Figure 5/GENERAL).
 - (a) Determine damage per Paragraph 4.A./GENERAL. Ensure that water and other contaminations are removed per Paragraph 4.B./GENERAL.
 - (b) Cut away delaminated plies per Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area per Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repairs per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband (Figure 12/GENERAL).

CAUTION: DELAMINATION MUST NOT REACH DEEPER THAN 0.5 IN. (12.7 MM) INTO THE PANEL EDGE BAND OR EXTEND TO WITHIN 0.5 IN. (12.7 MM) OF THE HONEYCOMB CORE (FIGURE 12/GENERAL). IF SO, REPAIR PER DAMAGED PLY METHOD.

- (a) Determine damage per Paragraph 4.A./GENERAL.
- (b) Remove all contaminants and water from damaged area. Area must be completely dried out.
- (c) Force Resin Mix 1 (Figure 1/GENERAL), BMS 5-25, or BMS 5-92, Type 1, Grade 1 into delaminated area.
- (d) Clamp plies together and remove excess resin.
- (e) Cure according to Paragraph 4.G./GENERAL, maintaining pressure until cured. Vacuum pressure is not required for this repair.
- (f) Refinish surface as required.
- (g) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.

B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel (Figure 15/GENERAL).

- (1) Remove clear or colored Tedlar film surface, as applicable, from repair area per Paragraph 4.C.(2)(b)1)/GENERAL.
- (2) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper.

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- (3) Dry out structure around puncture per Paragraph 4.B./GENERAL.
- (4) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape per Paragraph 4.C./GENERAL.
- (5) Clean repair area per Paragraph 4.C.(2)/GENERAL.
- (6) Prepare Resin Mix 6, or Resin Mix 8, according to Figure 1/GENERAL.
- (7) Work resin into the hole filling as much as possible.
- (8) Cure according to Paragraph 4.G./GENERAL.
- (9) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.25 mm).

NOTE: A 0.010 in. (0.25 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (10) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
 - (11) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
 - (12) Prepare and apply two fabric cover plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Figure 2/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
 - (5) Clean surface according to Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Figure 6/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL, except it is not necessary to vacuum bag the core plug installation at this time.
 - (5) Prepare and apply repair plies to one surface of the panel according to Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
 - (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
 - (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.

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- (8) Prepare and apply repair plies to the other surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

E. Replacement of Honeycomb Core on Damaged Edge of Panel (Figure 7/GENERAL).

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
- (5) Clean surfaces according to Paragraph 4.C.(2)(e)/GENERAL.
- (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side Only (Figure 8/GENERAL).

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side. See Figure 8/GENERAL when making this repair.

CAUTION: THIS REPAIR IS NOT ALLOWED IF INSPECTIONS DESCRIBED IN THE SPECIFIC COMPONENT REPAIR SECTION CANNOT BE MADE ON THE FAR SIDE SKIN.

- (1) Determine extent of damage per Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
- (3) Remove damage and prepare area per Paragraph 4.C./GENERAL and the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + \{N \times [1.0 \text{ in. (25.4 mm) for each ply}]\} + 1.0 \text{ in. (25.4 mm)}$

d = major diameter of oval hole in inner skin and is limited to 1.5 in. (38.1 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole.
- (c) Taper sand the outer skin plies per Paragraph 4.C.(2)/GENERAL.
- (4) Fabricate an airtight patch, (Figure 8/GENERAL, Details II thru V) to cover the oval hole from the inaccessible side as follows:
 - (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
 - (b) Cover the mold with parting film or release agent.

STRUCTURAL REPAIR MANUAL

- (c) Lay up five plies of the same material used in the repair on the mold, using the procedures of Paragraph 4.E./GENERAL, except that all repair plies will have the same diameter. Make diameter of the repair plies at least equal to D diameter.
 - (d) Bag and cure the patch per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Place thermocouples at the edge of the patch before cure.
 - (e) Remove the patch from the mold.
 - (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
 - (g) Drill a 0.125 in. (3.175 mm) diameter hole in the center of the patch for a Cleco fastener.
 - (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
 - (i) Fabricate a strip of spring steel 1.0 in. (25 mm) X 10.0 in. (254 mm) and drill a 0.125 in. (3.175 mm) diameter hole in the center for the Cleco fastener.
- NOTE:** This repair illustrates the use of a spring steel clamp. However, any suitable retaining method may be used.
- (j) Assemble the patch and spring steel together with a 0.125 in. (3.175 mm) diameter Cleco fastener.
- (5) Remove Tedlar, if required and abrade the underside of the inner skin to a distance of 0.38 in. (9.7 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN TRICHLOROETHANE SOLVENT OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
- (7) Bend up both ends of the spring steel and apply BMS 5-109, Type II adhesive paste to the precured patch.
- (8) Holding the spring steel up - insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
- (9) Cure the adhesive per Figure 1/GENERAL. When cure is complete, remove the Cleco fastener and spring. Fill hole for Cleco fastener with BMS 5-109, Type II adhesive paste or BMS 5-95, Class B 1/2 sealant and let cure.

NOTE: Cure BMS 5-109 adhesive as given in Figure 1/GENERAL. Cure BMS 5-95 sealant as given in 51-20-05, GENERAL.

- (10) Clean out the repair area per Paragraph 4.C.(2)(e)/GENERAL.
 - (11) Apply Resin Mix 1 to the surface of the inner skin which fays with the inner skin repair plies.
 - (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin.
 - (13) Fabricate, clean, and install core plug per Paragraph 4.D./GENERAL.
 - (14) Prepare and apply repair plies to the outer skin surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Figure 9/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.

STRUCTURAL REPAIR MANUAL

- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.

CAUTION: DO NOT SAND INTO BOND PLY OR CORE (FIGURE 9/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THIS CAUTION IS NOT OBSERVED. BOND PLY IS PLY ADJACENT TO CORE.

- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

H. Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels (Figure 20/GENERAL).

NOTE: This repair applies to components made from laminated fabric plies and epoxy resin without a honeycomb core.

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.

CAUTION: DO NOT PENETRATE THE UNDAMAGED PLIES. LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR.

- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL except taper or step sand minimum of 0.5 in. (12.7 mm) per repair ply instead of 1.0 in. (25.4 mm) when cleaning up damage.

NOTE: Taper sand edges of plies around repair on damaged side of panel.

- (4) Prepare and apply repair plies and complete repairs per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

I. Repair of Punctures, 0.50 in. (12.7 mm) Diameter or Less, in Solid Laminate Panels (Figure 21/GENERAL).

- (1) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out.
- (3) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape per Paragraph 4.C./GENERAL.
- (4) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
- (5) Prepare Resin Mix 1, including 42% \pm 3% milled glass fiber, according to Figure 1/GENERAL.
- (6) Work resin into the hole filling as much as possible.
- (7) Cure according to Paragraph 4.G./GENERAL.
- (8) Carefully sand any projecting material to fair with surrounding surface within \pm 0.010 in. (0.25 mm).

NOTE: A 0.010 in. (0.25 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (9) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.

STRUCTURAL REPAIR MANUAL

- (10) Clean repair area per Paragraph 4.C.(2)(e)/GENERAL.
 - (11) Prepare and apply two fabric cover plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- J. Repair of Delaminations Between Plies in Solid Laminate Panels
- NOTE:** This repair applies to components made from laminated fiberglass fabric plies and epoxy resin without a honeycomb core.
- (1) Repair delaminations using methods described in Paragraph 5.H./GENERAL.
- K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Laminated Panels (Figure 10/GENERAL).
- (1) Determine the extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
 - (3) Taper sand around the hole to remove damage according to Figure 10/GENERAL.
 - (4) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.
 - (5) Prepare and apply repair plies according to Paragraph 4.E./GENERAL and Figure 10/GENERAL.
 - (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
 - (7) Refinish the repair according to Paragraph 4.H./GENERAL.
 - (8) Drill and countersink fastener holes.
 - (9) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.
- L. Repair of Surface Dents (Figure 16/GENERAL).
- (1) Check for delamination and broken fibers per Paragraph 4.A./GENERAL.
 - (2) If delamination is found, repair per Paragraph 5.A./GENERAL.
 - (3) If broken fibers are found, repair per Paragraph 5.B./GENERAL or Paragraph 5.C./GENERAL.
 - (4) If no delamination or broken fibers are found, mask off damaged area allowing 1.0 in. (25.4 mm) of overlap for the repair ply.
 - (5) Clean damaged area according to Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Remove Tedlar or decorative finish using methods described in Paragraph 4.C.(2)(b)/GENERAL and Paragraph 4.C.(2)(c)/GENERAL.
 - (7) Pot dent flush or slightly higher than surrounding surface with Resin Mix 11 potting compound.
 - (8) Cure per Paragraph 4.G./GENERAL.
- CAUTION:** DO NOT SAND INTO FIBERS IN THE AREA SURROUNDING DENT.
- (9) Sand flush using 150 grit or finer sandpaper.
 - (10) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.
 - (11) Prepare and apply one ply layer of Type H-2 or H-3 glass fabric according to Paragraph 4.E.(1)/GENERAL. The ply layer is to be 2.0 in. (50.8 mm) larger than the potted area (Figure 16/GENERAL).

STRUCTURAL REPAIR MANUAL

(12) Apply vacuum and cure per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.

(13) Refinish per Paragraph 4.H./GENERAL.

M. Repair of Lightning Strike Damage (Figure 17/GENERAL).

CAUTION: THIS REPAIR IS LIMITED TO LIGHTNING DAMAGE NOT PENETRATING FIBERS. IF FIBERS OR CORE HAVE BEEN DAMAGED, REMOVE AND REPLACE PER PARAGRAPH 4.A./GENERAL, PARAGRAPH 4.B./GENERAL, PARAGRAPH 4.C./GENERAL, PARAGRAPH 4.D./GENERAL, PARAGRAPH 4.E./GENERAL, PARAGRAPH 4.F./GENERAL, PARAGRAPH 4.G./GENERAL, PARAGRAPH 4.H./GENERAL, AND PARAGRAPH 4.I./GENERAL.

- (1) Check for delamination per Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair per Paragraph 5.A./GENERAL or Paragraph 5.G./GENERAL.
- (3) If delamination is not found, mark off damaged area allowing 1.0 in. (25.4 mm) of overlap for the repair ply.
- (4) Clean damaged area according to Paragraph 4.C.(2)(e)/GENERAL.
- (5) Mask area for repair with masking tape.
- (6) Remove Tedlar or decorative finish using methods described in Paragraph 4.C.(2)(b)/GENERAL and Paragraph 4.C.(2)(c)/GENERAL.
- (7) Seal surface with Resin Mix 3, prepared as shown in Figure 1/GENERAL. Excess resin must be scraped off before it gels.
- (8) Cure per Paragraph 4.G./GENERAL.
- (9) Prepare and apply one ply layer of Type H-2 or H-3 glass fabric according to Paragraph 4.E.(1)/GENERAL. The ply layer is to overlap the lightning damage by 1.0 in. (25.4 mm) all around (Figure 17/GENERAL).
- (10) Apply vacuum and cure per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (11) Refinish per Paragraph 4.H./GENERAL.

N. Repair of Small Damage to One Skin (Figure 19/GENERAL).

CAUTION: THIS REPAIR HAS INSPECTION REQUIREMENTS AND TIME LIMITS. SEE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR REPAIR LIMITATIONS.

- (1) Determine damaged area per Paragraph 4.A./GENERAL.
- (2) Mask area for repair with masking tape.
- (3) Remove Tedlar or decorative finish using method described in Paragraph 4.C.(2)(b)1)/GENERAL.
- (4) Remove any moisture and contamination using vacuum or oil-free compressed air.
- (5) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
- (6) Lightly abrade masked area with 150 grit or finer sandpaper.
- (7) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.
- (8) Make a wet layup of one ply of Type 181 glass fabric for each damaged ply. The plies are to overlap the damage and each other as shown in Figure 19/GENERAL.
- (9) Apply vacuum and cure per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.



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O. Repair of Erosion Damage to Panel Edges (Figure 22/GENERAL).

- (1) Determine the damaged area per Paragraph 4.A./GENERAL. If damage exceeds the limits specified in Figure 22/GENERAL, repair per Paragraph 5.G./GENERAL. If delamination is present, repair per Paragraph 5.A.(2)/GENERAL.
- (2) Mask the damaged area with masking tape. Use care to keep the rework area within the limits specified in Figure 22/GENERAL.
- (3) Remove the moisture and contamination from the rework area with a vacuum or oil free compressed air and by heating the area to between 150°F (66°C) and 170°F (77°C). The rate of heating must not exceed 5°F (3°C) per minute. Refer to Paragraph 4.B./GENERAL.
- (4) Taper sand the damaged area using 180 grit or finer sandpaper. Maintain the limits specified in Figure 22/GENERAL.
- (5) Clean the area. Refer to Paragraph 4.C.(2)(e)/GENERAL.
- (6) Seal the area with Resin Mix 1 (BMS 8-301, Class 2). See Figure 1/GENERAL for resin specifications, mixing, and curing procedures.

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RESIN TYPE	COMPONENTS	PARTS BY WEIGHT	POT LIFE OF MIXTURE	CURE CYCLE SUFFICIENT FOR HANDLING, DRILLING, SANDING
RESIN MIX 1 (LAMINATING RESIN) (BMS 8-301 CLASS 2)	FR 7020 PART A RESIN BASE PART B HARDENER EY 3804 PART A RESIN BASE PART B HARDENER	100 ±2 58 ±0.5	APPROX 30 MINUTES AT 75°F	30 MINUTES AT 150°F ±10°F (66°C ±6°C) OR 10 HOURS AT ROOM TEMPERATURE 68°F (20°C) B
RESIN MIX 2 (POTTING RESIN) (BMS 5-28, TYPE 5)	TA 4027 RESIN TB 4027 HARDENER	98 TO 102 19 TO 21	60 TO 75 MINUTES AT 70°F TO 80°F (21°C TO 27°C)	12 HRS AT 65°F (19°C) MIN OR 2 HRS AT 120-130°F (49-54°C)
RESIN MIX 3 (SEALER RESIN)	EPIBOND 156A RESIN EPIBOND 156B HARDENER	98 TO 102 5.7 TO 6.3	15 TO 25 MINUTES AT 77°F (25°C)	12 HRS AT 70°F (21°C) OR 1 TO 3 AT 150°F (66°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE	FIBER-RESIN 5318S RESIN FIBER-RESIN 5318C HARDENER	98 TO 102 49 TO 51	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4
RESIN MIX 3 EPOX-O WELD (SEALER RESIN) ALTERNATE	TWO COMPONENT KIT	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT		
			45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4
RESIN MIX 3 (SEALER RESIN) ALTERNATE	EPIBOND 156A RESIN EPIBOND 941 HARDENER	98 TO 102 9.5 TO 10.5	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4

NOTES

- MATERIALS MUST GEL AT ROOM TEMPERATURE PRIOR TO HEATING. RATE OF HEAT RISE MUST BE NO GREATER THAN 7°F (4°C) PER MINUTE.
- REFER TO SRM 51-30-00 FOR SOURCES OF MATERIALS.
- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

A FORMERLY EPOCAST H-1835

B FOR OPTIMUM PROPERTIES, CURE 180 MINUTES AT 150°F (66°C) OR 5 DAYS AT ROOM TEMPERATURE 68°F (20°C).

**Resin Type Specifications and Mixing Procedures
Figure 1 (Sheet 1 of 4)**



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RESIN TYPE	COMPONENTS	PARTS BY WEIGHT	POT LIFE OF MIXTURE	^B CURING TIME
RESIN MIX 6 (POTTING RESIN) READY-TO-USE PACKAGE NO. 80055-44 OR NO. 80055-45	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT			
RESIN MIX 7 (POTTING RESIN)	QUICKSET EPOXI-PATCH KIT 615 PHENOLIC MICROBALLONS	100 15 TO 20	APPROX 4 MINUTES AT 70°F (21°C)	1 HR AT 70°F (21°C)
RESIN MIX 8 (POTTING RESIN)	RESIN MIX 1 MILLED GLASS FIBERS 1/32-INCH LONG CATIONIC BINDER	100 30 TO 40	SAME AS FOR RESIN MIX 1 USED IN MIXTURE	SEE FIG. 4
RESIN MIX 9 (POTTING RESIN)	RESIN MIX 1 PHENOLIC MICROBALLONS	100 15 TO 30	SAME AS RESIN MIX 1	SEE FIG. 4
RESIN MIX 11 (POTTING RESIN) (BMS 5-28, TYPE 15)	EPOCAST 1615A WITH 1615B HARDENER	100 14	10 TO 30 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54°C)
RESIN MIX 11 (POTTING RESIN)	EPOCAST 1616A WITH 1616B HARDENER	100 7	20 TO 40 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54°C)
RESIN MIX 11 (POTTING RESIN) (ALTERNATE)	EPOCAST 1617A WITH 1617B HARDENER	100 20	60 TO 90 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54°C)
RESIN MIX 11 (POTTING RESIN) (ALTERNATE)	EPOCAST 7176A WITH 7176B HARDENER	100 15	12 TO 17 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54°C)
RESIN MIX 11 (POTTING RESIN)	EPOCAST 1618A WITH 1618B HARDENER	100 12	12 TO 20 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54°C)
RESIN MIX 11 (POTTING RESIN) (ALTERNATE) (BMS 5-28, TYPE 19)	EPOCAST 1619A WITH 1619B HARDENER	100 25	20 TO 40 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54°C)
BMS 5-109, TYPE II ADHESIVE PASTE	EA 9394 PART A EA 9394 PART B OR EA 934 NA PART A EA 934 NA PART B	REFER TO MANUFACTURERS' DATA	30 MINUTES	130 MINUTES ±10 MINUTES AT 150°F (66°C) ±20°F (7°C)

Resin Type Specifications and Mixing Procedures
Figure 1 (Sheet 2 of 4)

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RESIN TYPE	COMPONENTS	PARTS BY WEIGHT	POT LIFE OF MIXTURE	^B CURING TIME
RESIN MIX 11 (POTTING RESIN)	EPOCAST 1620A WITH 1620B HARDENER	100 20	20 TO 70 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54 °C)
RESIN MIX 11 (POTTING RESIN) (ALTERNATE)	TS 4038A WITH TS 4038B HARDENER	100 20	20 TO 70 MINUTES AT 70° TO 80°F (21° TO 27°C)	↓
RESIN MIX 11 (POTTING RESIN) (ALTERNATE)	FR 7174A WITH 7174B HARDENER	100 24	20 TO 70 MINUTES AT 70° TO 80°F (21° TO 27°C)	
RESIN MIX 11 (POTTING RESIN) (ALTERNATE)	EPOCAST 1511A WITH 1511B HARDENER	100 15	20 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 77°F (25°C) OR 5 HRS AT 120° TO 130°F (49° TO 54 °C)
BMS 5-25 GRADE 1 ADHESIVE	ADHESIVE PASTE EA 901 CURING AGENT B-1	100 16 TO 17	1 HR AT 70° TO 80°F (21° TO 27°C)	24 HRS AT 65° TO 80°F (19° TO 27°C) OR PER FIG. 4
BMS 5-25 GRADE 1 ADHESIVE (ALTERNATE)	ADHESIVE PASTE AEROBOND 223BA WITH 223B HARDENER	100 16 TO 18	1 HR AT 70° TO 80°F (21° TO 27°C)	24 HRS AT 70° TO 80°F (21° TO 27°C) OR PER FIG. 4
BMS 5-92, TYPE I, II, OR IV LIQUID ADHESIVE	EC2216A WITH EC2216B, COLORS OPTIONAL	TYPE I { 58 42 TYPES II { 50 AND IV { 50	80 TO 100 MINUTES AT 70° TO 80°F (21° TO 27°C)	7 DAYS AT 70° TO 80°F (21° TO 27°C)

Resin Type Specifications and Mixing Procedures
Figure 1 (Sheet 3 of 4)



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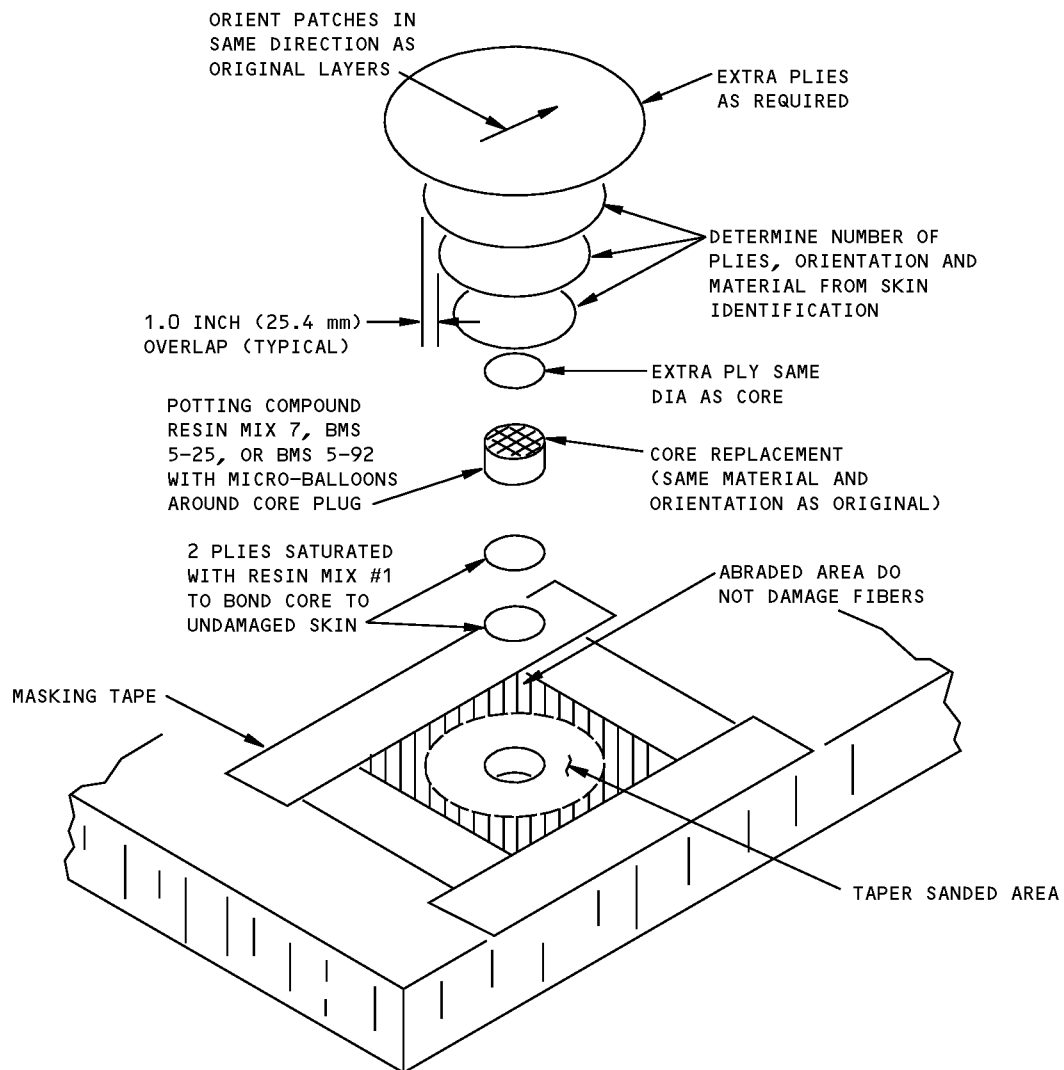
WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

MIXING PROCEDURE	
RESIN MIX 1 RESIN MIX 2 RESIN MIX 3 RESIN MIX 11	ADD HARDENER TO RESIN AND MIX THOROUGHLY.
RESIN MIX 6	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT
RESIN MIX 7	1. MIX COMPONENTS OF KIT ACCORDING TO MANUFACTURERS INSTRUCTIONS. 2. ADD PHENOLIC MICROBALLONS TO MIXTURE IN 1. ABOVE AND MIX THOROUGHLY.
RESIN MIX 8	ADD MILLED GLASS FIBERS TO RESIN MIX 1 TO PROVIDE A CONSISTENCY SIMILAR TO A THIN PUTTY.
RESIN MIX 9	1. ADD PHENOLIC MICROBALLONS TO RESIN AND MIX THOROUGHLY. 2. ADD HARDENER AND MIX THOROUGHLY.
BMS 5-25 GRADE 1	MIX COMPONENTS THOROUGHLY UNTIL A UNIFORM PURPLE-RED COLOR DEVELOPS.
BMS 5-92	MIX COMPONENTS THOROUGHLY TO OBTAIN A UNIFORM COLOR.

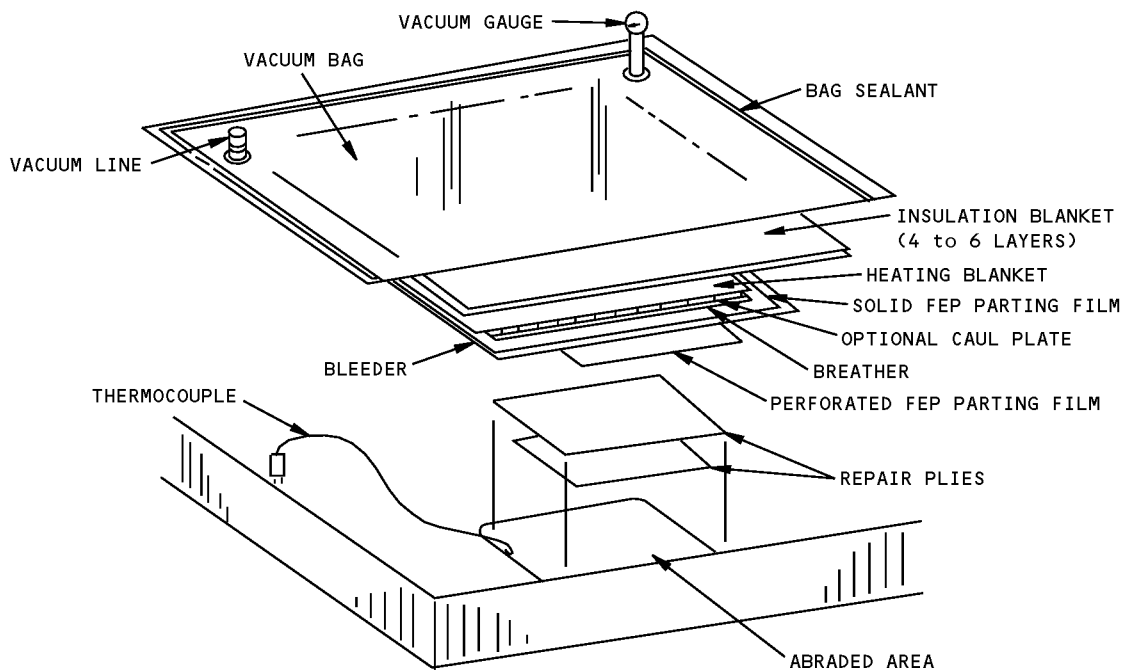
**Resin Type Specifications and Mixing Procedures
Figure 1 (Sheet 4 of 4)**

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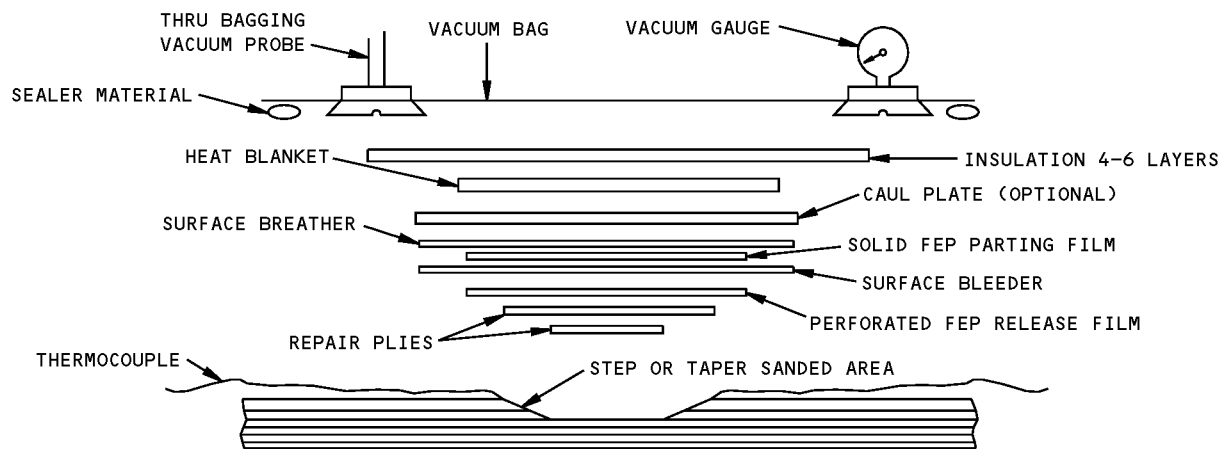


**Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - Wet Layup
Figure 2**

757-200 STRUCTURAL REPAIR MANUAL



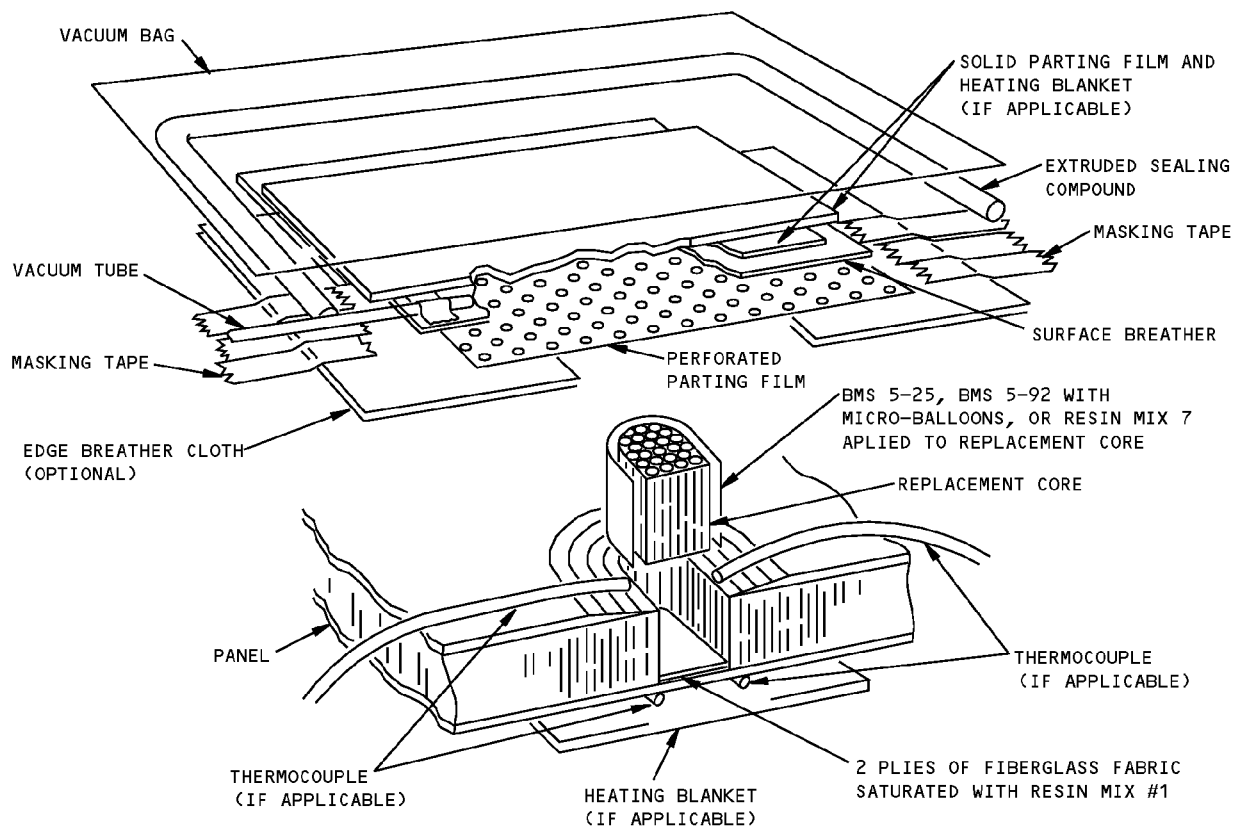
SKIN PLY REPAIR
(WET LAYUP)



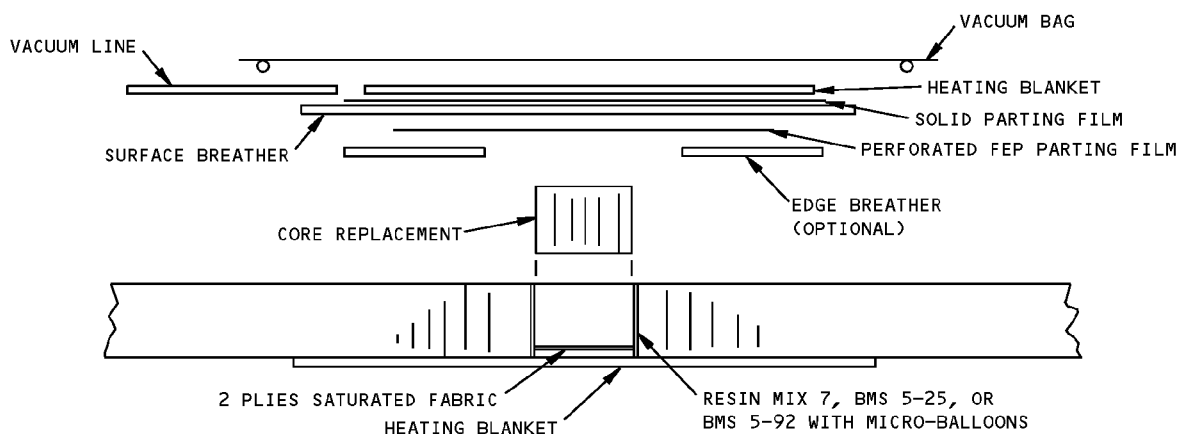
SECTION THRU LAYUP FOR SKIN PLY REPAIR
(WET LAYUP)

Application of Pressure During Cure - Wet Layup
Figure 3 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



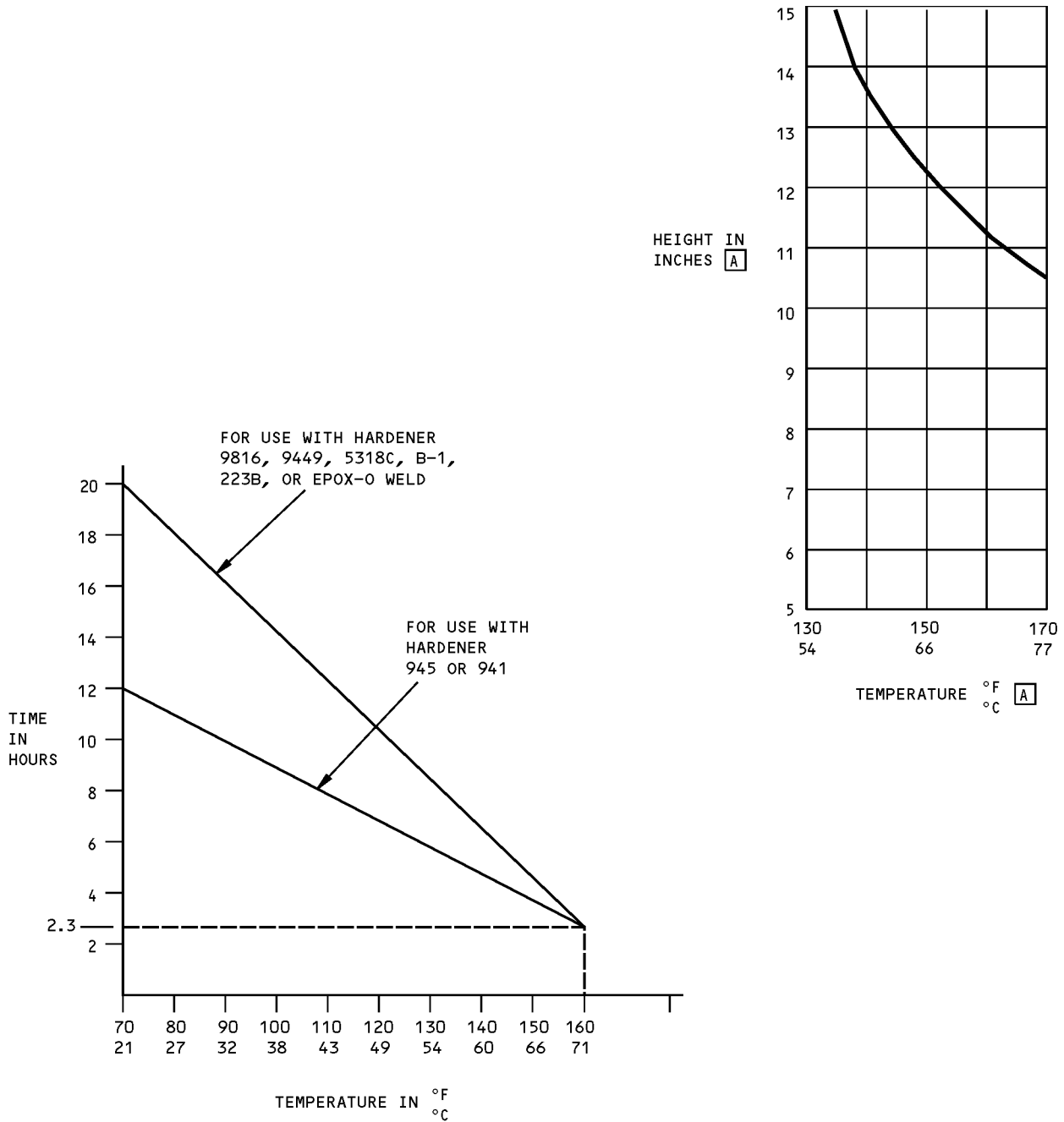
**BAGGING SEQUENCE FOR CORE REPLACEMENT
(WET LAYUP ONLY)**



**SECTION THRU LAYUP FOR CORE REPLACEMENT
(WET LAYUP ONLY)**

**Application of Pressure During Cure - Wet Layup
Figure 3 (Sheet 2 of 2)**

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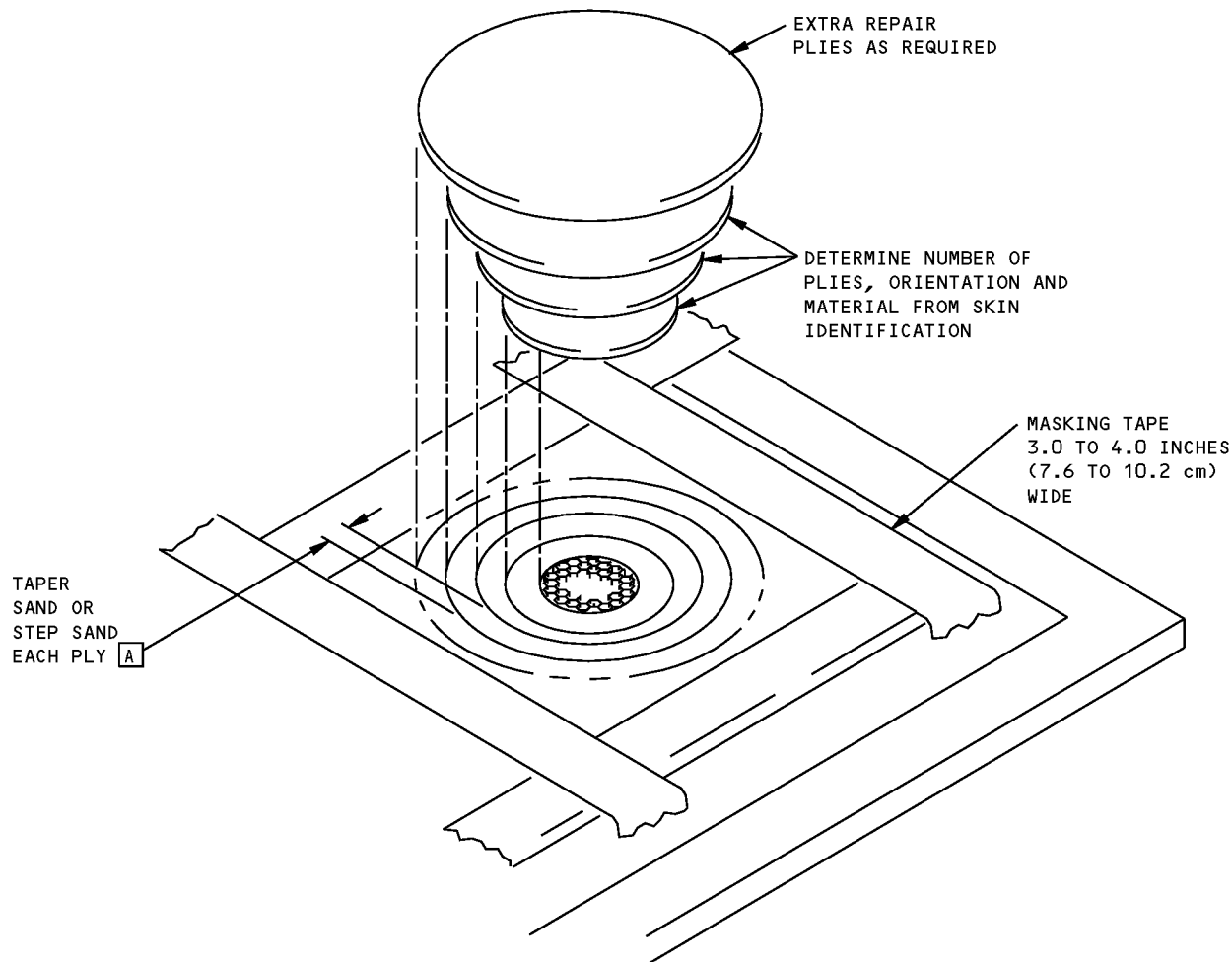
NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE

A THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

**Potting and Laminating Resin Cure Temperature
Figure 4**

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STRUCTURAL REPAIR MANUAL



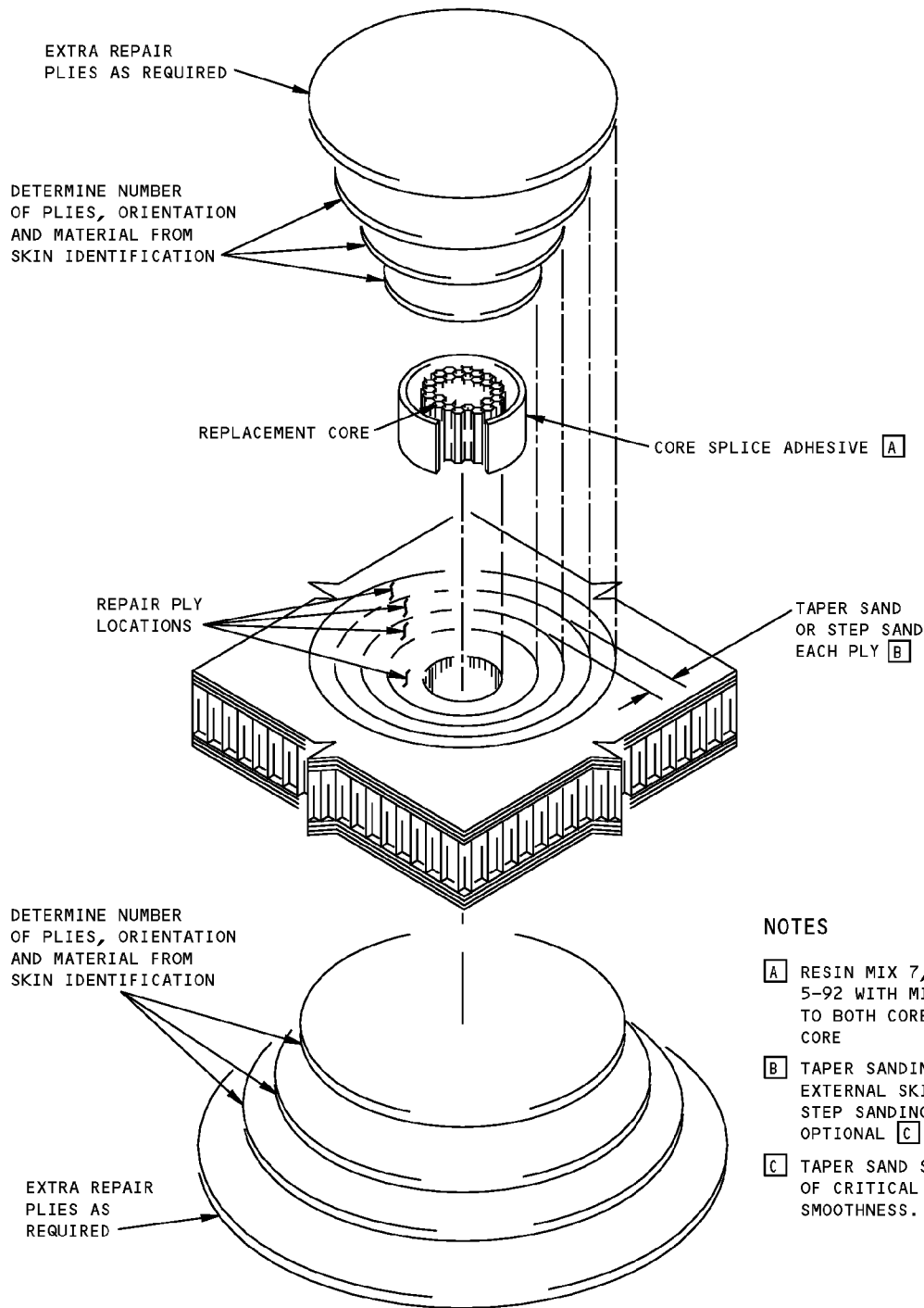
WET LAYUP ONLY

NOTES

- [A] TAPER SANDING OF EACH PLY OF EXTERNAL SKIN IS RECOMMENDED. STEP SANDING OF EACH PLY OF INTERNAL SKIN IS OPTIONAL [B]
- [B] TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. SEE SRM 51-10-01

Repair of Damaged External or Internal Skins of a Sandwich Panel - Wet Layup
Figure 5

**757-200
STRUCTURAL REPAIR MANUAL**



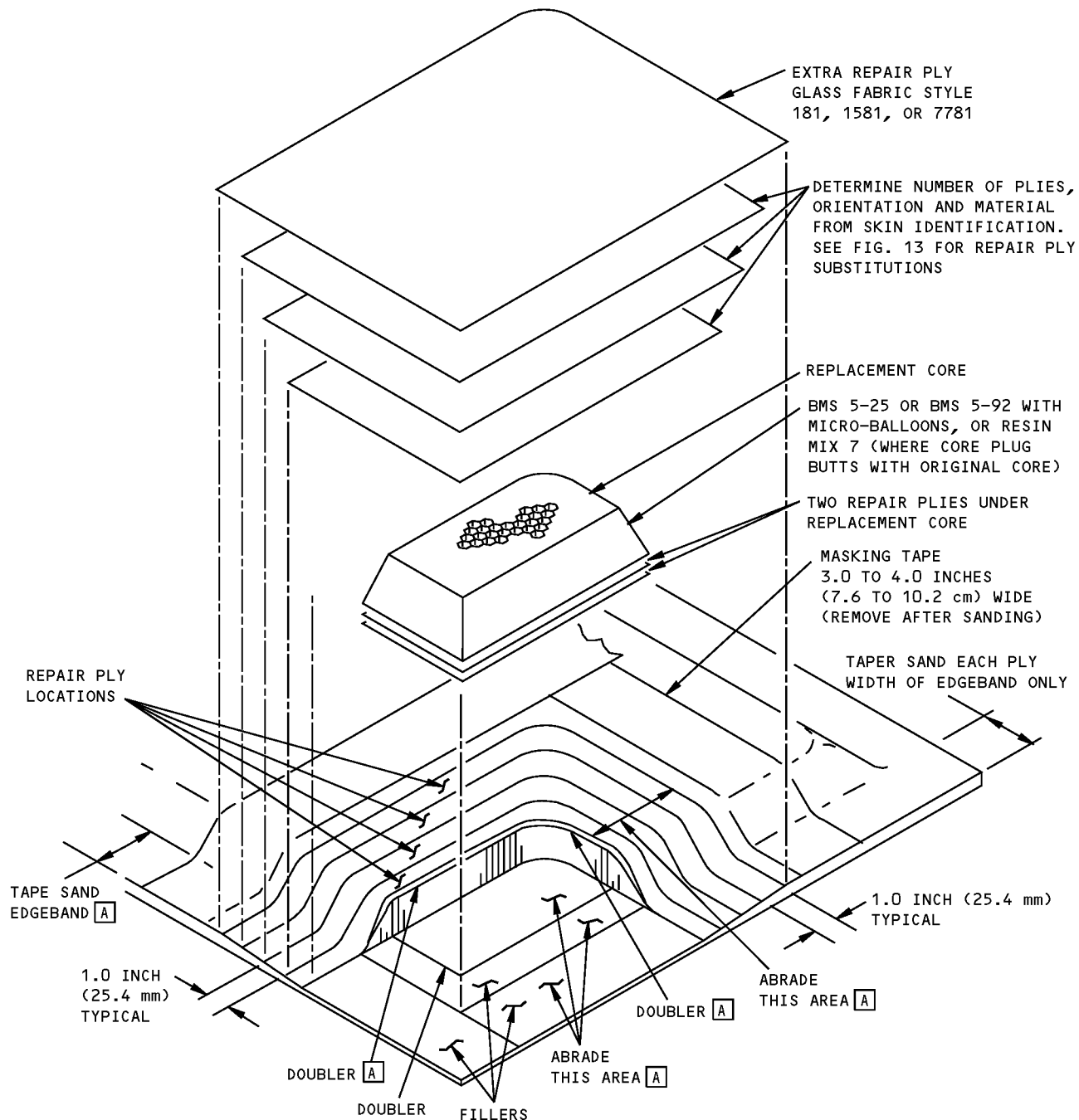
NOTES

- [A] RESIN MIX 7, BMS 5-25, OR BMS 5-92 WITH MICRO-BALLOONS APPLIED TO BOTH CORE PLUG AND ORIGINAL CORE
- [B] TAPER SANDING OF EACH PLY OF EXTERNAL SKIN IS RECOMMENDED. STEP SANDING OF EACH PLY IS OPTIONAL [C]
- [C] TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO 51-10-01

WET LAYUP ONLY

**Repair of Large Punctures Through Both Skins of a Sandwich Panel Including Core Damage - Wet Layup
Figure 6**

757-200 STRUCTURAL REPAIR MANUAL



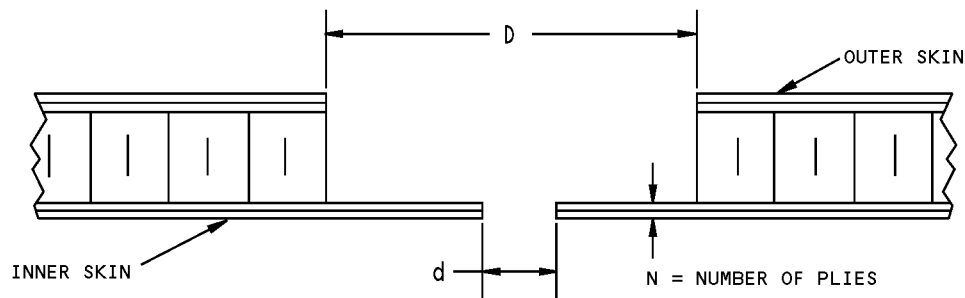
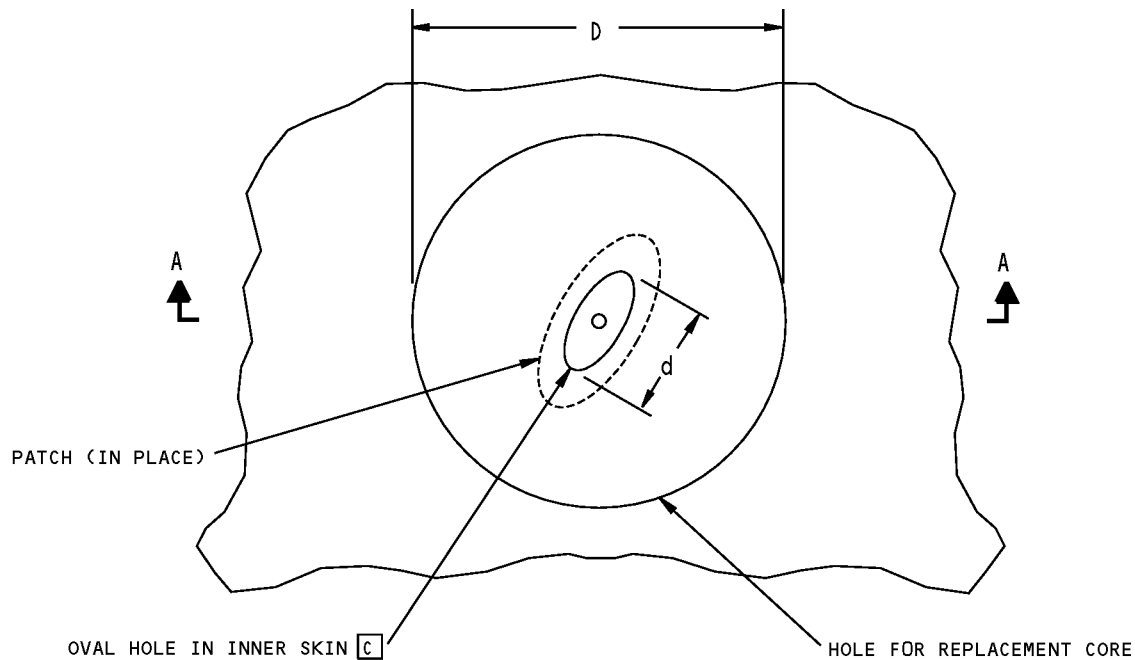
NOTE

WET LAYUP ONLY

- A** TAPER SANDING IS OPTIONAL TO JUST ABRADING THE SURFACE OF THE SKIN AND DOUBLER PLYS ABOVE AND BELOW THE HONEYCOMB CORE. HOWEVER, TAPER SANDING IS REQUIRED ON THE EDGE BAND

**Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel - Wet Layup
Figure 7**

757-200 STRUCTURAL REPAIR MANUAL



SECTION A-A
(PATCH NOT SHOWN)
DETAIL I

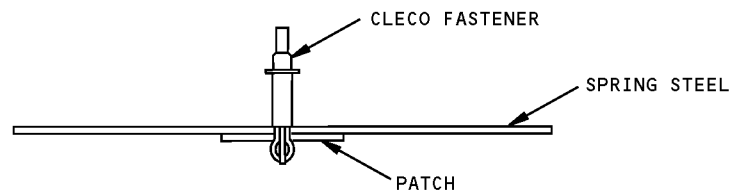
NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
- $D = d + \{N \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)}\}$
 d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN
 N = NUMBER OF PLYS
 D = DIAMETER OF HOLE FOR REPLACEMENT CORE
 FOR EXAMPLE:
 IF $d = 0.50 \text{ INCH (12.7 mm)}$ THEN,
 $D = 0.50 \text{ INCH (12.7 mm)} + \{[2 \text{ PLYS}] \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)}\}$
 $= 3.50 \text{ INCH (88.9 mm) DIAMETER}$

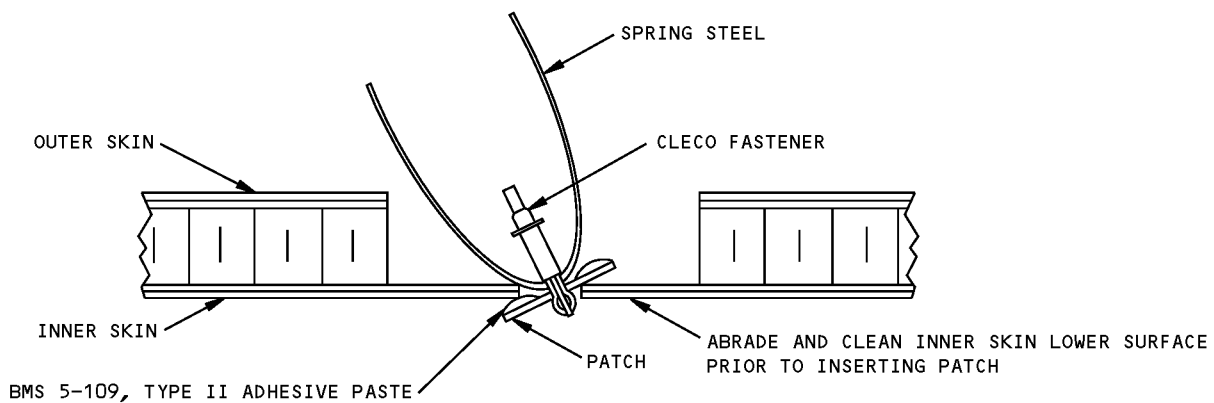
- [A] RESIN MIX 7, BMS 5-25 OR 5-92 WITH MICRO-BALLOONS APPLIED TO BOTH CORE PLUG AND ORIGINAL CORE
- [B] MAKE TAPER AND OVERLAP PER FIGURE 14
- [C] MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR

Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 1 of 3)

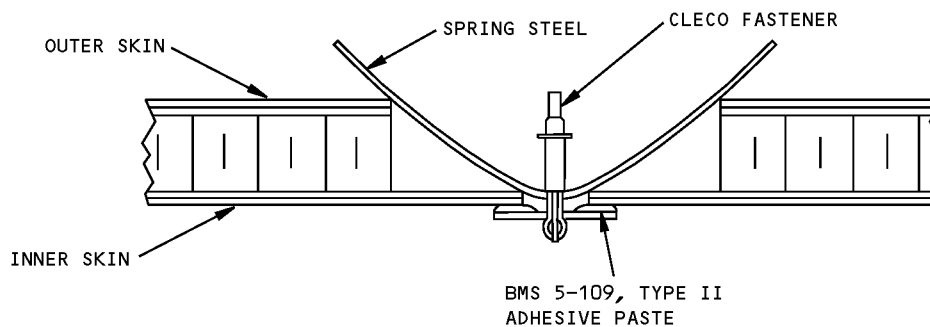
757-200 STRUCTURAL REPAIR MANUAL



ASSEMBLE PATCH AND SPRING STEEL
DETAIL II



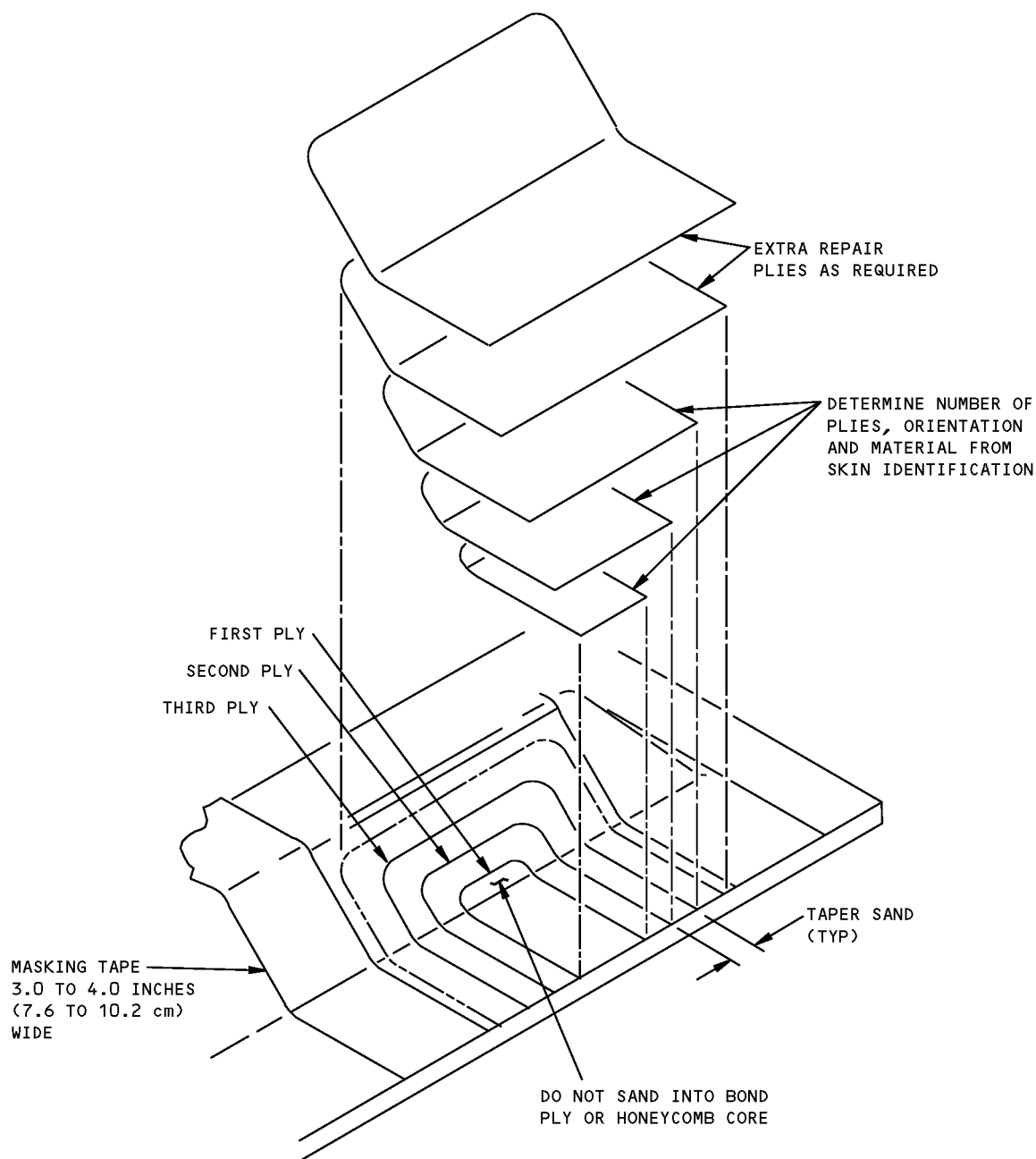
INSERT PATCH INTO OVAL HOLE
DETAIL III



HOLD PATCH IN PLACE WHILE CURING
DETAIL IV

Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 2 of 3)

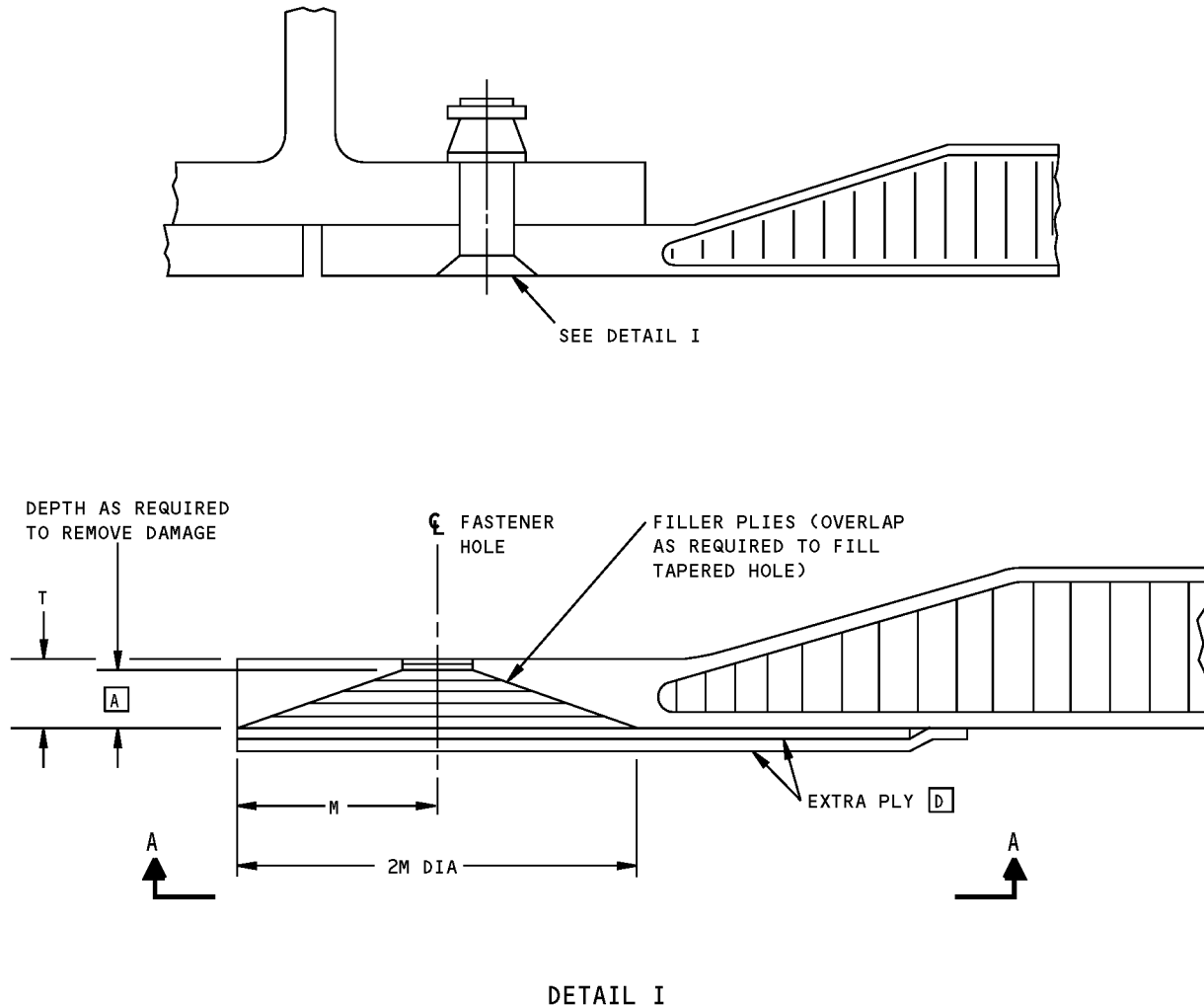
757-200
STRUCTURAL REPAIR MANUAL



WET LAYUP ONLY

Repair of Damaged Skin Plies On A Panel Edge - Wet Layup
Figure 9

757-200 STRUCTURAL REPAIR MANUAL



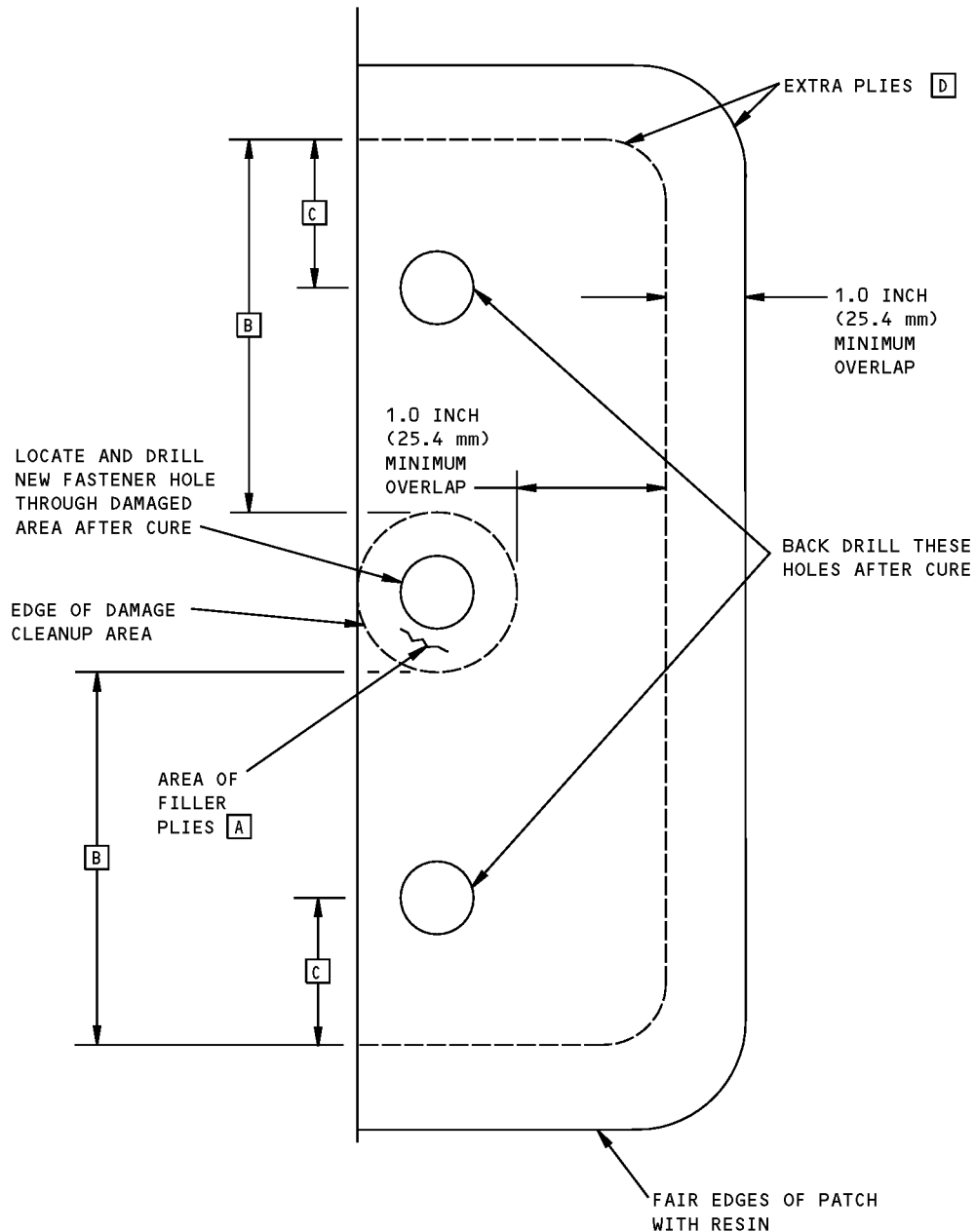
NOTES

- $M = 5T$ MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGEBAND. DO NOT CUT INTO CORE
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES
- D EQUALS FASTENER DIAMETER

- [A] APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA
- [B] EXTEND EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 1.0 INCH (25.4 mm) PAST EDGE OF DAMAGED AREA
- [C] EXTEND EXTRA REPAIR PLY FAR ENOUGH TO PROVIDE AT LEAST $2D$ EDGE MARGIN
- [D] ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER

Repair of Damaged Panel Attach Hole - Wet Layup
Figure 10 (Sheet 1 of 2)

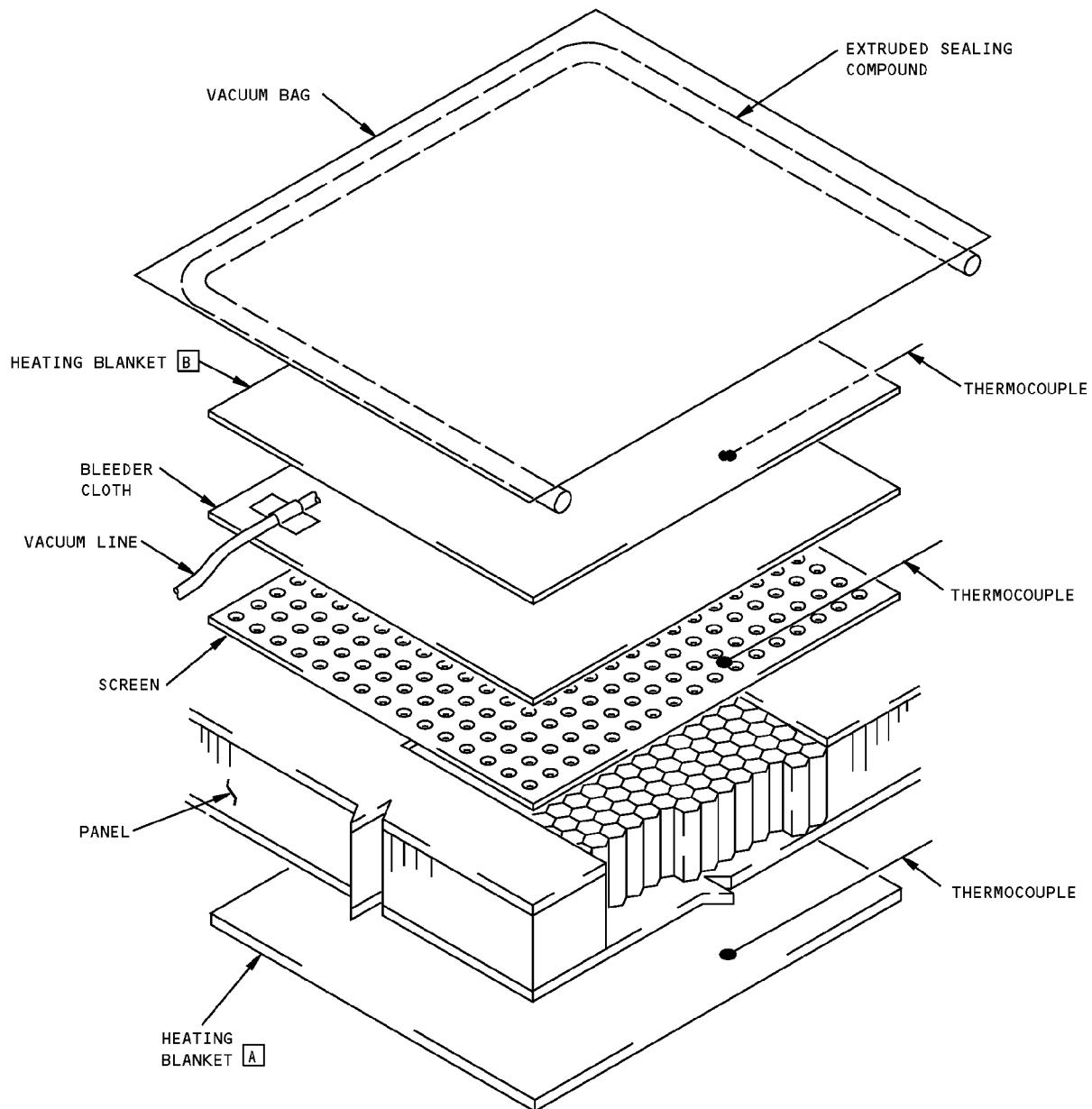
757-200
STRUCTURAL REPAIR MANUAL



SECTION A-A

Repair of Damaged Panel Attach Hole - Wet Layup
Figure 10 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL

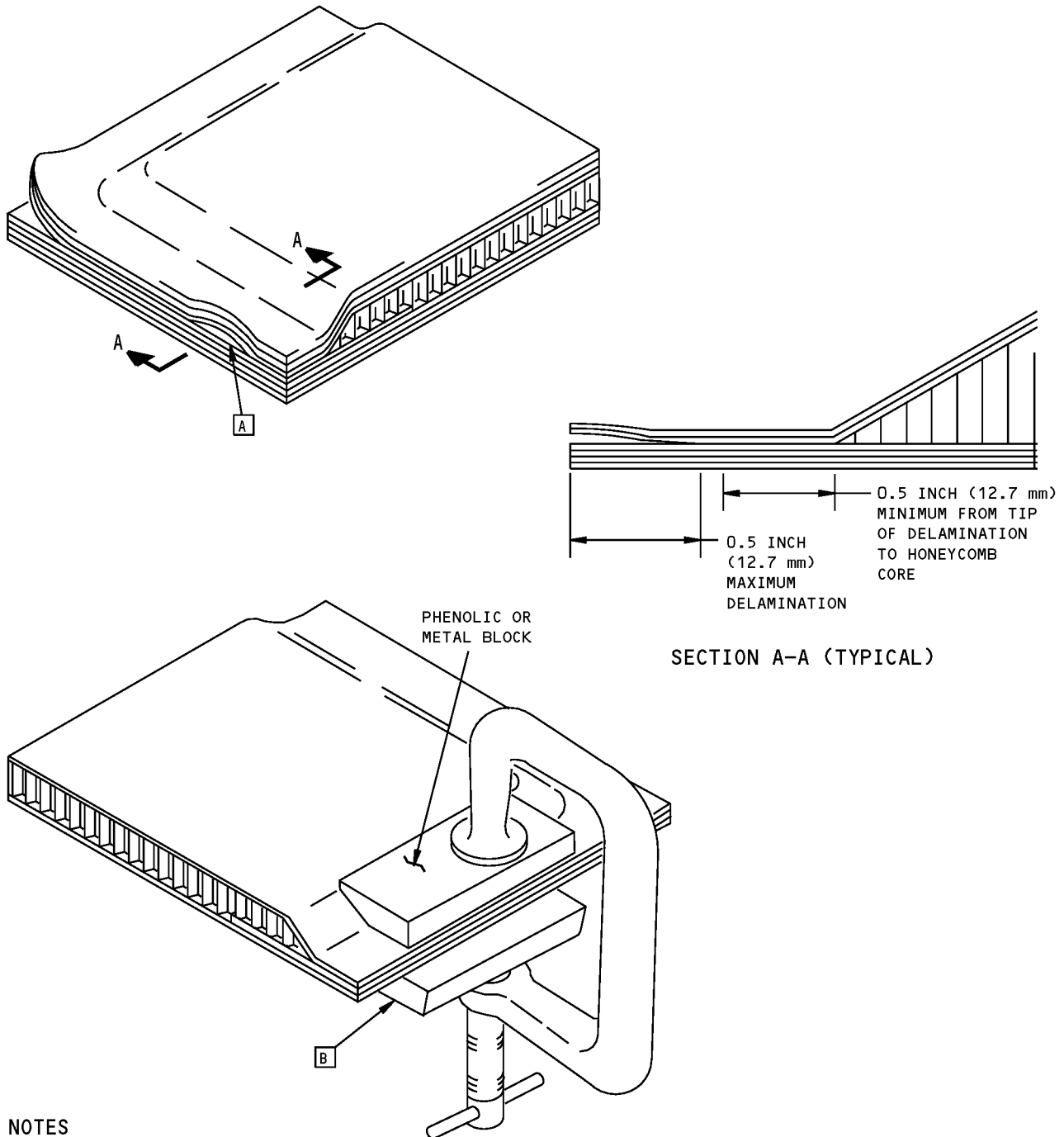


NOTES

- [A] PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B] ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

Water Removal From Honeycomb Sandwich
Figure 11

757-200
STRUCTURAL REPAIR MANUAL



NOTES

- REFER TO PARAGRAPH 5.A.(2) FOR COMPLETE REPAIR INSTRUCTIONS

[A] FORCE RESIN MIX 1 INTO DELAMINATED AREA

[B] CLAMP PLIES TOGETHER AND CURE

Repair of Delaminations Between Plies of Panel Edgeband
Figure 12



757-200
STRUCTURAL REPAIR MANUAL

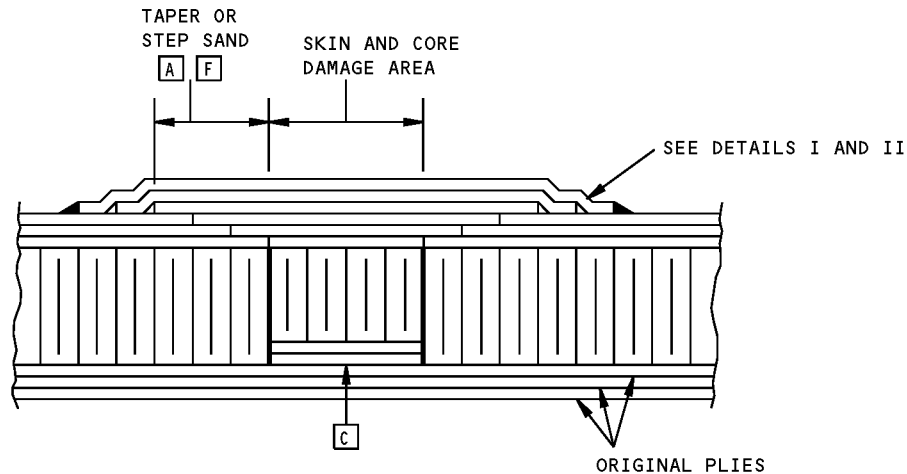
BMS 9-3 TYPE	FABRIC STYLE	THICKNESS PER PLY INCHES	BMS 8-79 EQUIVALENT TYPE	BMS 8-139 EQUIVALENT TYPE	PLY SUBSTITUTIONS
D	120	0.004-0.006	120	120	USE THREE PLIES OF TYPE D IN PLACE OF ONE PLY OF TYPE H-2 OR H-3
H-2 H-3	181-150 181-77	0.008-0.012 0.008-0.011	1581 7781	181	USE ONE PLY OF TYPE H-2 OR H-3 IN PLACE OF TWO PLIES OF TYPE D USE ONE PLY OF TYPE H-3 IN PLACE OF ONE PLY OF TYPE H-2, AND VICE VERSA

NOTE

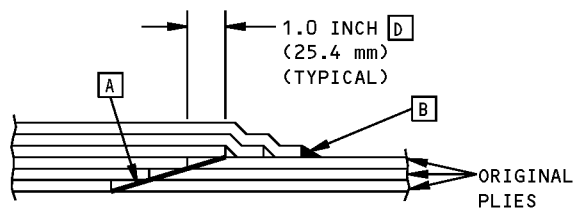
- BMS 9-3, CLASSES 2, 5 THRU 13, AND 16 THRU 19
CAN BE USED.

BMS 9-3 Glass Fabric Substitution
Figure 13

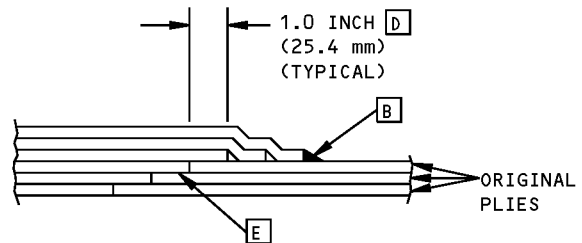
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(WET LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



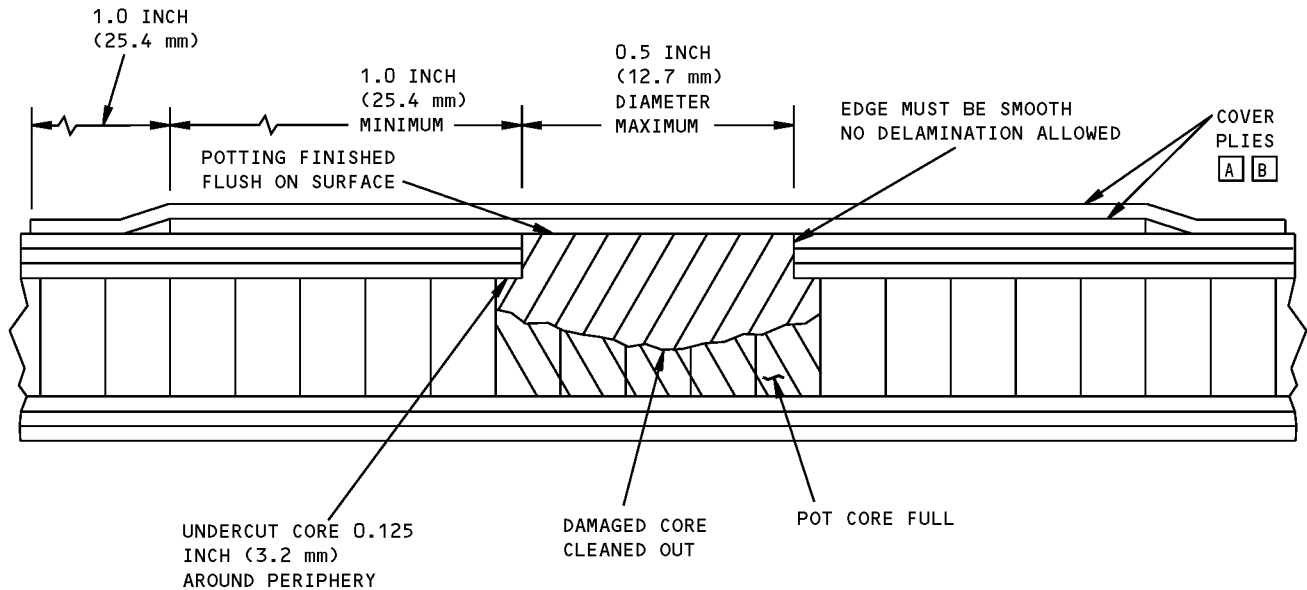
STEP SANDED SKIN
DETAIL II

NOTES

- | | |
|--|---|
| <p>[A] TAPER SAND OR STEP SAND EXISTING PLIES AROUND REPAIR AREA A MINIMUM OF 1.0 INCH (25.4 mm) FOR EACH EXISTING PLY.</p> <p>[B] DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING.</p> <p>[C] SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE).</p> <p>[D] EACH PLY MUST OVERLAP AT LEAST 1.0 INCH (25.4 mm) PAST EDGE OF PRECEDING PLY.</p> | <p>[E] REMOVE DAMAGED PLIES IN STEPS.</p> <p>[F] TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO SRM 51-10-01</p> |
|--|---|

Sanding and Overlap Requirements Figure 14

757-200 STRUCTURAL REPAIR MANUAL



TYPICAL SECTION

NOTES

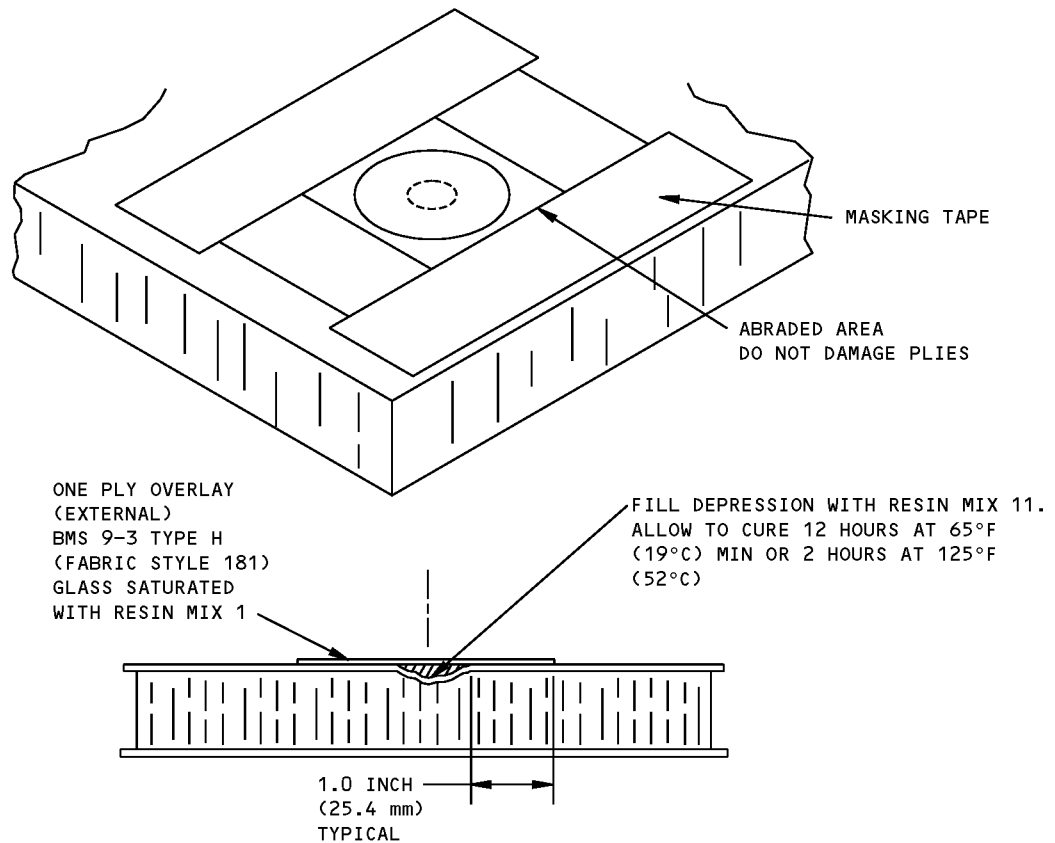
- OVERLAP COVER PLIES PER FIG. 14.
DO NOT TAPER SAND OR STEP SAND ANY PLIES

A ORIENT COVER PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER

B PREPARE AND APPLY TWO GLASS FABRIC COVER PLIES PER PARAGRAPH 4.E, EXCEPT USE TYPE H-2 OR H-3 PLIES ONLY

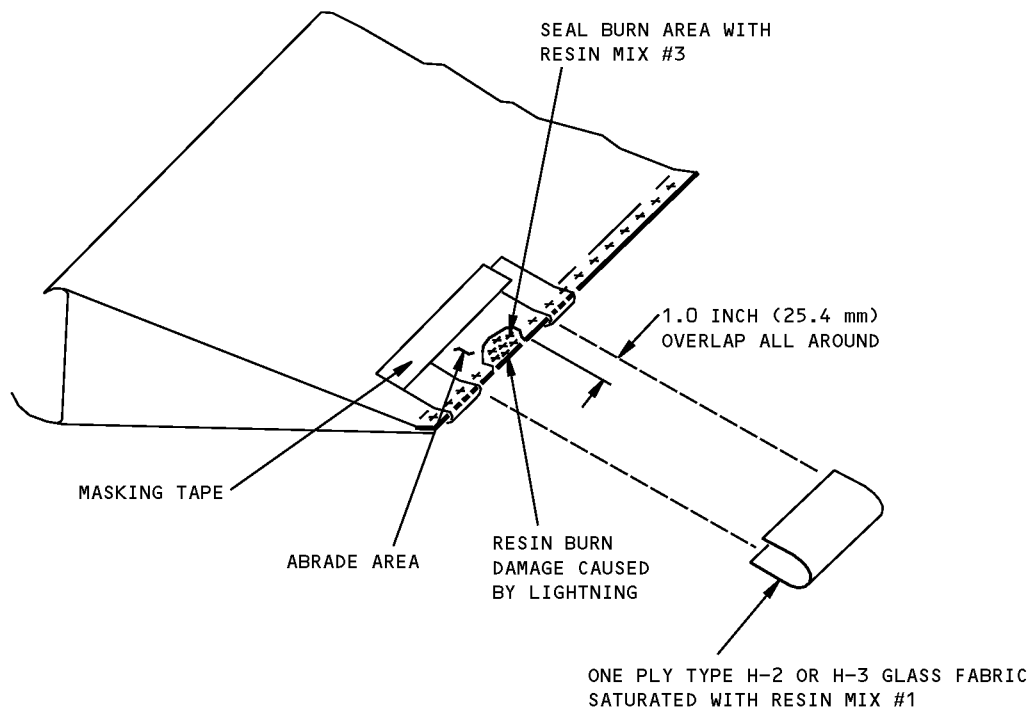
Typical Puncture Repair, 0.50 - Inch Diameter or Less - Room Temperature Cure
Figure 15

757-200
STRUCTURAL REPAIR MANUAL



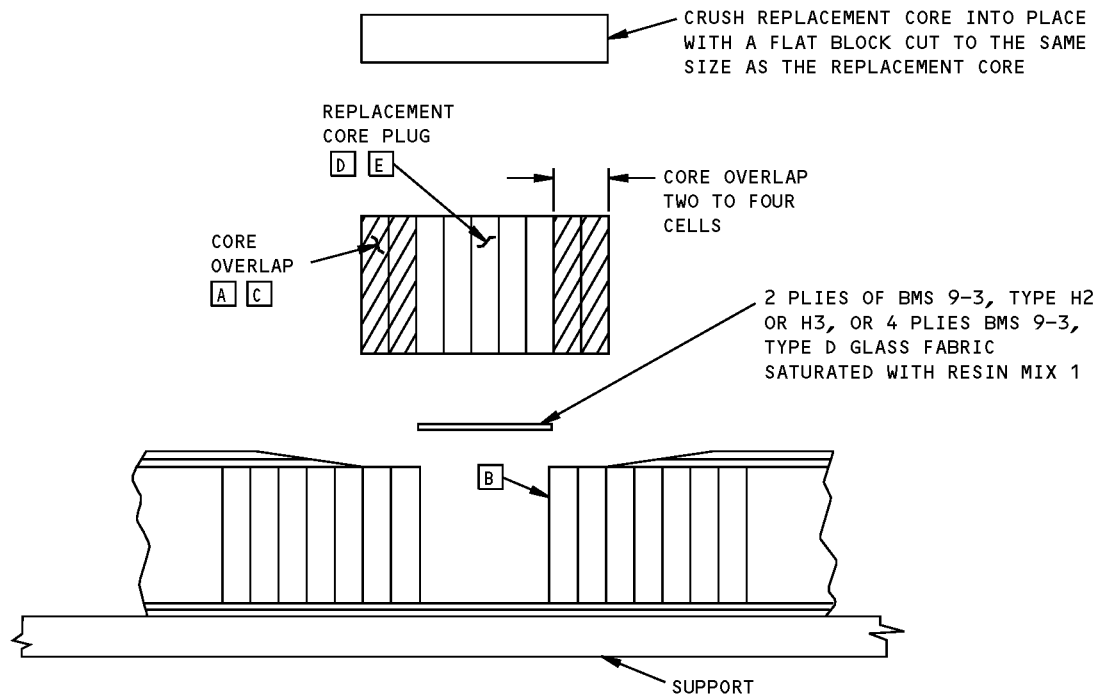
Typical Repair for Dents - Wet Layup
Figure 16

**757-200
STRUCTURAL REPAIR MANUAL**



**Typical Repair for Lightning Damage at Trailing Edge - Wet Layup
Figure 17**

757-200 STRUCTURAL REPAIR MANUAL

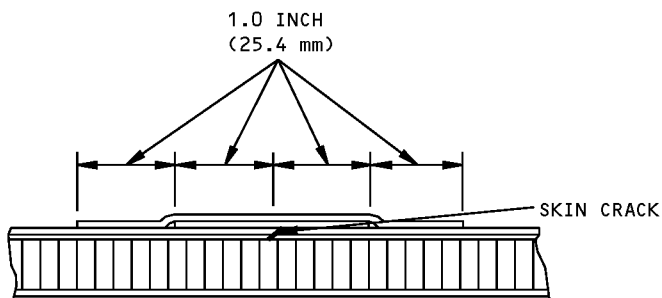
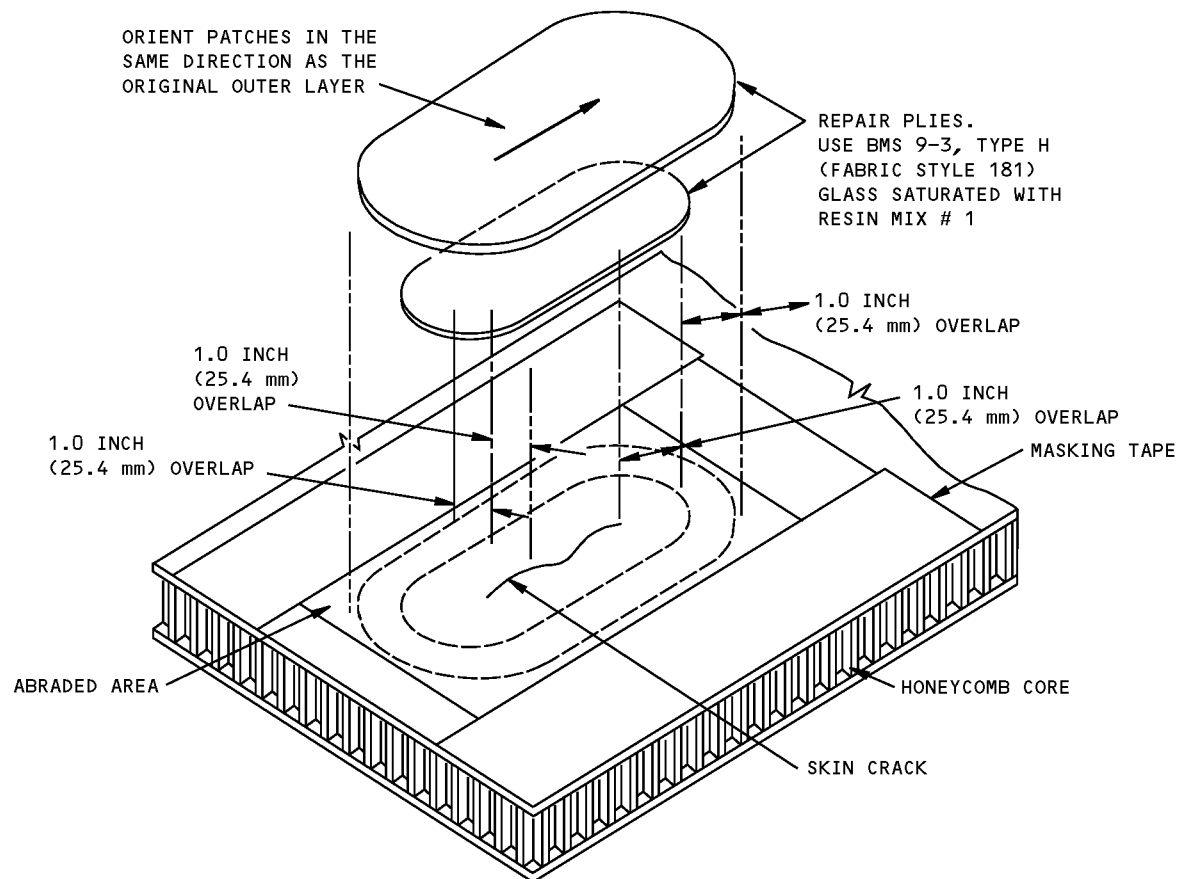


NOTES

- [A] WHEN CRUSH SPLICING CORE 1 INCH (25.4 mm) OR THICKER, THE JOINT MAY BE CHAMFERED.
- [B] PRIOR TO SPLICING, CORE MAY BE STABILIZED WITH SC 1008 PHENOLIC RESIN. LIMIT RESIN APPLICATION TO A MAXIMUM OF 1 INCH (25.4 mm) BEYOND THE EDGE CORE THAT IS TO BE SPLICED. THINNING RESIN WITH ACETONE IS PERMITTED.
- [C] USE BMS 8-301, CLASS 2 OR BMS 8-214 EPOXY RESIN AFTER SPLICING TO KEEP THE SPLICE FROM SEPARATING.
- [D] ALIGN HONEYCOMB CELLS OF REPAIR PLUG WITH ORIGINAL CORE.
- [E] REPLACEMENT CORE PLUG MUST BE MADE FROM CORE MATERIAL A MAXIMUM OF TWO GRADES DENSER THAN THE ORIGINAL CORE.

Core Crush Splicing Requirements - Wet Layup
Figure 18

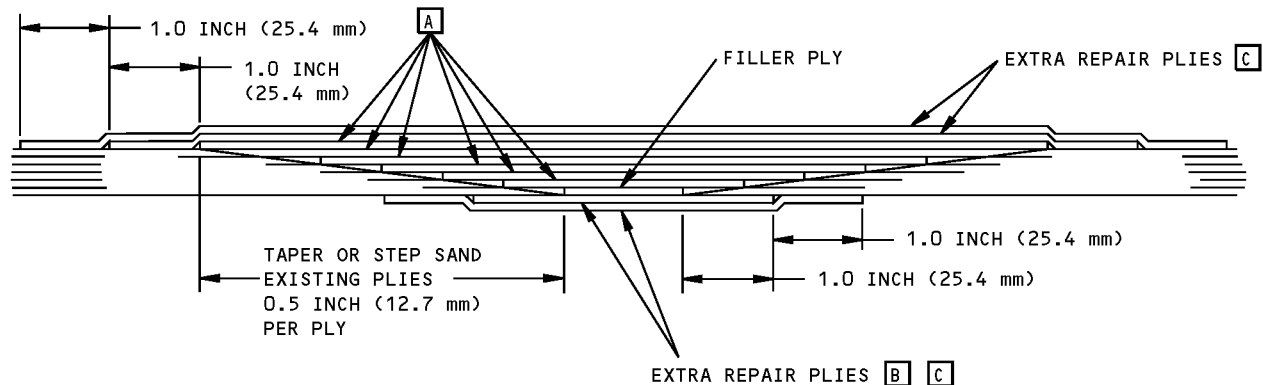
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SECTION VIEW

Repair of Small Damage to One Skin
Figure 19

757-200
STRUCTURAL REPAIR MANUAL

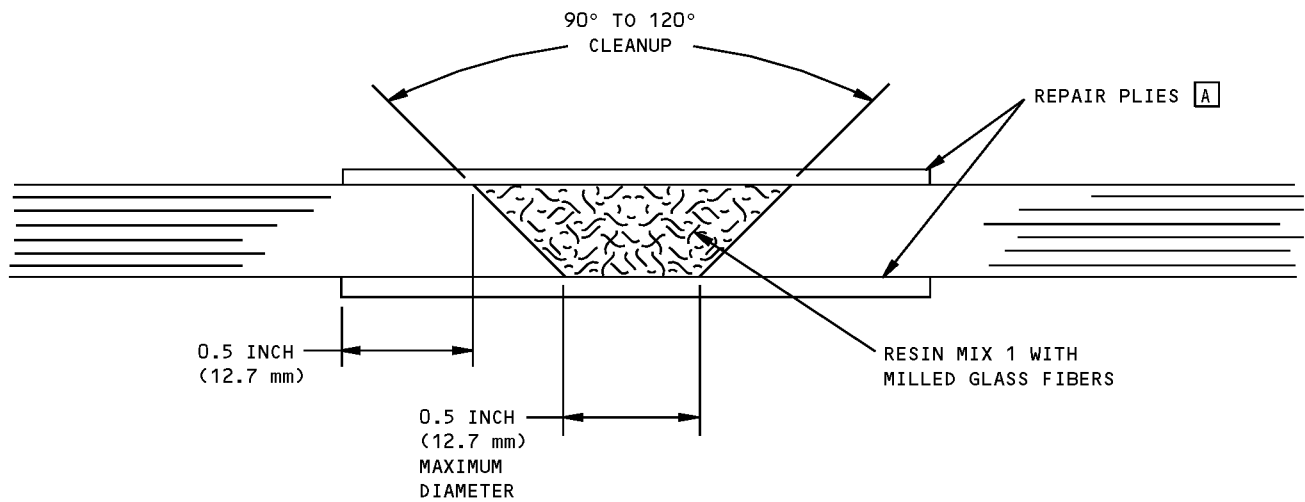


NOTES

- | | |
|---|---|
| <p>[A] DETERMINE NUMBER OF PLIES, ORIENTATION, AND MATERIAL FROM SPECIFIC COMPONENT STRUCTURE IDENTIFICATION</p> <p>[B] EXTRA REPAIR PLIES AT THIS LOCATION ARE REQUIRED ONLY IF THE DAMAGE PENETRATES THIS SURFACE</p> | <p>[C] THE ORIENTATION OF THE OUTERMOST EXTRA REPAIR PLY IS TO BE THE SAME AS THE OUTERMOST PLY OF THE ORIGINAL LAMINATE. ANY OTHER EXTRA REPAIR PLY IS TO BE ORIENTED +45° TO THE EXTRA REPAIR PLY IMMEDIATELY ABOVE IT</p> |
|---|---|

Solid Laminate Repair
Figure 20

757-200
STRUCTURAL REPAIR MANUAL

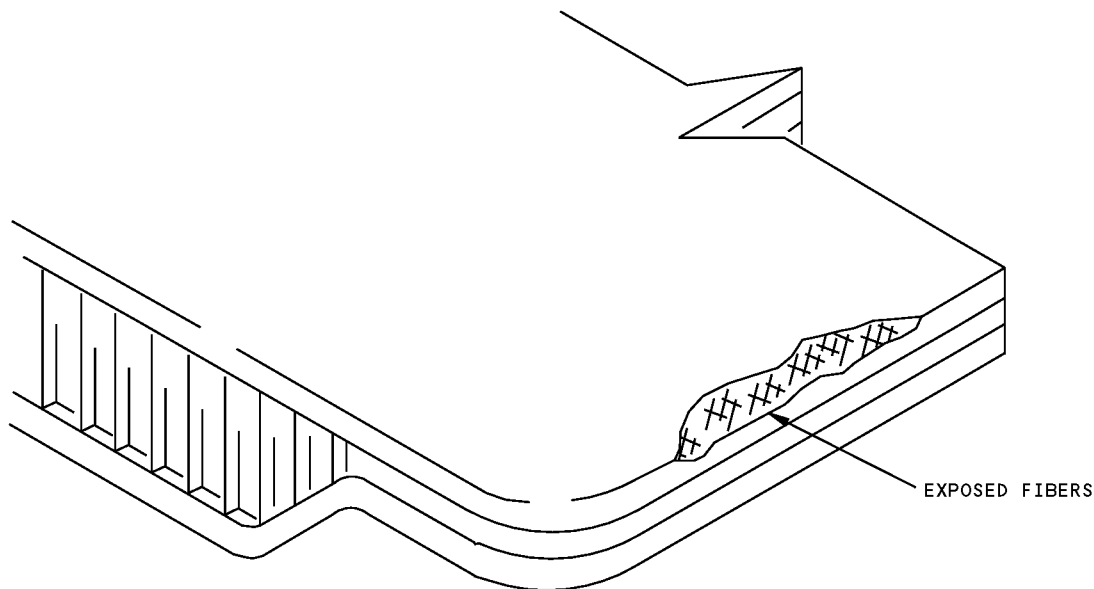


NOTES

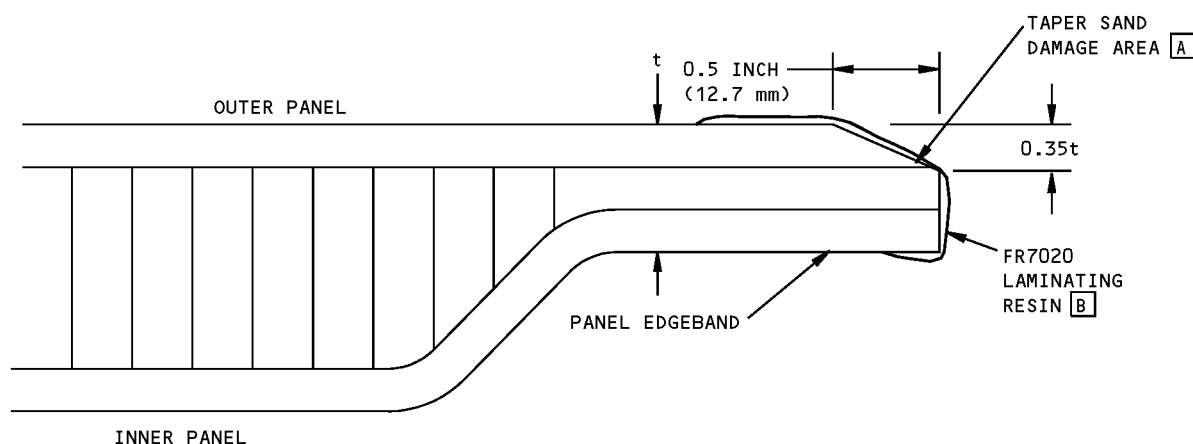
- A** REPAIR PLIES ARE TO HAVE THE SAME
ORIENTATION AS THE ORIGINAL SURFACE
PLIES

Repair of Punctures, 0.50 Inch Diameter or Less, in Solid Laminate
Figure 21

757-200 STRUCTURAL REPAIR MANUAL



PANEL EDGE WITH EROSION DAMAGE



SECTION THRU PANEL

NOTES

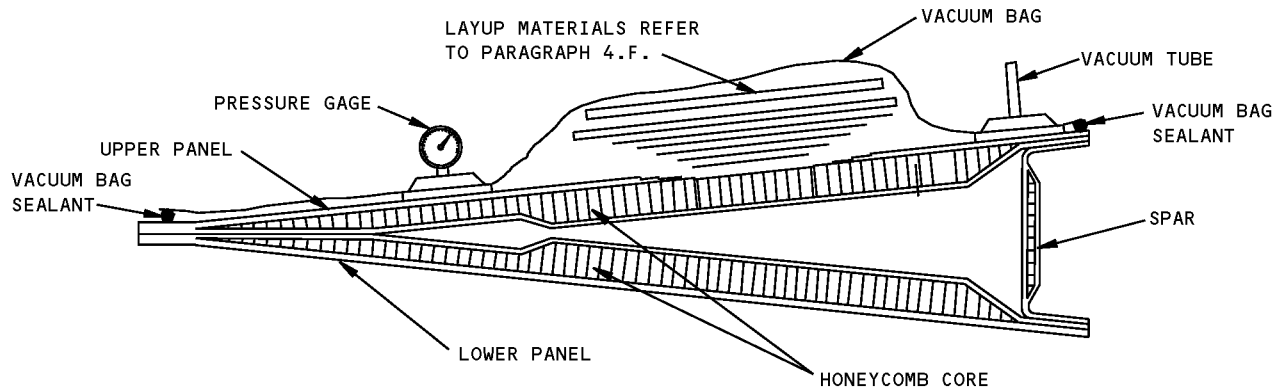
- REFER TO SRM 51-10-01 FOR AERODYNAMIC SMOOTHNESS REQUIREMENTS
- REPAIR IS APPLICABLE TO BOTH HONEYCOMB PANEL EDGE BANDS AND SOLID LAMINATE PANEL EDGES

A TAPER SAND EROSION DAMAGE AREA TO 0.5 INCH (12.7 mm) MAX DISTANCE FROM PANEL EDGE AND 0.35t MAX DEPTH. t = PANEL EDGE BAND THICKNESS

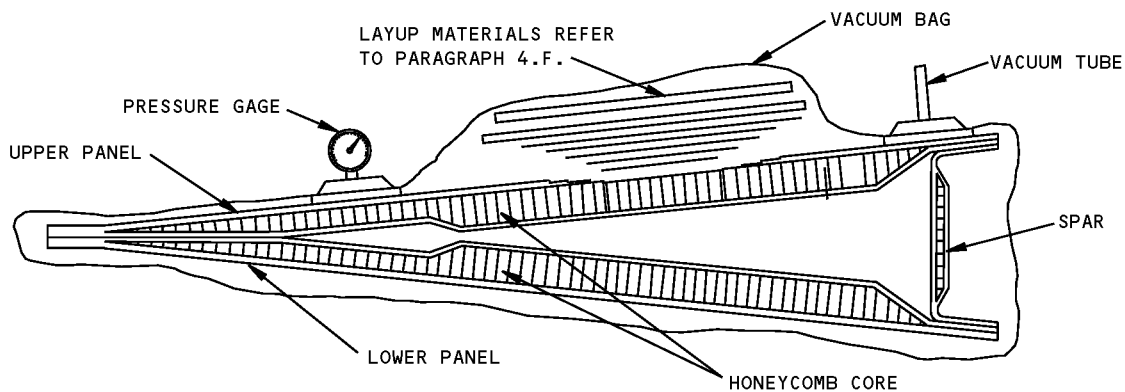
B REFER TO FIGURE 1 FOR RESIN SPECIFICATIONS AND MIXING PROCEDURES

**Repair of Erosion Damage to Panel Edges
Figure 22**

757-200 STRUCTURAL REPAIR MANUAL



ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



NOT ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART
MAY CAUSE ASSEMBLY DISTORTION DURING CURE CYCLE

PARTS CONSISTING OF UPPER AND LOWER PANELS A

NOTES

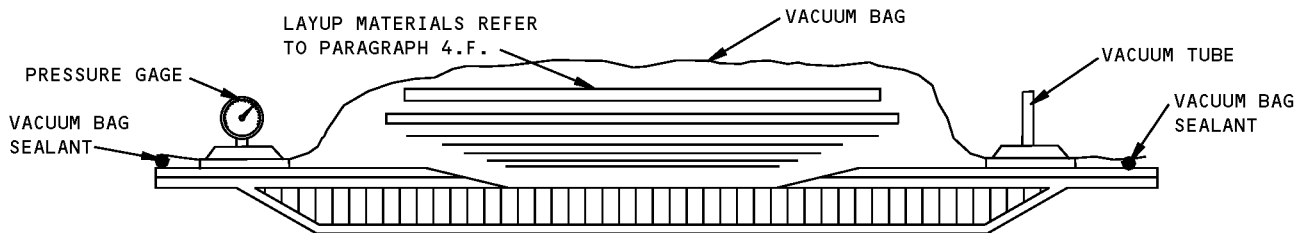
- REFER TO PARAGRAPH 4.F. FOR LAYUP AND BAGGING PROCEDURES

A THIS TYPE OF COMPONENT MUST NOT BE COMPLETELY SEALED IN A VACUUM BAG. DAMAGE TO PART WILL OCCUR. VACUUM BAG ONE SIDE OF COMPONENT ONLY

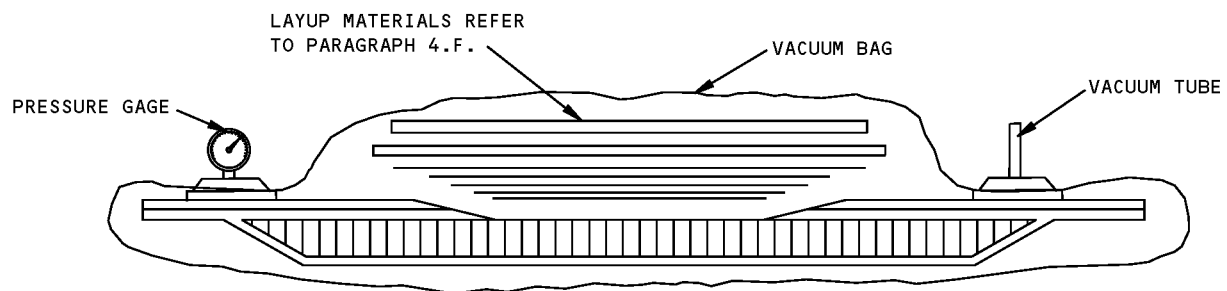
B THIS TYPE OF COMPONENT MAY BE COMPLETELY SEALED IN A VACUUM BAG OR MAY BE SEALED ON ONE SIDE ONLY

Vacuum Bagging Restrictions
Figure 23 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**



ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

**Vacuum Bagging Restrictions
Figure 23 (Sheet 2 of 2)**



757-200

STRUCTURAL REPAIR MANUAL

GENERAL - GLASS FABRIC REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH REPAIRS - 250°F (121°C) CURE

1. Applicability

- A. Repairs contained herein are to components made from epoxy resin reinforced with several layers of fiberglass fabric. The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Glass fabric is also known as fiberglass cloth. Solid laminate is used for small components, honeycomb panel edgebands, and at fitting locations.
- B. These repairs use 250°F (121°C) cure fiberglass epoxy preimpregnated (prepreg) materials which are cured in a vacuum bag either in an autoclave or with a heating blanket as a heat source.
- C. These repairs are permanent in nature. Once completed and the final finish applied per the Maintenance Manual, the original strength will be restored.

CAUTION: TO GET AN ACCEPTABLE QUALITY REPAIR, DO AS FOLLOWS:

- REFER TO THE APPLICABLE COMPONENT WHICH YOU ARE GOING TO REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE YOU USE THESE REPAIR INSTRUCTIONS.

- USE THE CORRECT MATERIALS FOR THE TYPE OF COMPONENT AND REPAIR THAT IS MADE.

- USE THE MATERIALS THAT AGREE WITH THE SPECIFICATIONS IN THE SRM.

- ACCURATELY FOLLOW THE SRM PROCEDURES AT EACH STEP OF THE REPAIR. IF YOU DO NOT DO THIS, IT CAN CAUSE A REPAIR THAT IS NOT SATISFACTORY AND IS NOT APPROVED.

250°F (121°C) CURE REPAIRS ARE RESTRICTED TO SPECIFIC AREAS AND COMPONENTS AS SHOWN IN THE INDIVIDUAL COMPONENT REPAIR IN THE MANUAL. THESE REPAIRS ARE PERMANENT WHEN APPLIED USING THE REPAIR MANUAL PROCEDURES TO COMPONENTS ORIGINALLY MADE FROM 250°F (121°C) CURE MATERIALS.

250°F (121°C) CURE REPAIRS MAY NOT RESTORE THE STRENGTH OR DURABILITY OF COMPONENTS ORIGINALLY MADE USING 350°F (177°C) CURE MATERIALS. THEIR USE IS RESTRICTED TO SPECIFIC AREAS OF COMPONENTS AS SHOWN IN THE INDIVIDUAL COMPONENT REPAIR OF THE MANUAL.

REPAIRS TO DAMAGE CONTAINED HEREIN, SPECIFY MATERIALS QUALIFIED FOR 250°F (121°C) CURE. 350°F (177°C) CURE MATERIALS WILL NOT CURE AT 250°F (121°C) AND MUST NOT BE USED TO ATTEMPT REPAIR OF 250°F (121°C) COMPONENTS.

- D. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

757-200 STRUCTURAL REPAIR MANUAL

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage
Paragraph 4.B./GENERAL	Remove Water and Dry Out Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Prepreg Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedure
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 5.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.H./GENERAL	Repair of Damage and Punctures in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels
Paragraph 5.L./GENERAL	Repair of Surface Dents

2. General

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR RUBBER GLOVES, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

- A. Use suitable holding fixtures per Paragraph 4.F./GENERAL to prevent distortion and delamination of the structure.



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- B. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- C. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- D. Store rolls or precut kits of prepreg and adhesive material below 10°F (-12°C) in sealed moisture-proof bags. An identification label must accompany the material inside the bag, with the following information: BMS type, class, grade, style, supplier name, batch number, roll number, prepreg lot number and date of kit preparation. Record storage time in and out of refrigeration.
- E. Refer to 51-70-02, GENERAL for the locations of principal composite components.
- F. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- G. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
- H. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- I. Restore aluminum flame spray per 51-70-14, GENERAL.
- J. Refer to 51-30-06, GENERAL for composite repair material ordering data.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-05, GENERAL	Repair Sealing
51-30	REPAIR MATERIALS
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-60	CONTROL SURFACE BALANCING
51-70-02, GENERAL	Locations of the Principal Composite Components
51-70-06, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
51-70-17, GENERAL	Repairs to 250°F (121°C) and 350°F (177°C) Cured Graphite/Aramid/Fiberglass Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Structure - 200°F (93°C) to 230°F (110°C) Wet Layup Repair Method
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
DOCUMENT D6-49327	Certification of Autoclaves for Metal Bonding and Curing of Composite Structure
DOCUMENT D6-56273	Qualification of Heat Blankets for Hot Bonding
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Repair Procedures Common to Various Repairs

- A. Determine Damage.

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- (1) Examine visually for extent of damage.

STRUCTURAL REPAIR MANUAL

- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic or thermographic methods. Remove contaminants. Refer to Paragraph 4.B./GENERAL for water removal instructions.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumented Nondestructive Inspection (NDI) methods or by tap test. For tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will give a dull sound. Solid bonded areas will give a sharp ring. Refer to NDT Part 1, 51-05-01.

B. Remove Water and Dry Out Damaged Area.

- (1) Remove water from honeycomb sandwich (Figure 11/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum and oil-free compressed air.
 - (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
 - (c) Apply a fiberglass or a metal fine mesh screen over the exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
 - (g) If the far side is accessible, apply thermocouple to the far side of the honeycomb sandwich panel.

NOTE: If the far side is accessible, it is acceptable to heat the area using a heating blanket only on the far side. An additional heating blanket and vacuum application may be used on the near side at the location shown in Figure 11/GENERAL to accelerate water removal. If the far side is inaccessible, use of a heating blanket on the near side is required.

- (h) When the far side is inaccessible or when using an additional heating blanket, place the heating blanket over the bleeder cloth on the near side.
 - (i) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
 - (j) Evacuate the layup to a minimum of 22 in/Hg (75 kPa) vacuum.
 - (k) Heat the area for 1 hour minimum at 150°F to 170°F (66°C to 77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
 - (l) Remove layup materials and proceed with repair procedure.
 - (2) Remove water from solid laminate.
 - (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
 - (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

CAUTION: REMOVE (FOR ALL TYPES OF CURE) OR ISOLATE (HEAT BLANKET ONLY) ALUMINUM STRUCTURE TO PREVENT LOSS OF STRENGTH IN THE ALUMINUM PARTS. ALL ALUMINUM ALLOYS, EXCEPT 2219, MUST BE KEPT BELOW 200°F (93°C). ALUMINUM 2219 CAN BE KEPT UP TO 400°F (204°C).



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(CAUTION PRECEDES)

REMOVE SEALANTS, PAINTS AND PRIMERS IN THOSE AREAS WHERE THE TEMPERATURE COULD REACH ABOVE THE MAXIMUM ALLOWABLE TEMPERATURE. REFER TO 51-20-01, GENERAL FOR THE MAXIMUM ALLOWABLE TEMPERATURES.

C. Remove Damage and Prepare Damaged Area.

(1) Damage removal.

- (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.

- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. For crush splice repairs (Paragraph 4.D./GENERAL) leave one to three core cells (0.4 maximum) visible between core cavity and skin (Figure 15/GENERAL). The core area removed should extend at least 0.5 in. (12.7 mm) further than the visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side. In cores greater than 1.0 in. (25.4 mm) thick, partially remove core (at least 0.5 in. (12.7 mm) deep) sufficient to clean up damage.

NOTE: When a potted core repair is to be made, removal of damaged core is not required.

- (c) In areas where contamination cannot be removed by cleaning or drying per Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 4.C.(1)(a)/GENERAL.
- (e) When core is removed from the inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 9/GENERAL AND FIGURE 13/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(2) Preparation of damaged area (Figure 13/GENERAL).

- (a) Determine the number of plies that have been cut. Mask off the area around the cleaned up damage allowing 0.5 in. (12.7 mm) overlap for each ply replacement, plus 0.5 in. (12.7 mm) extra for the extra ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the engineering drawing or applicable component structure identification in this manual.



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WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
 - 1) Remove the paint finish or Tedlar film using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper in the masked off area.
 - 2) Taper sand each ply or simply abrade the surface around the cleaned up damage a minimum of 0.5 in. (12.7 mm) per ply. Refer to Figure 13/GENERAL.
 - 3) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
 - 4) Abrade surfaces around repair using No. 150 or finer Scotch-Brite abrasive.

- (c) External surface of panel (critical aerodynamic surfaces).
 - 1) Taper sand a uniform taper around the cleaned up damage using No. 180 sandpaper. The taper is to be over a minimum distance of 0.5 in. (12.7 mm) for each existing ply of the laminate.

Step sanding is optional to taper sanding on honeycomb sandwich structure in areas of noncritical aerodynamic smoothness. Refer to 51-10-01, GENERAL for locations of areas of critical aerodynamic smoothness. Always taper sand on solid laminate structures.

NOTE: For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.

- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 0.5 in. (12.7 mm) border using No. 150 or finer sandpaper.

- (d) Edgeband of panel.

- 1) Taper sand panel edgeband according to Paragraph 4.C.(2)(c)1)/GENERAL.

NOTE: Edgeband is the solid laminate around the outer periphery of the honeycomb panel.

- (e) Cleaning of repair area.

- 1) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.



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(WARNING PRECEDES)

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

(1) Fabricate core plug.

- (a) Fabricate core plug. Refer to specific component structural identification to determine type of core called out on engineering drawing.
- (b) For butt splicing, the honeycomb core should fit flush with the original core and with the ribbon direction aligned. Trim the core plug no more than 0.05 in. (1.3 mm) smaller than the cut out. The core plug is to have a tight interference fit in the core cavity after it is wrapped with the foaming adhesive.
- (c) For crush splicing, the honeycomb core plug should be made two to four cells larger than the repair cavity and be made from core material which is a maximum of two grades denser than original core.

NOTE: Crush splicing applies to fiberglass core (BMS 8-124, Class I) only.

- (d) Trim core plug to full or partial depth of original core as given in Paragraph 4.C.(1)(b)/GENERAL and shown in Figure 2/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive film between core plug and undamaged core or skin (Figure 2/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL).

(2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED THE IMMERSION CRITERIA THAT FOLLOWS. DAMAGE TO CORE MATERIAL WILL OCCUR.

DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99) bath for 60 seconds.
- (b) Locally contaminated areas can be wiped with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
- (c) The core must be completely dry, clean and free of evidence of solvents before installation.

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- (3) Install core plug (Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL).

NOTE: Most of the materials used in this procedure have limited life and require controlled storage conditions. Refer to the applicable material specifications for the maximum time out of the controlled storage and for the uncontrolled storage conditions.

Before opening the adhesive film wrapper, condition refrigerated adhesives to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of adhesive horizontally through its axis free from other rolls or objects.

CAUTION: WHEN HANDLING ADHESIVE FILM WEAR CLEAN WHITE GLOVES TO PREVENT CONTAMINATION.

DO NOT TOUCH THE ADHESIVE FILM WITH BARE HANDS OR OTHER PARTS OF THE BODY.

DO NOT FOLD, STRETCH OR OTHERWISE THIN THE ADHESIVE FILM.

- (a) For partial core replacement, cut two pieces of BMS 5-129, Type 2 or 4, Grade 10 adhesive film and one piece of BMS 8-79, Style 120, fiberglass prepreg fabric to fit the repair hole. Place in position as shown in Figure 2/GENERAL, Section A-A.
- (b) For full depth core replacement, where damage does not extend through both skins, trim a piece of BMS 5-129, Type 2 or 4, Grade 10 adhesive film to fit repair hole and place on the inside surface of the undamaged skin (Figure 2/GENERAL, Figure 3/GENERAL, Figure 7/GENERAL, and Figure 13/GENERAL).
- (c) If both skins are damaged, tape a metal caul plate (such as 0.032 in. (0.81 mm) thick aluminum) against the exterior surface of the far side skin and repair as for damage to one skin only. Repair the other surface in a subsequent repair cycle.
- (d) For butt splicing, wrap the edges of the core plug with BMS 5-90, Type III or IV, Class 250/350, Grade 100, or two layers of Grade 50 foaming adhesive and install in the repair cavity. Align the honeycomb ribbon with the original core, ribbon direction.
- (e) For crush splicing, prepare and install the core plug per Figure 15/GENERAL. Align the honeycomb ribbon with the original core ribbon direction.
- (f) Put the layup materials and equipment in place per Figure 3 (Sheet 2).
 - 1) If the damage extends through both face skins, vacuum bag both sides of the panel (or the entire part) using the layup shown in Figure 3 (Sheet 2).
 - 2) If the replacement core plug is less than or equal to 0.5 in. (12.7 mm) thick, use the heating blanket on the near side and locate at least two separate thermocouples on the panel surface at the bondline.
 - 3) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and both sides are accessible, use heating blankets on both sides. Locate at least two separate thermocouples on the near side at the bondline and one on the far side corresponding to the center of the repair.

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- 4) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and only one side is accessible, use the heating blanket on the near side and put at least two separate thermocouples into the repair hole so the thermocouples touch the repair materials at the bottom of the repair hole.

NOTE: The ends of these thermocouples will be cured into the adhesive. Cut the thermocouples leaving the embedded ends behind before applying the repair plies. Only the portion of the thermocouple embedded in the core can be left in the repair. The thermocouples cannot come between the repair plies and the sanded surfaces of the original plies.

- (g) Evacuate the repair to a minimum of 22 in/Hg (75 kPa) vacuum.
- (h) Cure a minimum of 90 minutes at 250 to 270°F (121 to 132°C). See Figure 14/GENERAL.
- (i) Allow the repair area to cool under vacuum pressure until the temperature of the repair is 160°F (71°C) or less. Then, release restraints (if applicable) and remove layup materials and equipment.
- (j) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (k) Vacuum clean to remove sanding residue from core cells.

NOTE: The core plug and the repair plies can be cured at the same time if the temperature can be adequately monitored by thermocouples placed on the outside surfaces of the panel (refer to Paragraph 4.D.(3)(f)2)/GENERAL, Paragraph 4.D.(3)(f)3)/GENERAL, and Paragraph 4.D.(3)(f)4)/GENERAL). If the thermocouples must be embedded in the repair core adhesive, then the core plug must be cured separately to avoid curing the thermocouple between the repair plies and the sanded surface of the original plies.

CAUTION: DO NOT CURE MORE THAN TEN (10) PLIES DURING ONE CURE CYCLE FOR HEAT BLANKET AND OVEN CURES. IF THE REPAIR HAS MORE THAN 10 PLIES, DIVIDE THE REPAIR PLIES EVENLY INTO MULTIPLE CURE CYCLES. IF YOU DO NOT OBEY, POROSITY AND BULGES CAN OCCUR AND THE SUBSEQUENT REPAIR WILL BE UNSATISFACTORY.

E. Prepare and Apply Preimpregnated (Prepreg) Repair Plies.

NOTE: Before opening the prepreg material or adhesive film wrapper, condition refrigerated materials to room temperature until moisture no longer condenses on the wrapper. During use, suspend the film roll of material horizontally through its axis free from other rolls or objects.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

CAUTION: THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

- (1) Prepare prepreg glass fabric repair plies (BMS 8-79).

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- (a) Refer to the specific component structural identification to determine type and orientation of glass fabric used in original structure. Repair existing plies of original structure with BMS 8-79, Class III, Style 1581 or 7781 (Figure 12/GENERAL).
- (b) From BMS 8-79, Class III, Style 1581 or 7781 preimpregnated material, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(1)(c)/GENERAL, below for substitution of prepreg glass fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not indicated by individual repair, one extra ply is required and is to have the same orientation as the original surface ply.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) Substitution of prepreg glass fabric plies (Figure 12/GENERAL).
 - 1) If BMS 8-79, Style 1581 or 7781 prepreg material is not available, three plies of BMS 8-79, Style 120 prepreg material may be substituted for each ply of Style 1581 or 7781 prepreg material required (Figure 12/GENERAL).
- (2) Apply the repair plies (Figure 2/GENERAL and Figure 13/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with strips of preimpregnated material before application of the repair plies. Use the same material as used in the repair plies.

CAUTION: ENSURE THAT PARTING FILM AND POLYETHYLENE SEPARATOR ARE REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Make a temporary vacuum bag system.

NOTE: This vacuum bag is used to compact the repair plies and prevent contamination of the repair. Do not use this vacuum bag system for the repair cure.

- 1) Put one layer of perforated parting film above the repair.
- 2) Put one layer of glass fabric cloth as a surface breather above the repair.
- 3) Apply the vacuum sealing compound around the repair area.
- 4) Put the vacuum bag material over the repair area. Seal the edges with the vacuum sealing compound.
- 5) Attach a vacuum line above the surface breather.

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- (b) Cut two plies of BMS 5-129, Type 2 or 4, Grade 10 adhesive film, 0.125 in. (3.2 mm) larger than the largest patch ply which also covers the entire repair area.

NOTE: The second ply of adhesive film will be used as a nonstructural sanding ply. As an option, substitute a ply of BMS 8-79, Style 1581 fiberglass prepreg cut to the same size as the adhesive ply. The fiberglass ply is less likely to entrap air during the cure.

This nonstructural sanding ply is the final ply and covers the entire repair. After curing, this ply may be sanded as required to obtain a smooth surface for refinishing. Be careful not to sand through this nonstructural sanding ply into the structural repair plies below it.

- (c) Place one layer of adhesive film over the entire repair area.
(d) Install the repair plies and the sanding ply, if used.

NOTE: Add filler plies as necessary to get a smooth repair. Do not use more than four filler plies on one repair area.

- 1) Install the smallest repair ply first.
- 2) Make sure that the warp direction of each repair ply that you put in the repair is correct and that the overlap is correct.
- 3) Install the next ply. Make sure that it is smooth with no wrinkles.
- 4) Remove the separator sheet.
- 5) Boeing recommends that you do the steps that follow:
 - a) Compact the repair plies with a temporary vacuum system as follows for repairs that have five or more repair plies:
 - 1 minute for each ply (one ply at a time), or
 - 2 minutes for each two plies (two plies at a time), or
 - 6 minutes for each three plies (three plies at a time)
 - b) Do Paragraph 4.E.(2)(d)2)/GENERAL, Paragraph 4.E.(2)(d)3)/GENERAL, Paragraph 4.E.(2)(d)4)/GENERAL, and Paragraph 4.E.(2)(d)5)/GENERAL again for all of the repair plies as necessary to complete the layup.
- (e) Apply a cover ply of BMS 8-79, Style 1581 fiberglass prepreg or the second ply of adhesive film over the replaced plies.

F. Layup and Bagging Procedure.

- (1) Place one layer of perforated FEP parting film over the replacement plies and extending at least 1 in. (25 mm) beyond the largest patch ply.
- (2) Put on the thermocouples.
 - (a) If you use an autoclave or an oven, then do the step that follows:
 - 1) Put one or more thermocouples at the location where the temperature will increase the fastest and one or more thermocouples where the temperature will increase the slowest.

NOTE: Boeing recommends that you put one or more thermocouples at the thick areas of the part and tool and the thin areas of the part and tool. Use more than two thermocouples when more than 900 in² (0.58 m²) of a panel surface is repaired. Insulation is not necessary in the repair area for autoclave or oven cures.



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(b) If you use a heat blanket, then do the step that follows:

- 1) Secure three thermocouples (spaced evenly around the repair) to the panel at the edge of the repair and secure them to the temperature recording device.

(3) Place a layer of dry peel ply over the perforated FEP.

NOTE: The peel ply must be cut large enough to make contact with the surface breather.

(4) Place one layer of solid FEP parting film over the layup extending to 0.5 in. (12.7 mm) short of the edge of the dry peel ply.

(5) If you use a heat blanket, then place it over the repair area.

NOTE: The heat blanket must extend a minimum of 2 in. (5 cm) beyond the edge of the patch.

When you use a heat blanket that is longer than 12 in. (30 cm) on one side, it is recommended that you use an aluminum pressure plate (0.040 in. (1.0 mm) thick max) to minimize localized heating.

If you use two or more pads, then you must also use a pressure plate.

(a) If the area to be repaired is near or attached to aluminum structure that was not removed in Paragraph 4.C./GENERAL, do the steps that follow:

- 1) Isolate the aluminum structure from the areas that will get hot.
- 2) Add one or more thermocouples to put on the aluminum structure. Make sure that the temperature does not go above 200°F (93°C).
- 3) You can put insulation around all other metals to prevent cold locations in the repair.

(6) Place a layer of Airweave SS Style 120 glass fabric over the solid FEP as a surface breather, or, if heat blanket is used, place four to six layers of breather material over the heat blanket to act as an insulator and a surface breather.

NOTE: The surface breather material and the dry peel ply must make contact.

(7) Lay the vacuum line over the edge of the breather material.

(8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.

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CAUTION: HOLLOW COMPOSITE COMPONENTS SUCH AS RUDDERS, ELEVATORS, AND AILERONS MUST NOT BE COMPLETELY BAGGED BECAUSE THEY MAY COLLAPSE UNDER 22 IN/HG (75 KPA) VACUUM. ATTACH VACUUM BAG TO ONE SIDE OF COMPONENT ONLY OR ATTACH SEPARATE VACUUM BAGS TO EACH SIDE TO ENSURE THAT ATMOSPHERIC PRESSURE IS MAINTAINED INSIDE OF COMPONENT DURING REPAIR. COMPONENTS CONSISTING OF A SINGLE PANEL MADE OF FULL DEPTH HONEYCOMB CORE WITH LAMINATE FACE SHEETS AND EDGE BANDS MAY BE COMPLETELY BAGGED (FIGURE 16/GENERAL).

- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. In some cases, it is optional to vacuum bag the entire part.

NOTE: The entire repair surface must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts sagging and distortion could occur due to the weight of the part.

- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
- (11) Check the vacuum bag for leak paths.
- G. Cure the repair. Do Paragraph 4.G.(1)/GENERAL for the autoclave procedure, Paragraph 4.G.(2)/GENERAL for the oven cure procedure, or do Paragraph 4.G.(3)/GENERAL for the heat blanket/heat lamp cure procedure.

- (1) For an autoclave cure, see Figure 14/GENERAL, Detail I and do the steps that follow:

NOTE: Boeing recommends that you use a certified autoclave when you do the procedure that follows. DOCUMENT D6-49327, Certification of Autoclaves, is a procedure that Boeing uses, and you can use this as a guide to certify your autoclave.

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. This must be done for all parts that were initially made at a cure temperature of 250°F (121°C). Boeing also recommends that you hold the part in the specified part tool, if the part was initially made at a cure temperature of 350°F (177°C). The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Pressurize the autoclave to 40 to 50 psig (276 to 345 kPa gauge). Open the vacuum bag to the atmosphere when the autoclave pressure is above 20 psig (138 kPa gauge).
- (c) Increase the temperature of the autoclave until it is at 130°F (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 2°F to 8°F (1°C to 5°C) for each minute until all thermocouples are in the cure temperature range.

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- (d) Hold the cure temperature for the time specified as given in Figure 14/GENERAL, Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature range during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (e) Keep the vacuum bag connection to the atmosphere open and the autoclave pressurized until after the cure is complete and the temperature of the part has decreased to 125°F (52°C).
- (f) Decrease the autoclave temperature at a maximum rate of 5°F (3°C) for each minute.
- (g) When the temperature is less than 125°F (52°C), release the autoclave pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONNEL.

- (2) For oven cure, see Figure 14/GENERAL, Detail I and do the steps that follow:

NOTE: Use a circulating oven that has equipment that can supply a vacuum and can control the temperatures as given in this procedure.

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. This must be done for all parts that were initially made at a cure temperature of 250°F (121°C). Boeing also recommends that you hold the part in the specified part tool, if the part was initially made at a cure temperature of 350°F (177°C). The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum vacuum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the oven until it is at 130°F (54°C). When the temperature is at 150°F (54°C), increase the temperatures at a rate of 2°F to 8°F (1°C to 5°C) for each minute until all thermocouples are in the cure temperature range.
- (d) Hold the cure temperature for the specified time as given in Figure 14/GENERAL, Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (e) Decrease the oven temperature at a maximum rate of 5°F (3°C) for each minute.
- (f) When the temperature is less than 125°F (52°C), remove the vacuum pressure.
- (g) Remove the vacuum bag equipment from the part and tool.

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WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONNEL.

(3) For heat blanket cure, see Figure 14/GENERAL, Detail II and do the steps that follow:

NOTE: Boeing recommends that you use a qualified heat blanket when you do the procedure that follows. DOCUMENT D6-56273, Qualification of Heat Blankets for Hot Bonding, is a procedure that Boeing uses, and you can use this as a guide to qualify your heat blanket.

- (a) Make sure there is a minimum of three thermocouples for each heat blanket used. Refer to Paragraph 4.F./GENERAL.
- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum vacuum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the heat source until the temperature of the repair is at 130°F (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 2°F to 8°F (1°C to 5°C) for each minute until all thermocouples are at the cure temperature.

NOTE: When you use a hot bond console, obey the manufacturer's operation instructions.

- (d) If necessary, put insulation on the cooler areas of the repair area, opposite of the heat source.
- (e) Hold the cure temperature for the specified time, as given in Figure 14/GENERAL, Detail II.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (f) Decrease the temperature at a rate maximum of 5°F (3°C) for each minute.
- (g) When the temperature decreases to less than 125°F (52°C), release the vacuum pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

H. Refinish After Repair.

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of top most repair ply as necessary to fair the edge. Do not sand through the nonstructural sanding ply into the structural repair plies below it.
- (2) Apply finish to the repaired surface using the following applicable methods.
 - (a) Where clear Tedlar film surfaces have been removed, seal with a brush coat of Resin Mix 3 (Figure 1/GENERAL). Cure for 6 to 8 hours at room temperature or at elevated temperature per Figure 4/GENERAL.
 - (b) Where gray or white Tedlar film surfaces have been removed, seal with Resin Mix 3 (Figure 1/GENERAL). Cure 6 to 8 hours at room temperature (or per Figure 4/GENERAL) and apply one coat of BMS 10-79, Type II primer and one coat of BMS 10-60, Type II enamel (gray, BAC 705; white, BAC 7106).
 - (c) Where conductive coating BMS 10-21 has been removed, reapply per AMM 51-24-02.

STRUCTURAL REPAIR MANUAL

- (d) Where the abrasion resistant Teflon finish has been removed from the internal surface of the panel edgeband, reapply the finish per AMM 51-24-13.
- (e) Where the original painted surfaces have been removed, restore original finish per AMM 51-21-00/701.
- (f) Where sealant has been removed from around fittings or fay surfaces to facilitate repairs, reapply BMS 5-95 sealant per 51-20-05, GENERAL.
- (g) Where permanent fasteners have been removed from aluminum fittings common to graphite, reinstall bolts wet with BMS 5-95 sealant and fillet seal around boltheads and nuts.
- (h) Where aluminum flame-sprayed areas have been damaged, repair per 51-70-14, GENERAL.
- (i) Where aluminum-coated glass fabric (BMS 8-278) has been repaired, aluminum flame spray per 51-70-14, GENERAL.

I. Perform Post-Repair Requirements.

- (1) Make an inspection of the repair that was done to make sure that the repair is satisfactory. The inspection must include these areas:
 - The area that was hot.
 - A minimum width of 2 in. (5 cm) all around the area that was hot.

If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: Post repair inspection is recommended. Examples of inspection procedures are given in NDT Part 1, 51-01-01. Other inspection methods that have been examined and found satisfactory by the airline can be used.

WARNING: FLIGHT SAFETY DEMANDS THAT CERTAIN CONTROL SURFACES BE PROPERLY BALANCED AT ALL TIMES.

- (2) Following repair of control surface, balance must be checked to determine whether or not rebalancing is required. Rebalance as necessary per CONTROL SURFACE BALANCING, SECTION/51-60.

CAUTION: REPAIRS MADE TO STRUCTURE ADJACENT TO CONTROL SURFACES MUST NOT INTERFERE WITH THE DESIGNED OPERATION OF THE CONTROL SURFACES. DAMAGE TO AIRPLANE STRUCTURE MAY OCCUR.

- (3) Check all repairs for clearance and noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

CAUTION: REPAIRS MUST NOT COVER EXISTING DRAIN HOLES IN PANELS. WATER WILL ACCUMULATE IF DRAIN HOLES ARE COVERED.

- (4) If repair covers the drain hole, drill through the repair at existing location.

NOTE: Drain holes are usually 0.375 in. (9.52 mm) diameter. Refer to AMM 51-41-01.

5. **Typical Repairs**

NOTE: These repairs apply to all 250°F (121°C) fiberglass fabric reinforced honeycomb components, except radomes, when called out in applicable repair index of specific structure.

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CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR FOR THE REPAIR LIMITS AND MATERIAL FOR THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

A. Repair of Delaminations Between Plies.

- (1) Delamination of plies over core area of panel Figure 5/GENERAL).
 - (a) Determine damage per Paragraph 4.A./GENERAL. Ensure that water and other contamination are removed as given in Paragraph 4.B./GENERAL.
 - (b) Cut away delaminated plies per Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area per Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband.
 - (a) Repair this type of damage per 51-70-17, GENERAL.

B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel.

- (1) Repair this type of damage per 51-70-17, GENERAL.

C. Repair of Damage to One Skin and Honeycomb Core using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Figure 2/GENERAL).

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area per Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
- (5) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Figure 6/GENERAL).

NOTE: For repair where access to inner surface is limited, refer to Paragraph 5.F./GENERAL.

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area. Refer to Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL, except do not perform Paragraph 4.D.(3)(e)/GENERAL, Paragraph 4.D.(3)(f)/GENERAL, Paragraph 4.D.(3)(g)/GENERAL, Paragraph 4.D.(3)(h)/GENERAL, Paragraph 4.D.(3)(i)/GENERAL, Paragraph 4.D.(3)(j)/GENERAL, and Paragraph 4.D.(3)(k)/GENERAL.
- (5) Prepare and apply repair plies to one surface of the panel according to Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.

STRUCTURAL REPAIR MANUAL

- (6) Apply vacuum pressure and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
- (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (8) Prepare and apply repair plies to the other surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

E. Replacement of Honeycomb Core on Damaged Edge of Panel (Figure 7/GENERAL).

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area as given in Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
- (5) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (6) Clean surfaces according to Paragraph 4.C.(2)(e)/GENERAL.
- (7) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side (Figure 8/GENERAL).

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side. Refer to Figure 8/GENERAL when making this repair.

- (1) Determine extent of damage (Paragraph 4.A./GENERAL).
- (2) Ensure that all contamination and water is removed from damaged area as given in Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area per Paragraph 4.C./GENERAL and the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + \{N \times [1.0 \text{ in. (25.4 mm) for each ply}]\} + 1.0 \text{ in. (25.4 mm)}$

d = major diameter of oval hole in inner skin and is limited to 1.5 in. (38.1 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole, see Figure 8/GENERAL, Detail I.
- (c) Taper sand the outer skin plies per Paragraph 4.C.(2)/GENERAL.

STRUCTURAL REPAIR MANUAL

- (4) Fabricate an airtight patch, Figure 8/GENERAL, Details II thru V to cover the oval hole from the inaccessible side as follows:
- (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
 - (b) Cover the mold with parting film or release agent.
 - (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 4.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D diameter.
 - (d) Bag and cure the patch per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Place thermocouples at the edge of the patch before cure.
 - (e) Remove the patch from the mold.
 - (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
 - (g) Drill a 0.125 in. (3.175 mm) diameter hole in the center of the patch for a Cleco fastener.
 - (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
 - (i) Fabricate a strip of spring steel 1.0 in. (25 mm) X 10.0 in. (254 mm) and drill a 0.125 in. (3.175 mm) diameter hole in the center for the Cleco fastener.
- NOTE:** This repair illustrates the use of a spring steel clamp. However, any suitable retaining device may be used.
- (j) Assemble the patch and spring steel together with a 0.125 in. (3.175 mm) diameter Cleco fastener, see Figure 8 (Sheet 2), Detail II.
- (5) Remove Tedlar, if required and abrade the underside of the inner skin to a distance of 0.38 in. (9.7 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean out the repair area with oil-free compressed air. Wipe the surface with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
 - (7) Bend up both ends of the spring steel and apply BMS 5-109, Type II adhesive paste to the precured patch.
 - (8) Holding the spring steel up - insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
 - (9) Cure the adhesive per Figure 1/GENERAL. When cure is complete, remove the Cleco fastener and spring. Fill hole for Cleco fastener with BMS 5-109, Type II adhesive paste or BMS 5-95, Class B 1/2 sealant and let it cure.
- NOTE:** Cure BMS 5-109 adhesive paste as given in Figure 1/GENERAL. Cure BMS 5-95 sealant as given in 51-20-05, GENERAL.
- (10) Clean out the repair area per Paragraph 5.F.(6)/GENERAL.
 - (11) Apply adhesive film BMS 5-129, Type II or IV, Grade 05, 0.10 in. (2.5 mm) bigger than diameter D to the surface of the inner skin which fays with the inner skin repair plies.
 - (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin.

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- (13) Fabricate, clean, and install core plug per Paragraph 4.D./GENERAL.
- (14) Prepare and apply repair plies to the outer skin surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Figure 9/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out.
- CAUTION:** DO NOT SAND INTO BOND PLY OR CORE (FIGURE 9/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THIS CAUTION IS NOT OBSERVED. BOND PLY IS PLY ADJACENT TO CORE.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- H. Repair of Damage and Punctures in Solid Laminate Panels.
- NOTE:** This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with other damage.
- (3) Remove all damage and prepare area per Paragraph 4.C./GENERAL.
- NOTE:** Taper sand edges of plies around repair on damaged side of panel.
- (4) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- NOTE:** If cleaned up damage penetrates solid laminate, secure a metal caul plate (such as 0.016 in. (0.4 mm) thick aluminum) to far side of panel to support repair plies.
- I. Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels.
- NOTE:** This repair applies to components made from laminated fiberglass fabric or tape plies and epoxy resin without a honeycomb core.
- (1) Check for delamination per Paragraph 4.A./GENERAL.
- (2) If no delamination is found, clean up damage to a smooth, rounded shape. Then repair per Paragraph 5.B./GENERAL.
- (3) If delamination is found, repair per Paragraph 5.H./GENERAL.
- J. Repair of Delaminations Between Plies in Solid Laminate Panels.
- NOTE:** This repair applies to components made from laminated fiberglass fabric or tape plies and epoxy resin without a honeycomb core.
- (1) Repair delaminations using methods described in Paragraph 5.H./GENERAL.
- K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels (Figure 10/GENERAL).



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- (1) Determine the extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
 - (3) Taper sand around the hole to remove damage according to Figure 10/GENERAL and Paragraph 4.C.(2)(d)/GENERAL.
 - (4) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.
 - (5) Prepare and apply repair plies according to Paragraph 4.E./GENERAL and Figure 10/GENERAL.
 - (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
 - (7) Refinish the repair according to Paragraph 4.H./GENERAL.
 - (8) Drill and countersink fastener holes.
 - (9) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.
- L. Repair of Surface Dents.
- (1) Check for delamination and broken fibers per Paragraph 4.A./GENERAL.
 - (2) If delamination is found, repair per Paragraph 5.A./GENERAL.
 - (3) If broken fibers are found, repair per Paragraph 5.B./GENERAL or Paragraph 5.C./GENERAL.
 - (4) If no delamination or broken fibers are found, repair per 51-70-06, GENERAL.



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STRUCTURAL REPAIR MANUAL

RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
(CONTINUED) BMS 8-79 (PREPREG) CLASS III, GRADE B, STYLE 7781	NOT APPLICABLE			
BMS 5-109, TYPE II (ADHESIVE TAPE)	EA 9394 PART A EA 9394 PART B OR EA 934 NA PART A EA 934 NA PART B	REFER TO MANUFACTURERS' DATA	30 MINUTES	130 MINUTES ±10 MINUTES AT 150°F (66°C) ±20°F (7°C)

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 2 of 4)

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
RESIN MIX 3 (SEALER RESIN)	EPIBOND 156A EPIBOND 156B HARDENER	98 TO 102 4.7 TO 5.3	12 TO 25 MINUTES AT 77°F (25°C)	12 HOURS AT 70°F (21°C) OR 1 TO 3 HOURS AT 150°F (66°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE	FIBER-RESIN 5318S FIBER-RESIN 5318C	98 TO 102 49 TO 51	45 TO 60 MINUTES AT 70°F (21°C)	REFER TO FIG. 4 OR 24 HOURS MINIMUM 70°F (21°C)
RESIN MIX 3 EPOX-O WELD (SEALER RESIN) ALTERNATE	TWO COMPONENT KIT	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT		
			45 TO 60 MINUTES AT 70°F (21°C)	REFER TO FIG. 4 OR 24 HOURS MINIMUM AT 70°F (21°C)
RESIN MIX 3 (SEALER RESIN)	EPIBOND 156A EPIBOND 941 HARDENER	98 TO 102 12 TO 15	45 TO 60 MINUTES AT 70°F (21°C)	12 HOURS AT 70°F (21°C) OR 1 TO 3 HOURS AT 150°F (66°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE BMS 8-207, TYPE 1, CLASS I (250°F)	EC1838A EC1838B HARDENER	50 50	20 MINUTES	12 HOURS MINIMUM AT 105°F (41°C) TO 125°F (52°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE BMS 8-207, TYPE 1, CLASS II (350°F)	FR-40 5413C HARDENER	99 TO 101 14.5 TO 15.5	20 MINUTES AT 75°F (24°C) TO 79°F (26°C)	12 HOURS MINIMUM AT ROOM TEMPERATURE (65°F MINIMUM)(18°C) 1 HOUR MINIMUM AT 150°F TO 170°F (66°C TO 77°C)
BMS 8-301 CLASS 2 LAMINATING RESIN	FR 7020 PART A RESIN BASE PART B HARDENER EY3804 PART A RESIN BASE PART B HARDENER	100 ± 2 58 ± 0.5	30 MINUTES AT 75°F	150° (66°) AT 180 MINS. 5 DAY AT ROOM TEMP 68° (20°C)

**Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 3 of 4)**



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WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

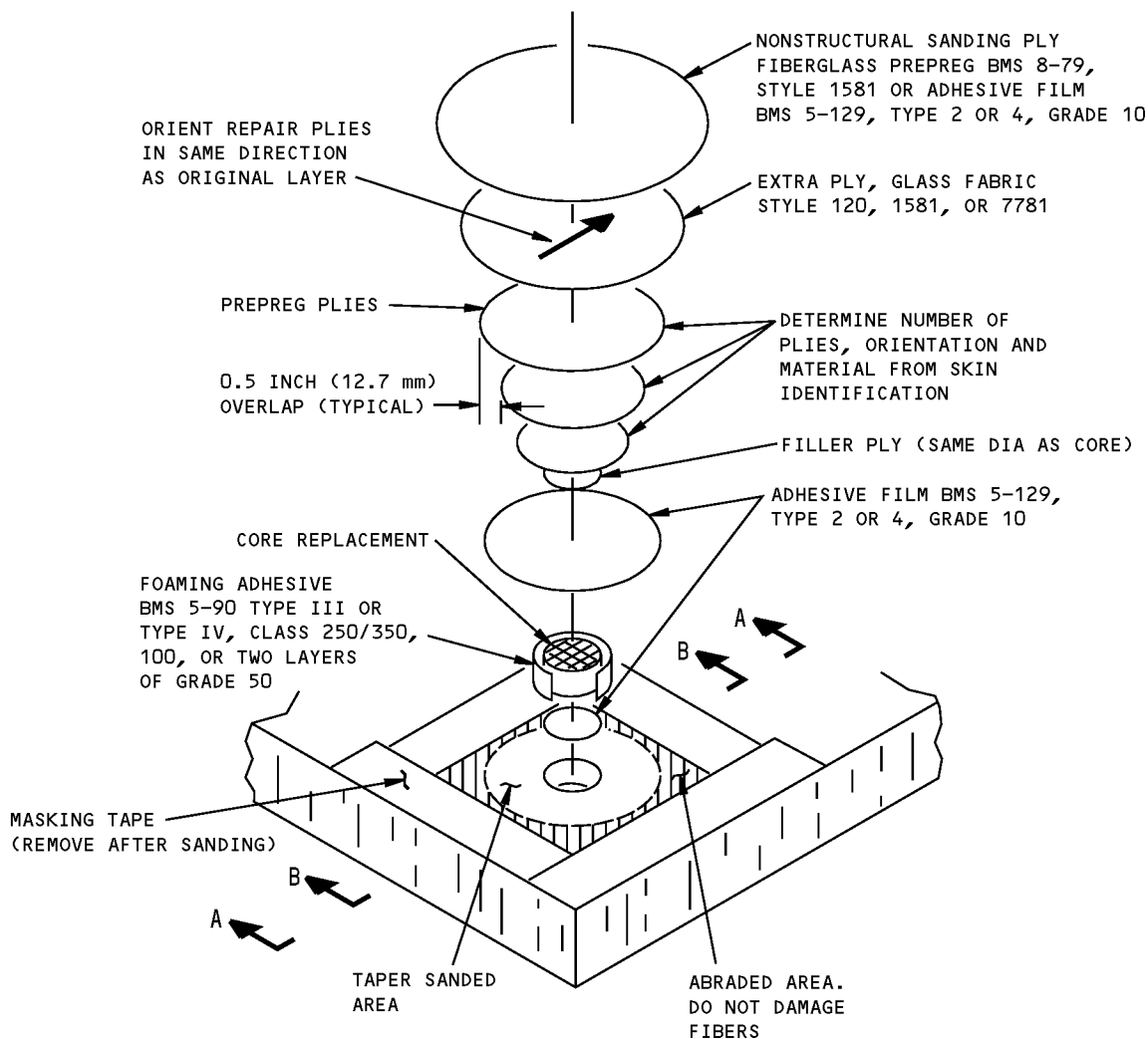
	RESIN MIXING AND ADHESIVE PREPARATION PROCEDURES
RESIN MIX 1 RESIN MIX 3 BMS 8-301	ADD HARDENER TO RESIN AND MIX THOROUGHLY
BMS 5-90 BMS 5-129	REMOVE WRAPPER FILM BEFORE USE

NOTES

- REFER TO SRM 51-30-00 FOR SOURCES OF MATERIALS.
 - REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.
- A** OUT-TIME OF THIS MATERIAL IS 200 EXPOSURE UNITS. ONE EXPOSURE UNIT IS ACCUMULATED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 10°F (-12°C) AND 80°F (27°C). THREE EXPOSURE UNITS ARE ACCUMULATED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 81°F (27°C) AND 100°F (38°C). MATERIALS EXPOSED TO TEMPERATURES ABOVE 100°F (38°C) ARE TO BE REJECTED.
- B** REMOVE THE MATERIAL FROM REFRIGERATION AND KEEP IT SEALED AT 65°F (18°C) TO 90°F (32°C) FOR A MINIMUM OF 8 HOURS FOR A FULL ROLL BEFORE IT IS USED.
- C** THE MATERIAL MAY BE PUT BACK INTO REFRIGERATION ONE OR MORE TIMES WHEN THE CUMULATIVE OUT-TIME IS NOT MORE THAN 10 DAYS.
- D** THE MATERIAL MAY BE PUT BACK INTO REFRIGERATION ONE OR MORE TIMES WHEN THE CUMULATIVE OUT-TIME IS NOT MORE THAN 5 DAYS.

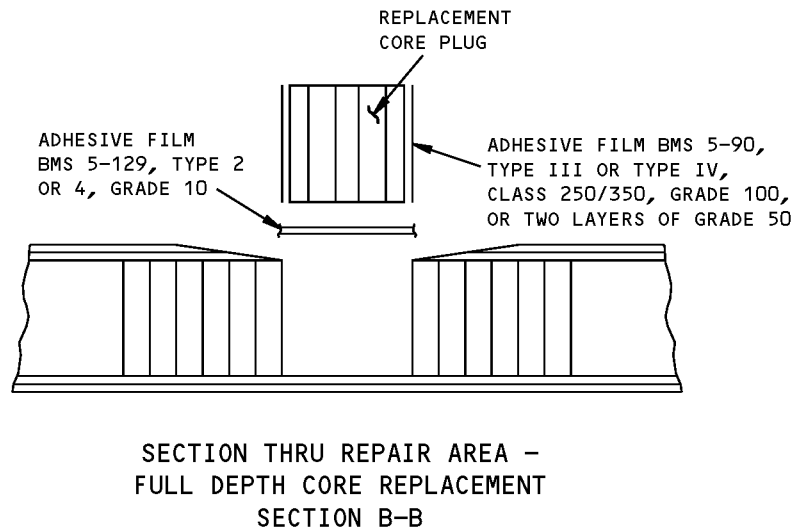
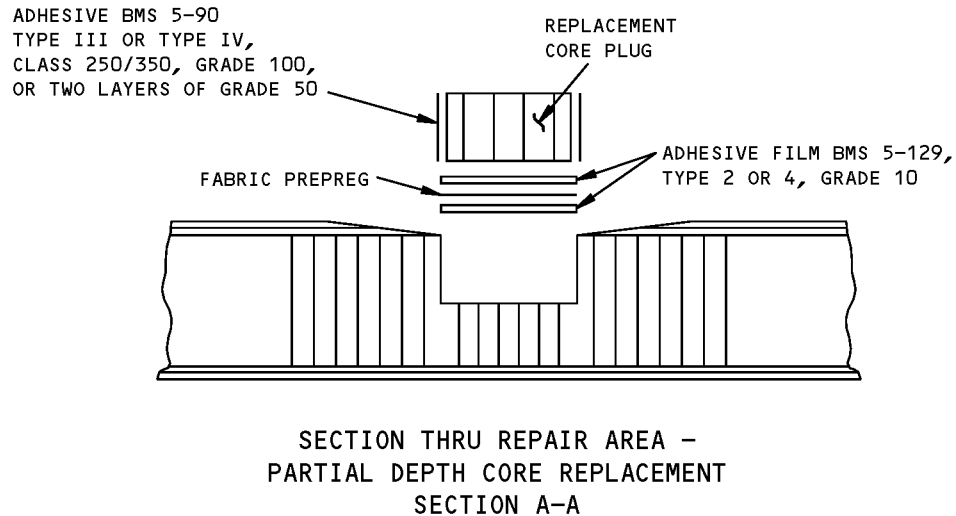
**Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 4 of 4)**

757-200 STRUCTURAL REPAIR MANUAL



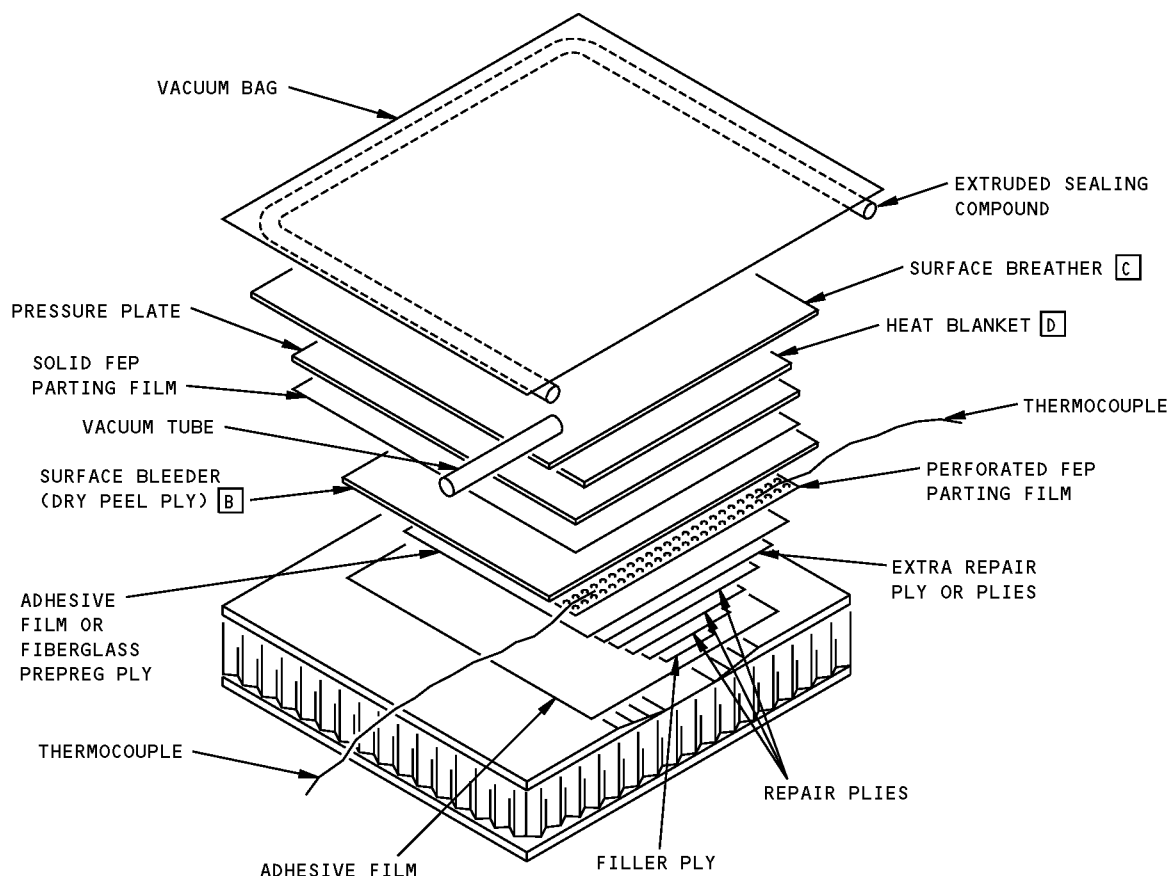
Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 250 Degrees F (121 Degrees C) Cure
Figure 2 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



**Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 250 Degrees F (121
Degrees C) Cure
Figure 2 (Sheet 2 of 2)**

757-200 STRUCTURAL REPAIR MANUAL



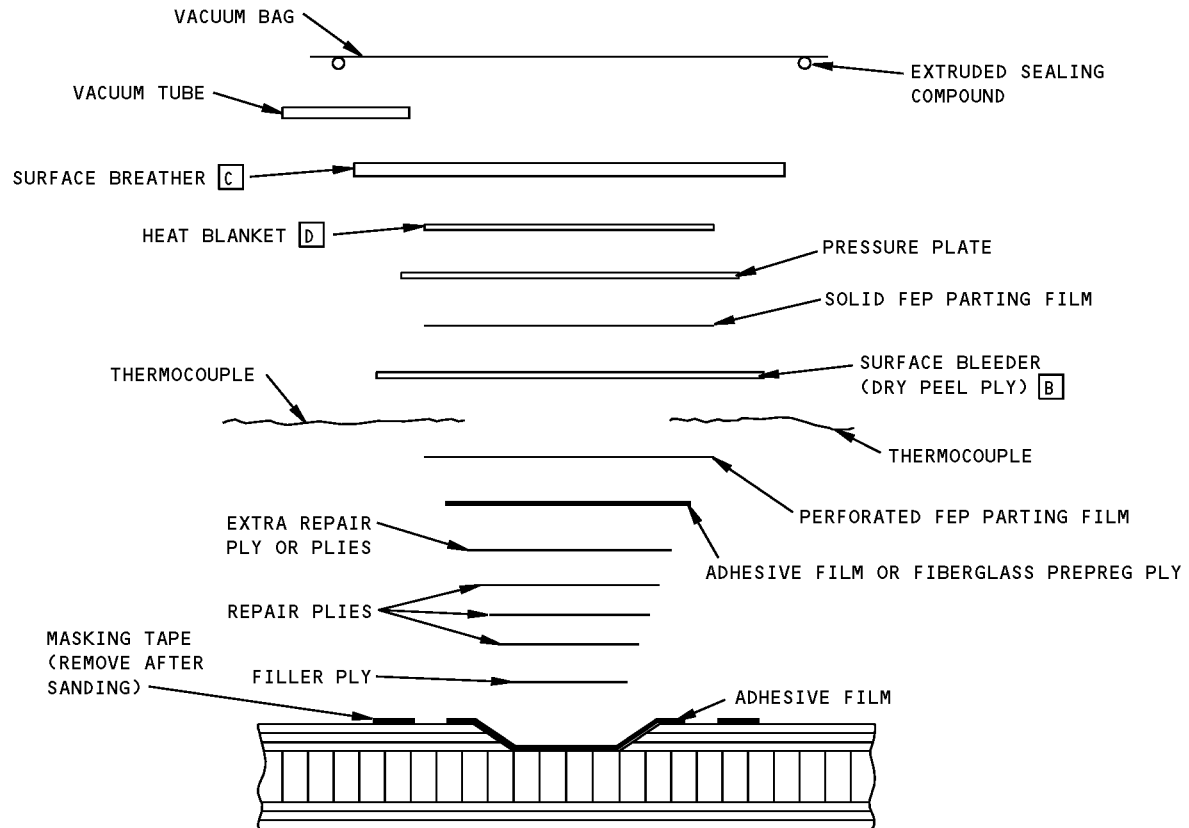
HONEYCOMB PANEL SHOWN
SOLID LAMINATE SIMILAR
BAGGING SEQUENCE FOR SKIN PLY REPAIR

NOTES

- | | |
|--|---|
| <p>[A] ONE PLY OF ADHESIVE FILM (FOR FULL DEPTH CORE REPLACEMENT, WHERE DAMAGE DOES NOT EXTEND THROUGH BOTH SKINS). FOR PARTIAL CORE REPLACEMENT USE TWO PLIES OF ADHESIVE FILM WITH ONE PLY OF BMS 8-79, CLASS III, STYLE 120 BETWEEN THEM.</p> <p>[B] DRY PEEL PLY MUST MAKE CONTACT WITH THE SURFACE BREATHER MATERIAL.</p> | <p>[C] WHEN USING A HEATING BLANKET, USE 4 TO 6 LAYERS OF BREATHER MATERIAL TO PREVENT DAMAGE TO VACUUM BAG.</p> <p>[D] HEATING BLANKET MUST EXTEND A MINIMUM OF 2 INCHES (50.8 mm) BEYOND EDGE OF REPAIR PATCH.</p> <p>[E] FOR THERMOCOUPLE PLACEMENT, REFER TO PAR. 4.D.(3)(f).</p> |
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Application of Pressure During Cure - 250 Degrees F (121 Degrees C) Cure
Figure 3 (Sheet 1 of 4)

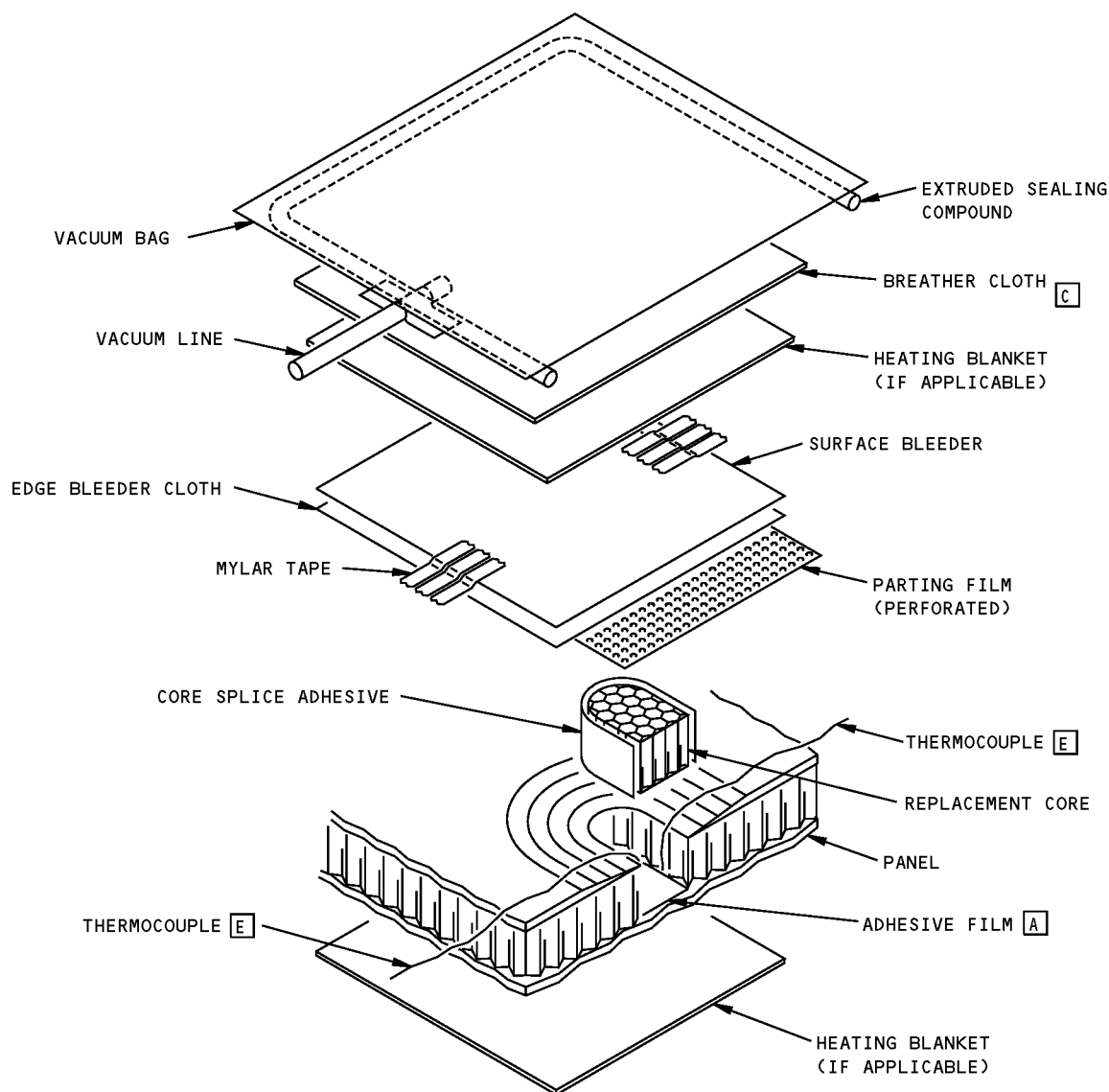
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SECTION THRU SKIN PLY REPAIR

Application of Pressure During Cure - 250 Degrees F (121 Degrees C) Cure
Figure 3 (Sheet 2 of 4)

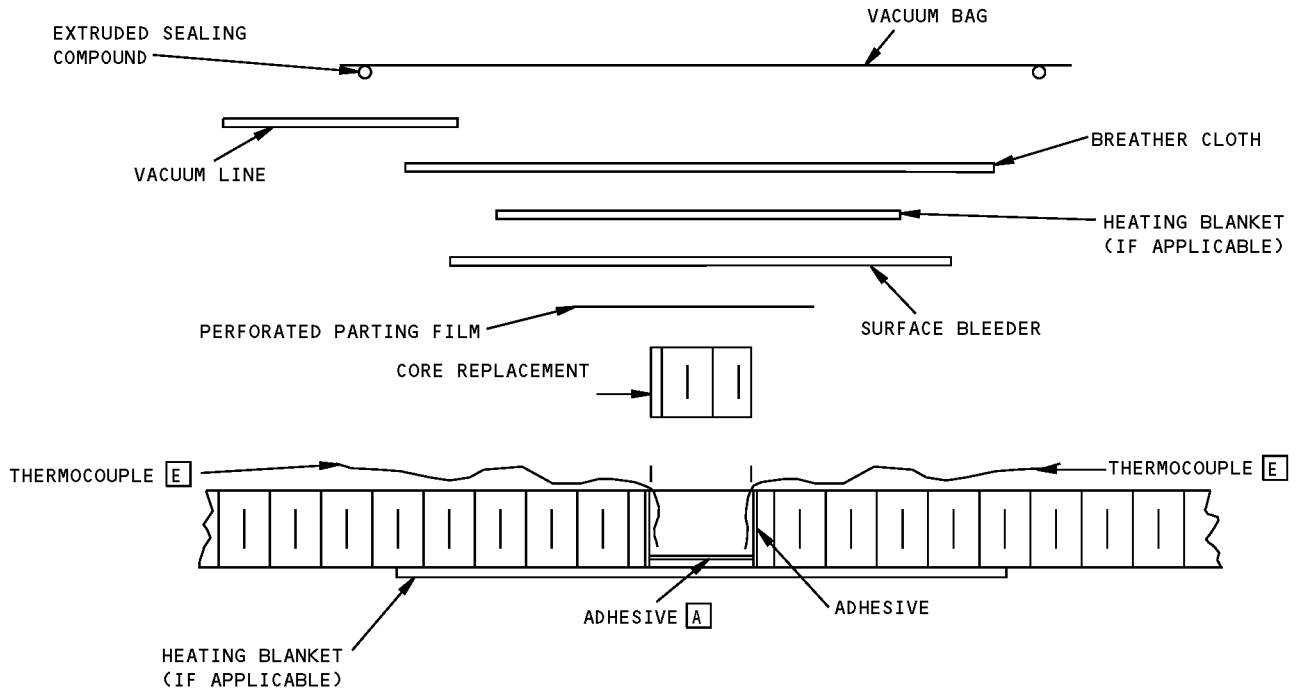
757-200 STRUCTURAL REPAIR MANUAL



BAGGING SEQUENCE FOR CORE REPLACEMENT

Application of Pressure During Cure - 250 Degrees F (121 Degrees C) Cure
Figure 3 (Sheet 3 of 4)

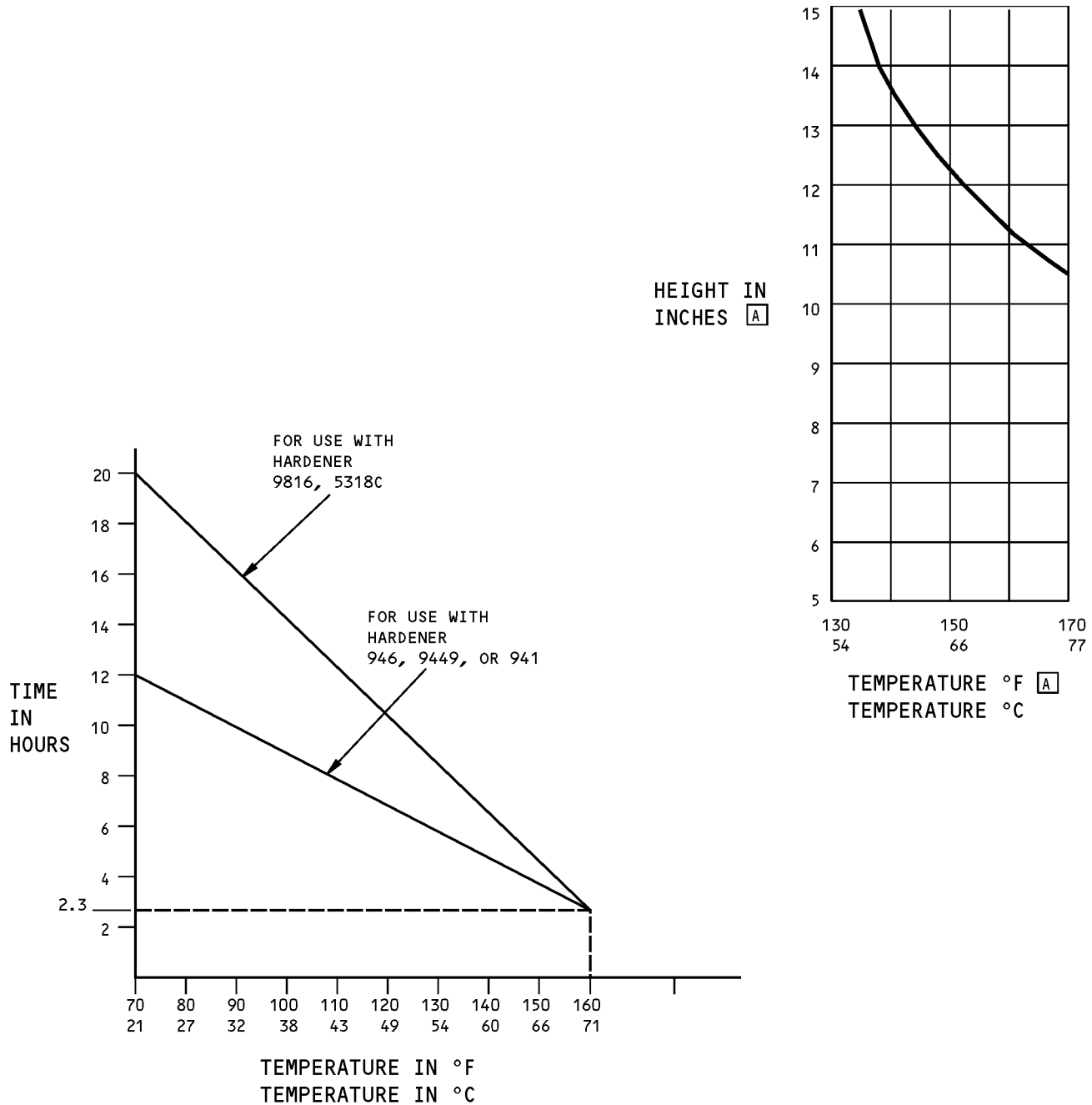
**757-200
STRUCTURAL REPAIR MANUAL**



SECTION THRU LAYUP FOR CORE REPLACEMENT

**Application of Pressure During Cure - 250 Degrees F (121 Degrees C) Cure
Figure 3 (Sheet 4 of 4)**

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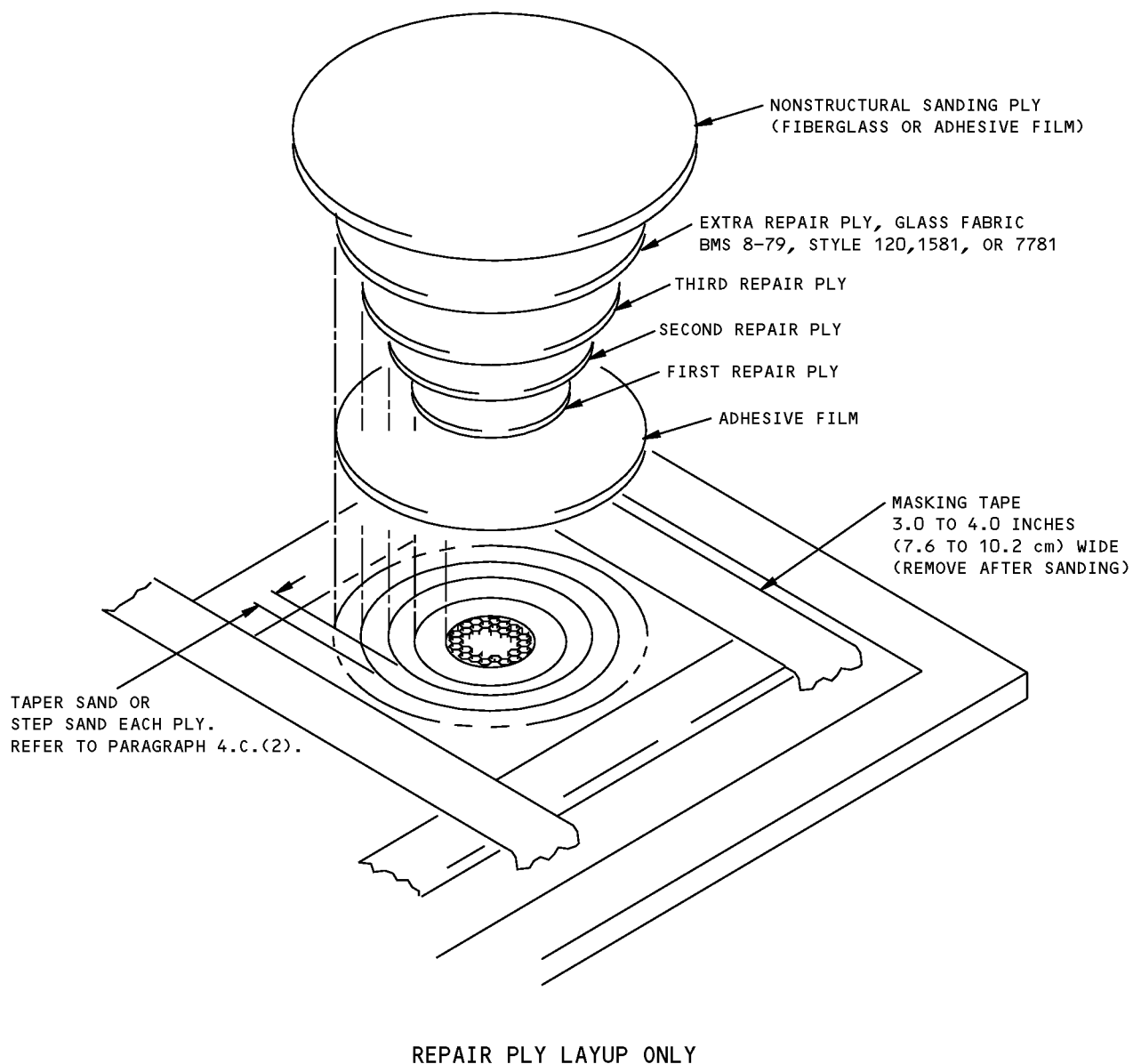
NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE

^A THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

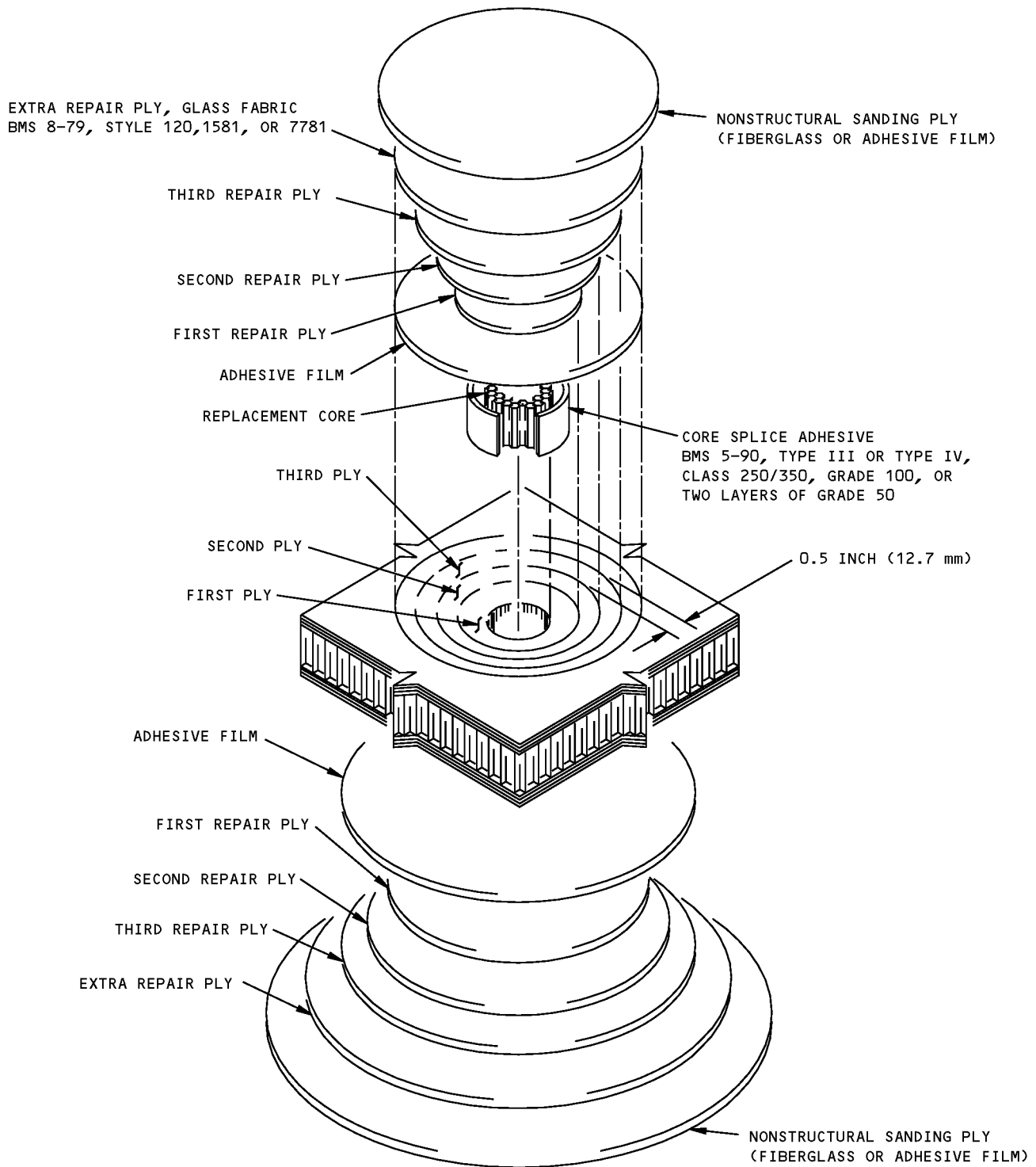
**Potting and Laminating Resin Cure Temperature
Figure 4**

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STRUCTURAL REPAIR MANUAL



Repair of Damaged External or Internal Skins of a Sandwich Panel - 250 Degrees F (121 Degrees C) Cure
Figure 5

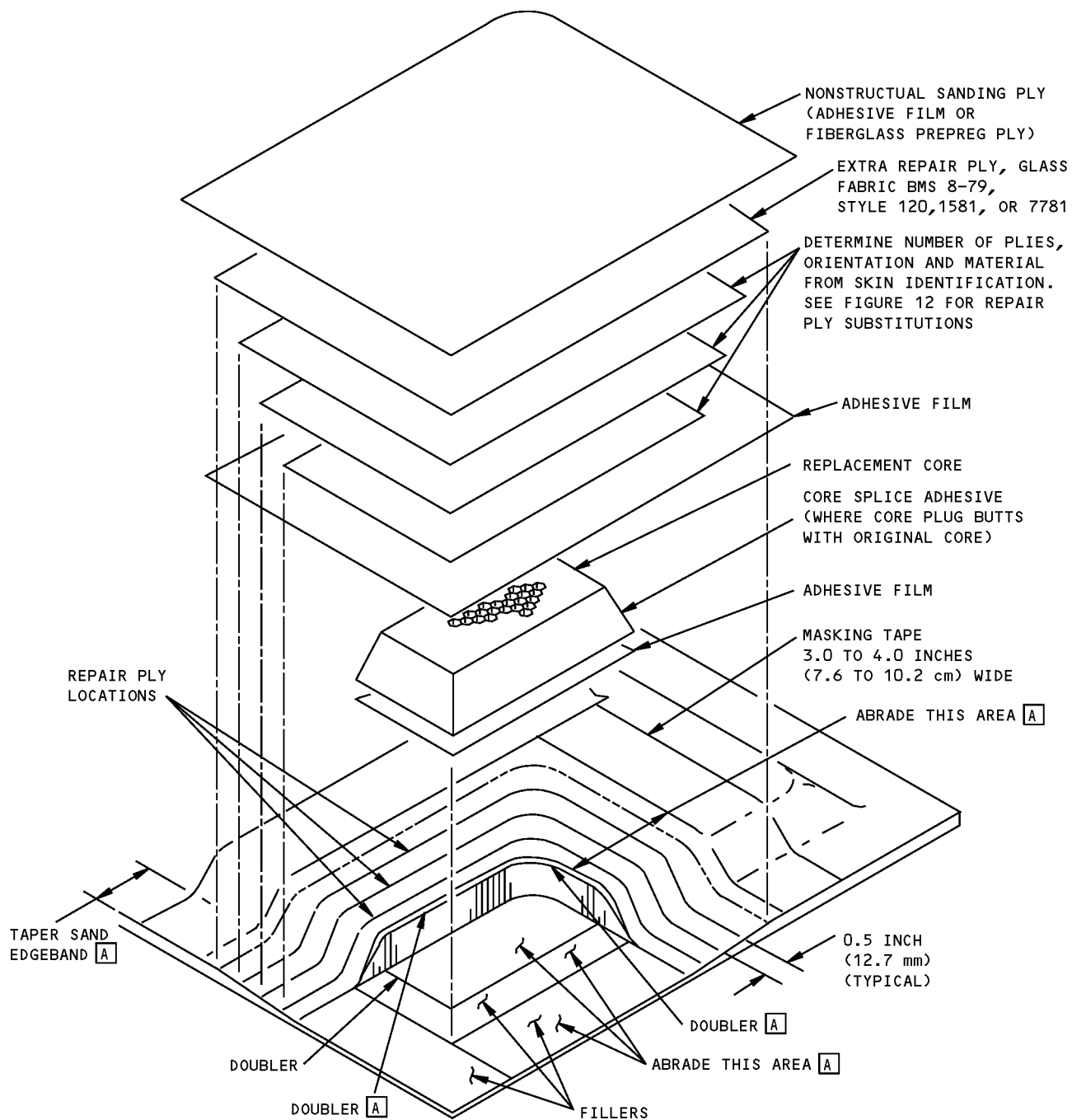
757-200 STRUCTURAL REPAIR MANUAL



PREPREG LAYUP ONLY

Repair of Large Punctures Thru Both Skins of a Sandwich Panel Including Core Damage - 250 Degrees F (121 Degrees C) Cure
Figure 6

757-200 STRUCTURAL REPAIR MANUAL



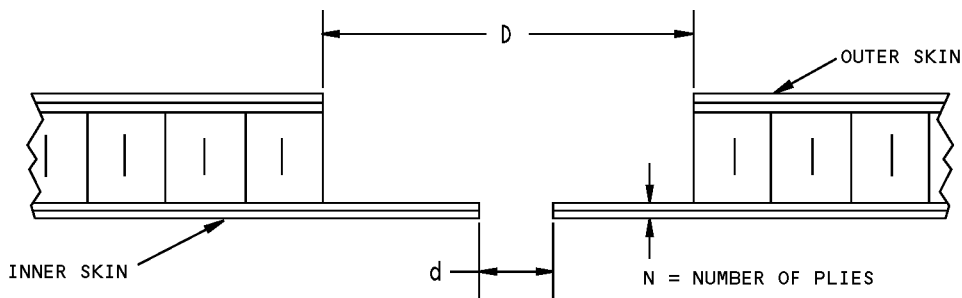
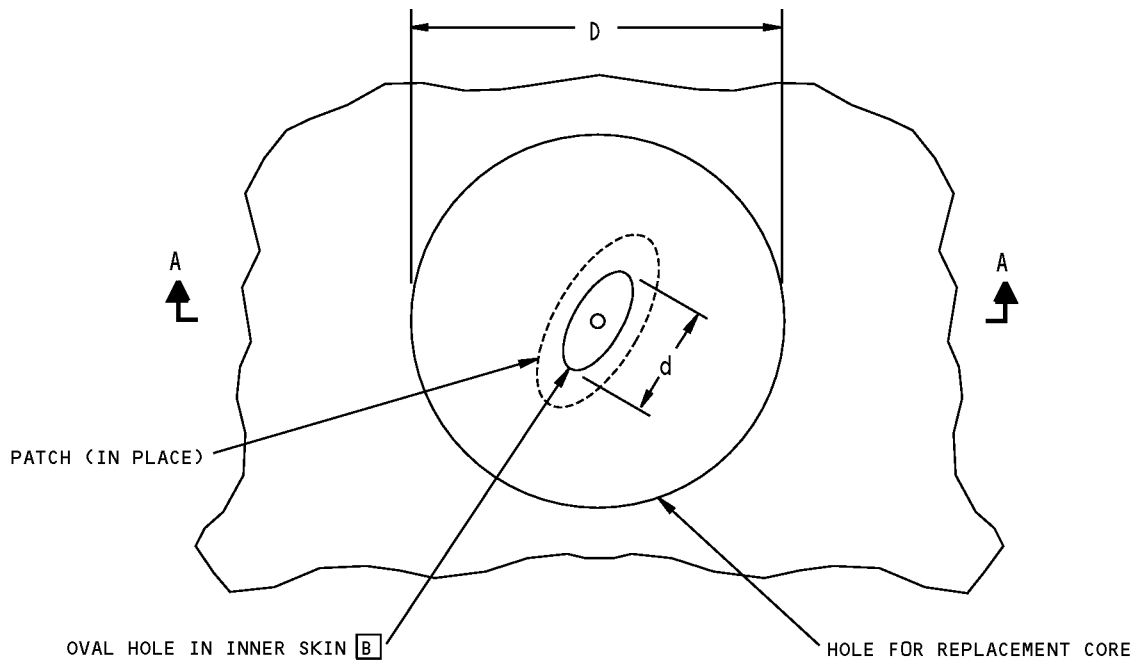
PREPREG LAYUP ONLY

NOTES

- [A] TAPER SANDING IS OPTIONAL TO JUST ABRADING THE SURFACE OF THE SKIN AND DOUBLER PLIES ABOVE AND BELOW THE HONEYCOMB CORE. HOWEVER, TAPER SANDING IS REQUIRED ON THE EDGE BAND.

Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel - 250 Degrees F (121 Degrees C) Cure Figure 7

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SECTION A-A
(PATCH NOT SHOWN)

DETAIL I

NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
- $D = d + \{N \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}]\} + 1.0 \text{ INCH (25.4 mm)}$
- d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN. SIZE LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR
- N = NUMBER OF PLIES
- D = DIAMETER OF HOLE FOR REPLACEMENT CORE

EXAMPLE:

IF $d = 0.5 \text{ INCH (12.7 mm)}$
 THEN, $D = 0.5 \text{ INCH (12.7 mm)} + \{[2 \text{ PLIES}] \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}]\} + 1.0 \text{ INCH (25.4 mm)}$
 $D = 3.50 \text{ INCHES (88.9 mm) DIAMETER}$

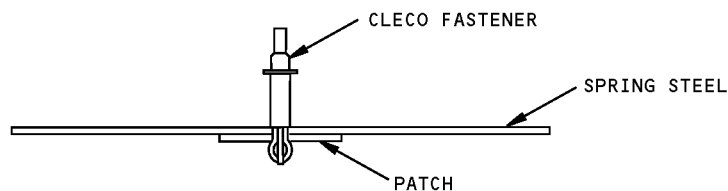
A MAKE TAPER AND OVERLAP PER FIGURE 13

B MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR

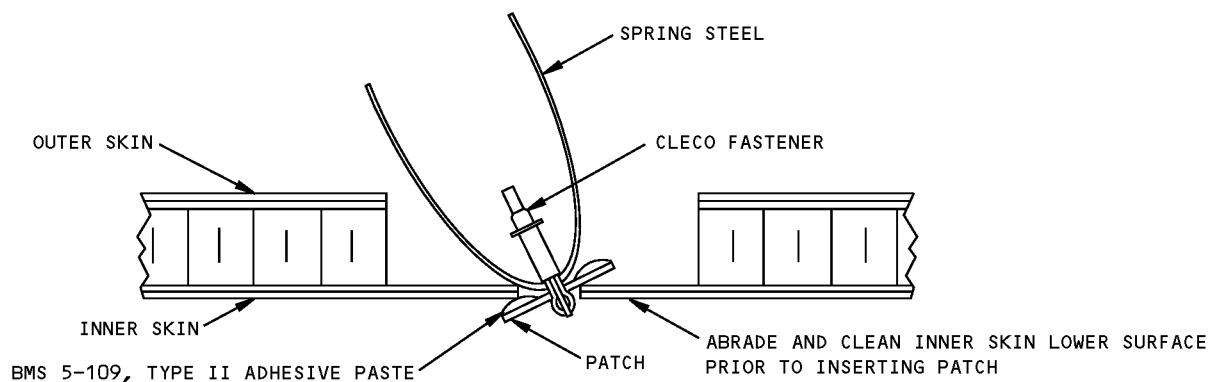
Repair of Damage to External and Internal Skins with Access Limited to One Side - 250 Degrees F (121 Degrees C) Cure

Figure 8 (Sheet 1 of 3)

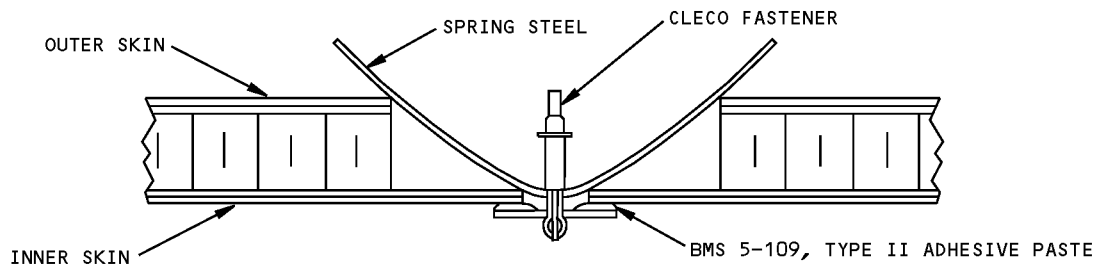
757-200 STRUCTURAL REPAIR MANUAL



ASSEMBLE PATCH AND SPRING STEEL
DETAIL II



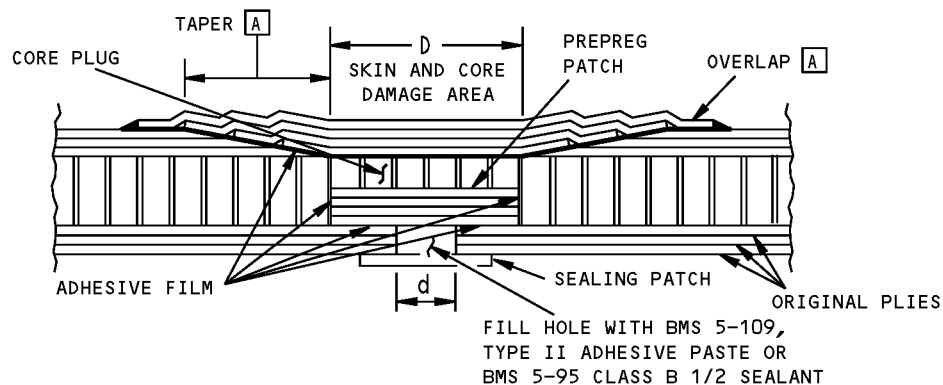
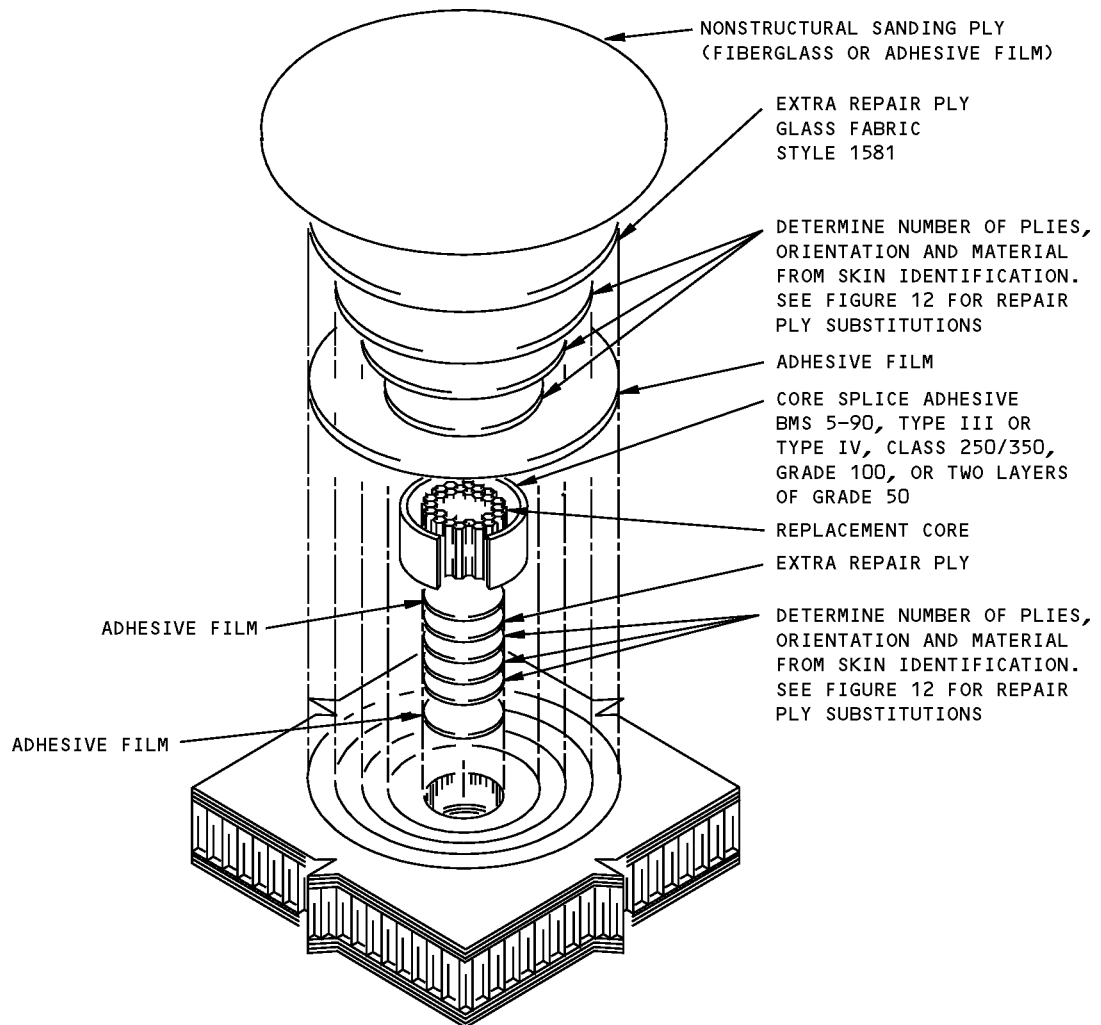
INSERT PATCH INTO OVAL HOLE
DETAIL III



HOLD PATCH IN PLACE WHILE CURING
DETAIL IV

Repair of Damage to External and Internal Skins with Access Limited to One Side - 250 Degrees F (121 Degrees
C) Cure
Figure 8 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



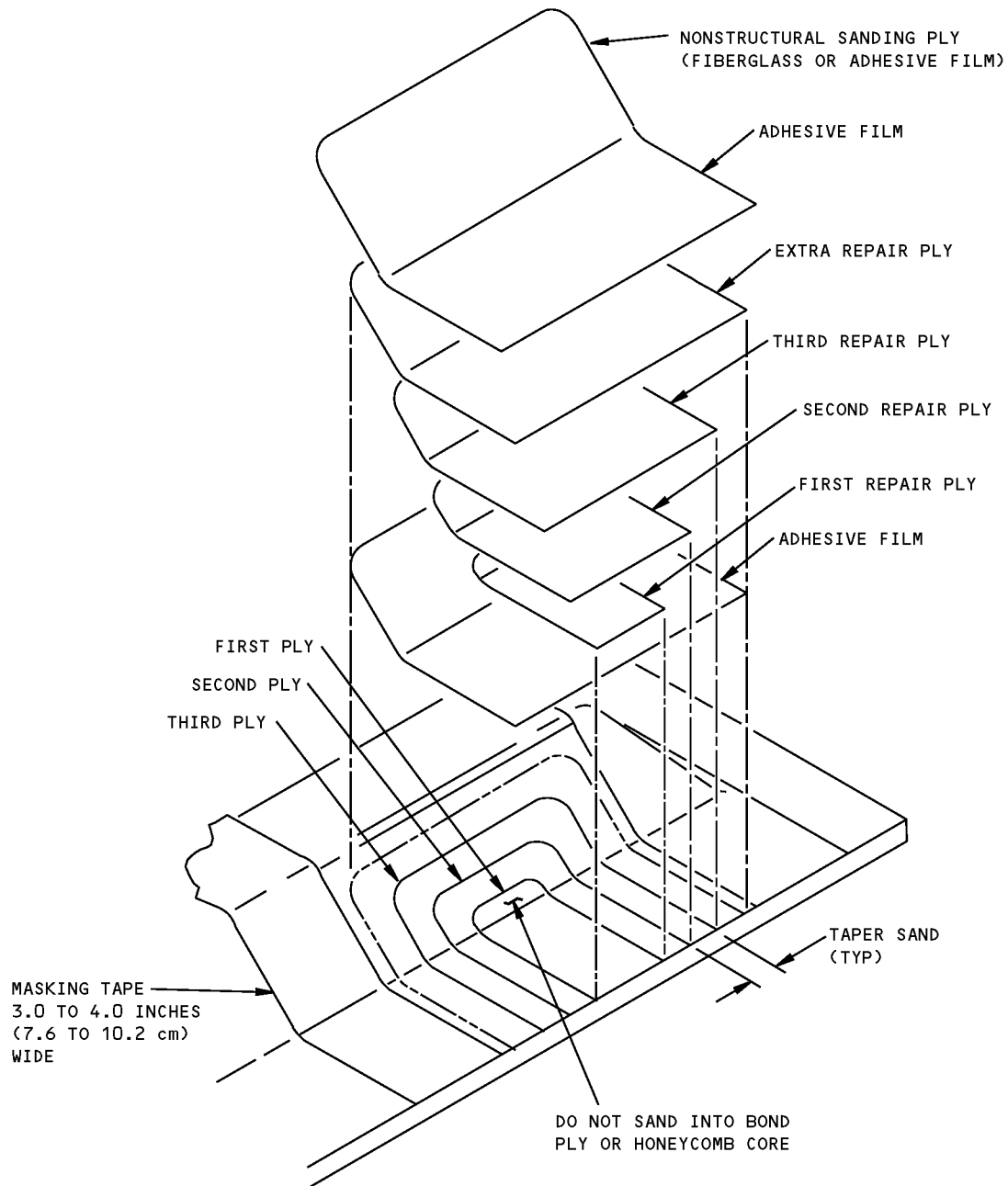
SECTION THROUGH REPAIR

PREPREG LAYUP ONLY
DETAIL V

Repair of Damage to External and Internal Skins with Access Limited to One Side - 250 Degrees F (121 Degrees C) Cure

Figure 8 (Sheet 3 of 3)

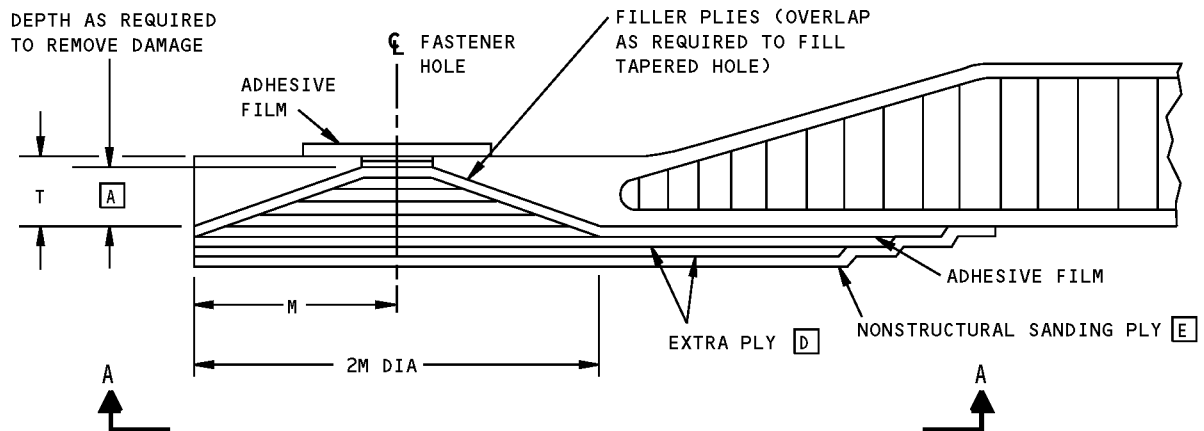
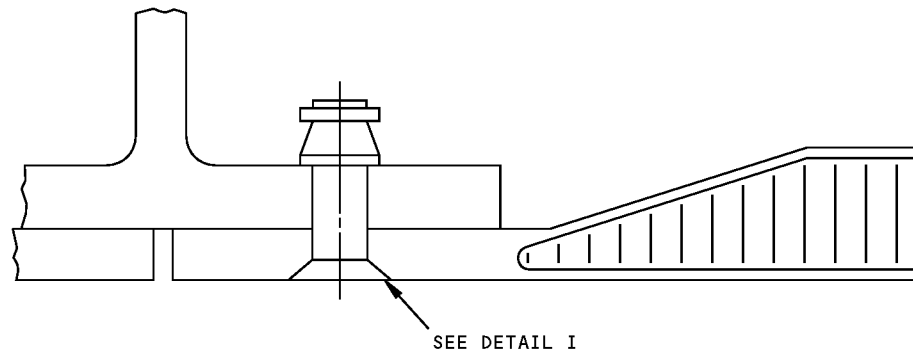
757-200
STRUCTURAL REPAIR MANUAL



PREPREG LAYUP ONLY

Repair of Damaged Skin Plies On A Panel Edge - 250 Degrees F (121 Degrees C) Cure
Figure 9

757-200 STRUCTURAL REPAIR MANUAL



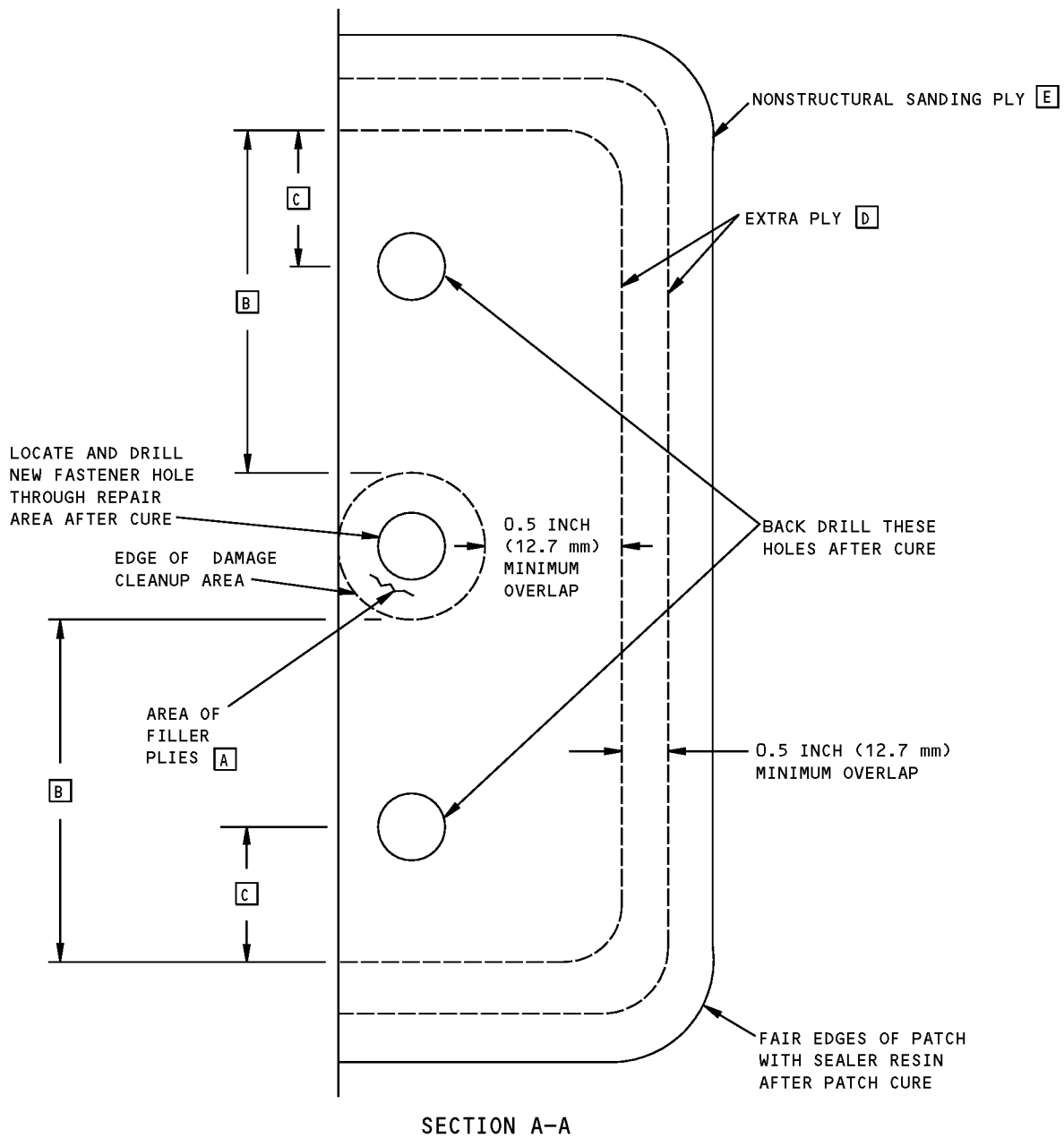
DETAIL I

NOTES

- D EQUALS FASTENER DIAMETER
- $M = 5T$ MAXIMUM AS SHOWN WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES.
- [A] APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA.
- [B] EXTEND FIRST EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF DAMAGED AREA.
- [C] EXTEND FIRST EXTRA PLY FAR ENOUGH TO PROVIDE AT LEAST 2D EDGE MARGIN.
- [D] ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER.
- [E] FIBERGLASS PREPREG BMS 8-79 OR ADHESIVE FILM BMS 5-129, TYPE 2 OR 4, GRADE 10.

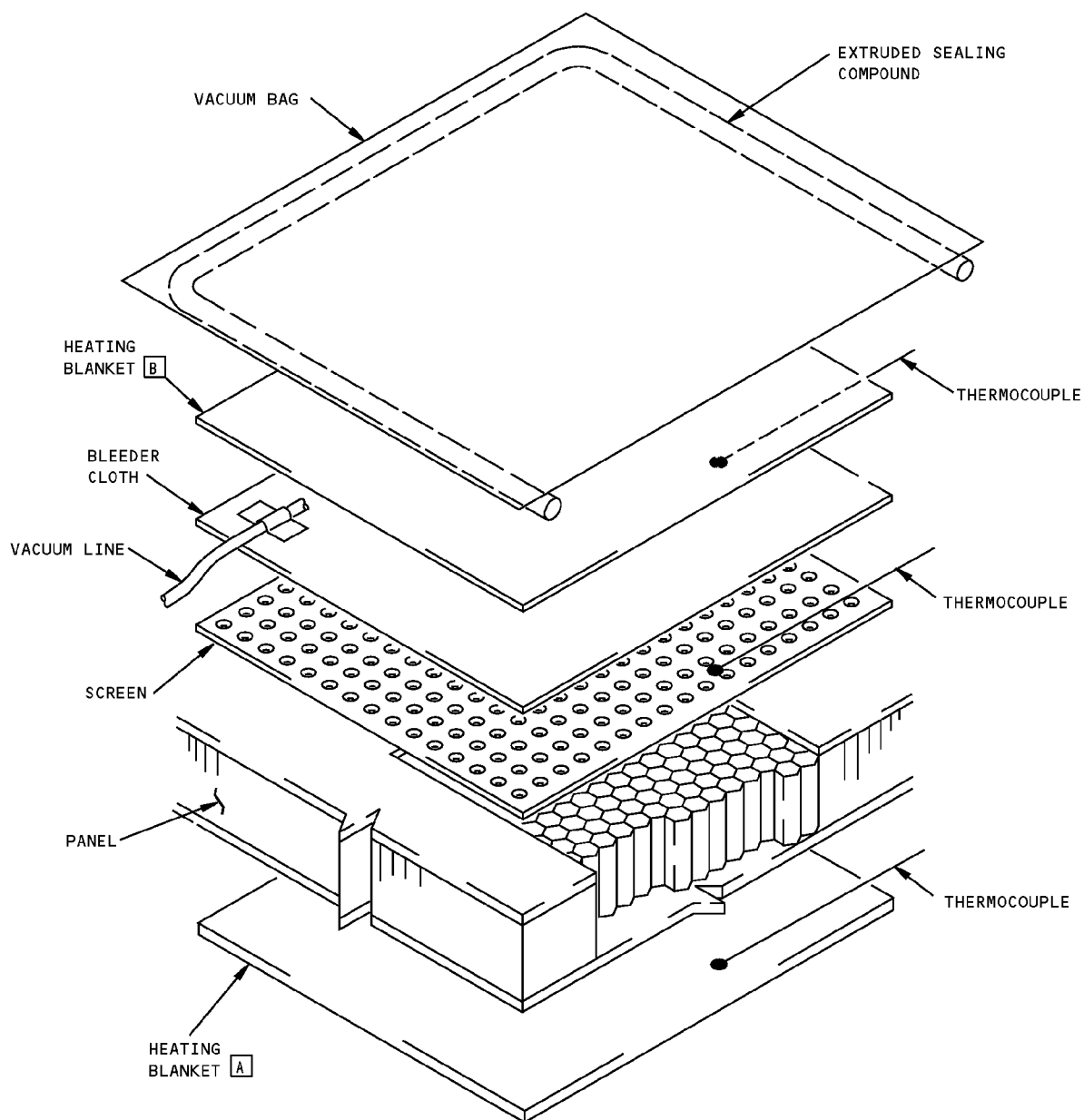
Repair of Damaged Panel Attach Hole - 250 Degrees F (121 Degrees C) Cure
Figure 10 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



Repair of Damaged Panel Attach Hole - 250 Degrees F (121 Degrees C) Cure
Figure 10 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL



NOTES

- [A] PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B] ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

Water Removal From Honeycomb Sandwich
Figure 11



757-200
STRUCTURAL REPAIR MANUAL

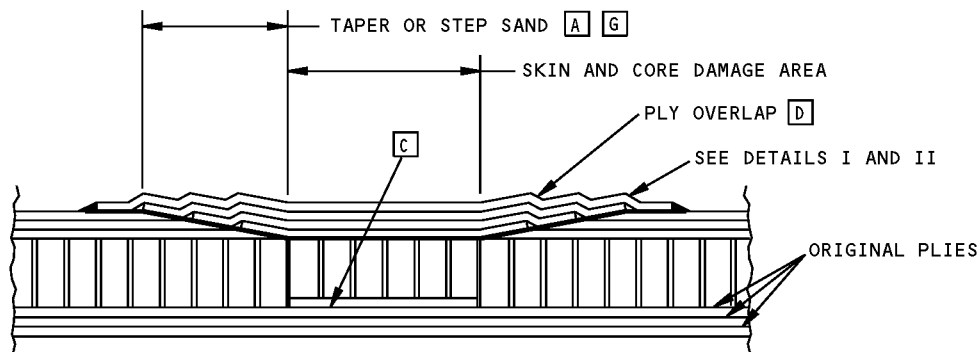
BMS 8-79 STYLE A	BMS 9-3 EQUIVALENT TYPE	BMS 9-3 EQUIVALENT STYLE NO.	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS A
120	D	120	RED	0.004-0.006	BMS 8-79, STYLE 220
1581	H-2	181-150	RED	0.008-0.012	BMS 8-79, STYLE 120
7781	H-3	181-77	RED	0.008-0.011	BMS 8-79, STYLE 120

NOTE

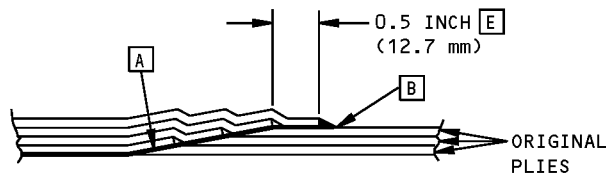
A STYLE 1581 AND STYLE 7781 ARE PREFERRED FOR USE AS REPAIR PLIES. THREE PLIES OF STYLE 120 MAY BE SUBSTITUTED FOR EACH PLY OF STYLE 1581 OR 7781.

BMS 8-79 Glass Fabric Prepreg Data
Figure 12

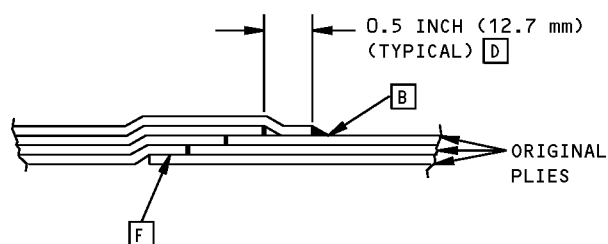
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(PREPREG LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



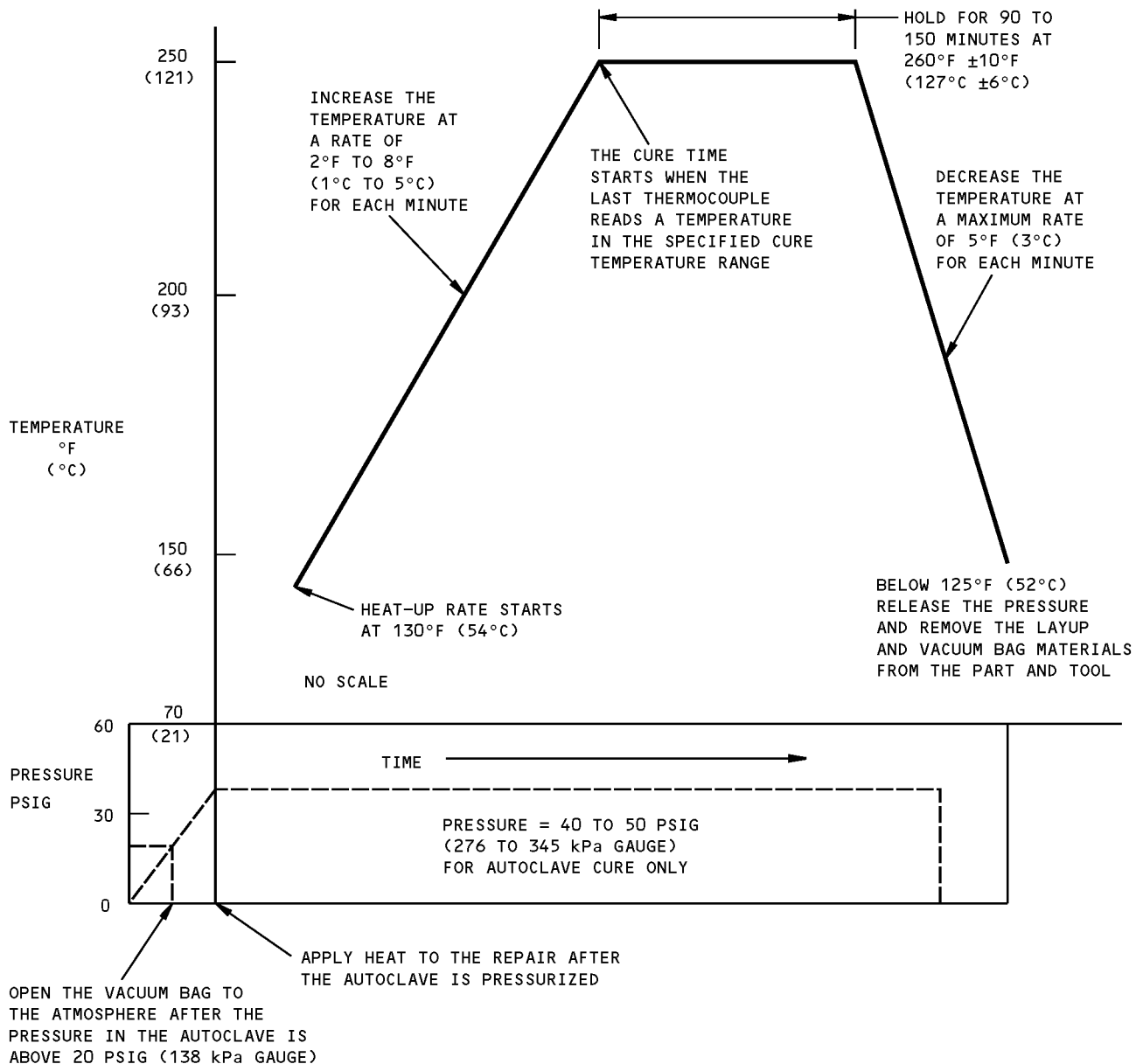
STEP SANDED SKIN
DETAIL II

NOTES

- | | |
|---|--|
| <p>A TAPER SAND AROUND REPAIR AREA OVER DISTANCE OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>B DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING</p> <p>C SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)</p> <p>D EXTRA PLY MUST OVERLAP AT LEAST 0.5 INCH (12.7 mm). EACH SUCCEEDING PLY MUST OVERLAP AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF PRECEDING PLY</p> | <p>E SURFACE PLY FAYING SURFACE MUST BE AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF TAPER</p> <p>F REMOVE DAMAGED PLIES IN STEPS OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>G TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO SRM 51-10-01</p> |
|---|--|

Sanding and Overlap Requirements
Figure 13

757-200 STRUCTURAL REPAIR MANUAL



NOTES

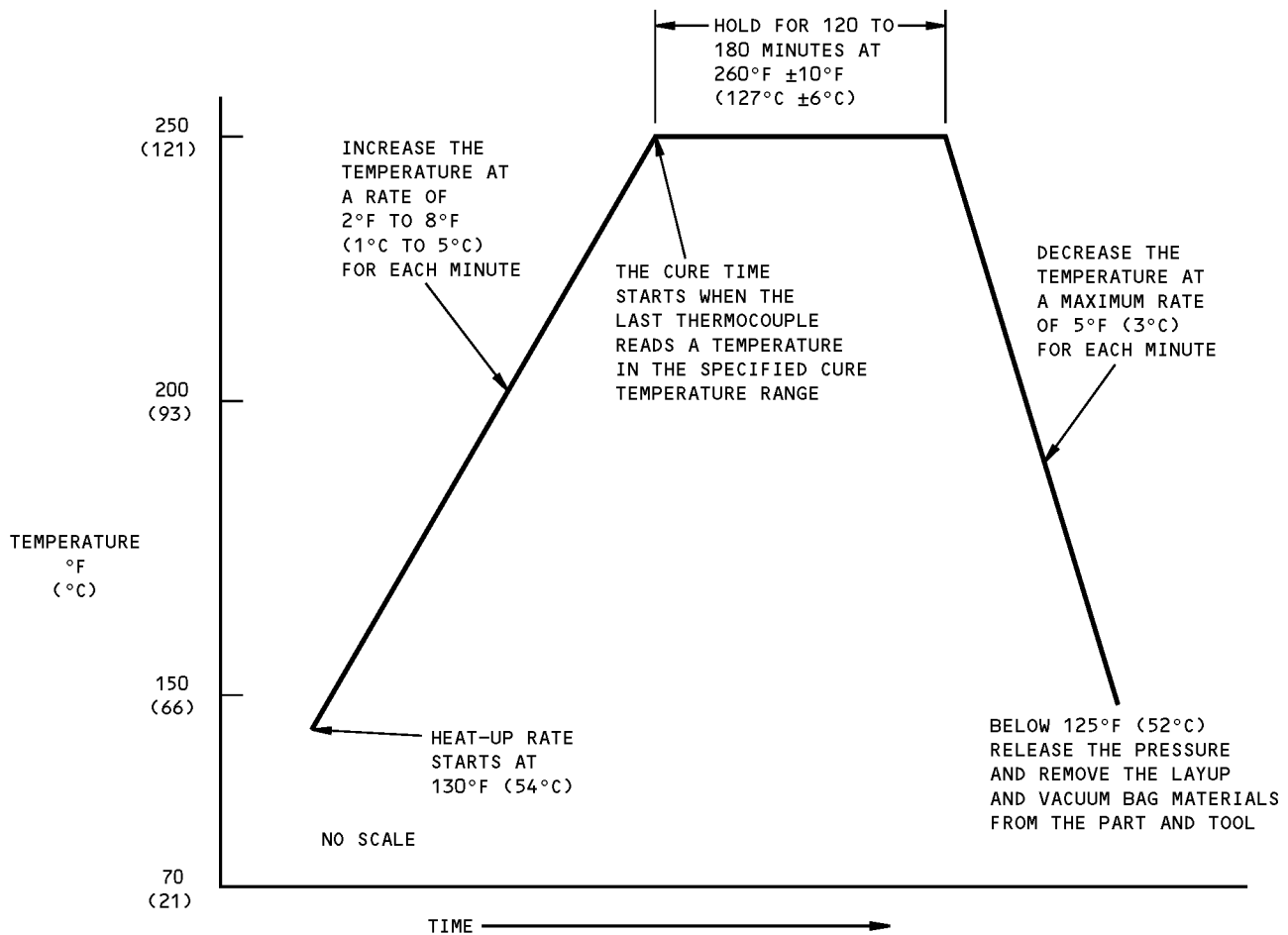
- FOR THE OVEN CURE, KEEP A MINIMUM VACUUM OF 22 in/Hg (75 kPa) DURING THE FULL CURE CYCLE.

250°F (121°C) AUTOCLAVE OR OVEN CURE CYCLE

DETAIL I

Repair Cure Cycles
Figure 14 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



NOTES

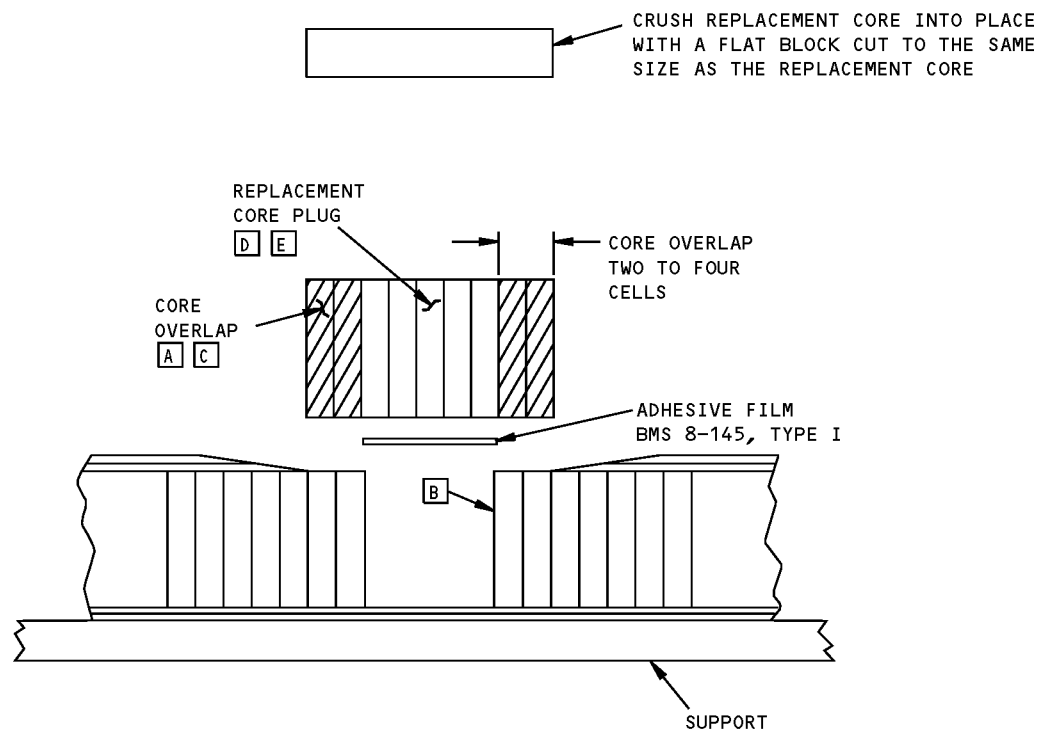
- KEEP A MINIMUM VACUUM OF 22 in/Hg (75kPa) DURING THE FULL CURE CYCLE.

250°F (121°C) HEAT BLANKET CURE CYCLE

DETAIL II

Repair Cure Cycles
Figure 14 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

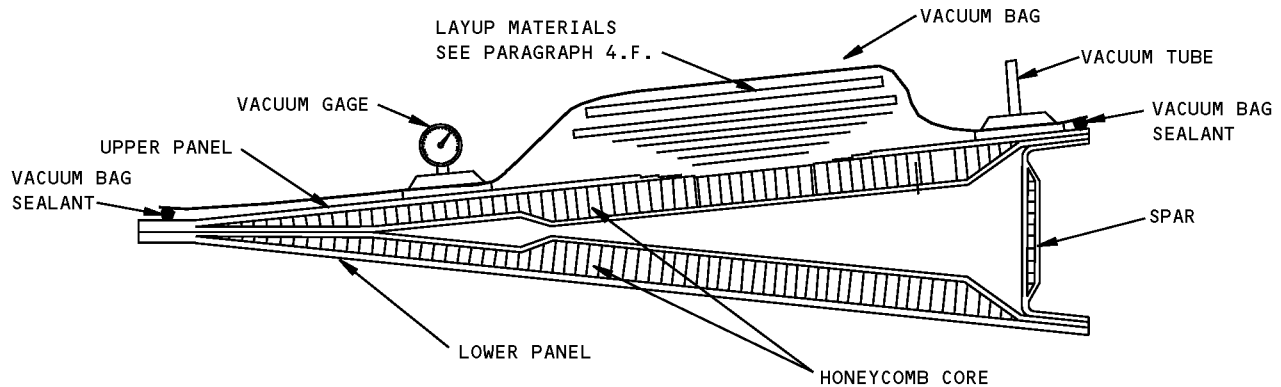


NOTES

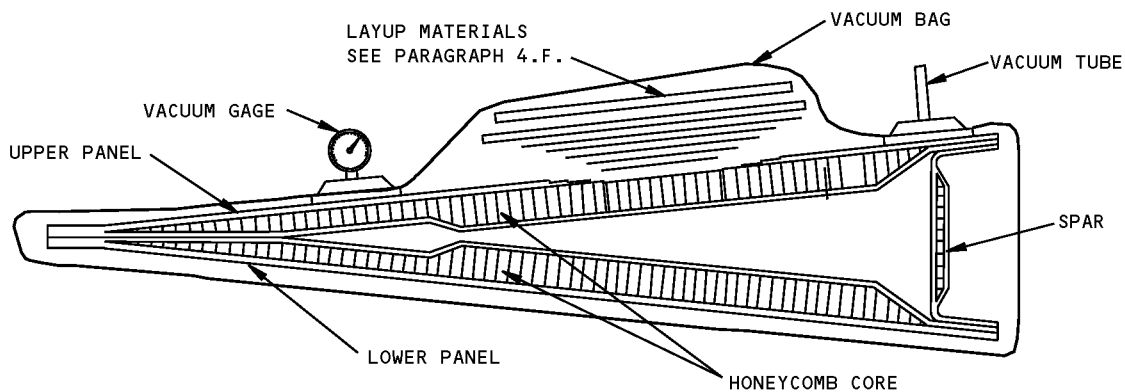
- [A] WHEN CRUSH SPLICING CORE 1.0 INCH (25.4 mm) OR THICKER, THE JOINT MAY BE CHAMFERED.
- [B] PRIOR TO SPLICING, CORE MAY BE STABILIZED WITH SC1008 PHENOLIC RESIN. LIMIT RESIN APPLICATION TO A MAXIMUM OF 1.0 INCH (25.4 mm) BEYOND THE EDGE CORE THAT IS TO BE SPLICED. THINNING RESIN WITH ACETONE IS PERMITTED.
- [C] USE BMS 8-301 CLASS 2 OR BMS 8-214 EPOXY RESIN AFTER SPLICING TO KEEP THE SPLICE FROM SEPARATING.
- [D] ALIGN HONEYCOMB CELLS OF REPAIR PLUG WITH ORIGINAL CORE.
- [E] REPLACEMENT CORE PLUG MUST BE MADE FROM CORE MATERIAL A MAXIMUM OF TWO GRADES DENSER THAN THE ORIGINAL CORE.

**Core Crush Splicing Requirements - 250 Degrees F (121 Degrees C) Core
Figure 15**

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ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



NOT ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART
MAY CAUSE ASSEMBLY DISTORTION DURING CURE CYCLE

PARTS CONSISTING OF UPPER AND LOWER PANELS A

NOTES

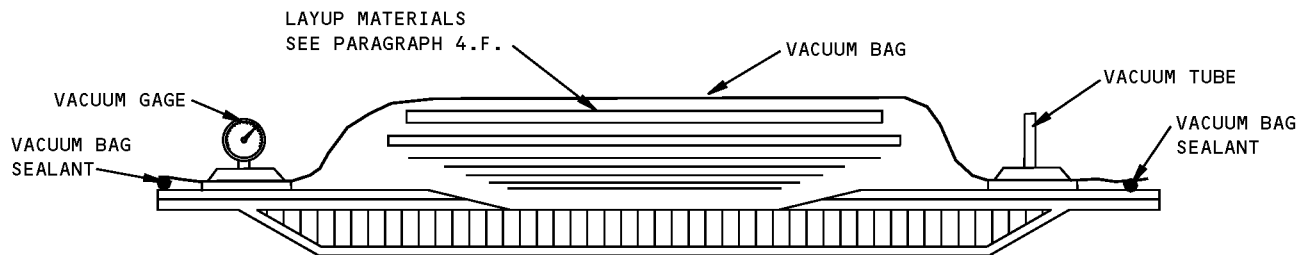
- REFER TO PARAGRAPH 4.F. FOR LAYUP AND BAGGING PROCEDURES

A THIS TYPE OF COMPONENT MUST NOT BE COMPLETELY SEALED IN A VACUUM BAG. DAMAGE TO PART WILL OCCUR. VACUUM BAG ONE SIDE OF COMPONENT ONLY

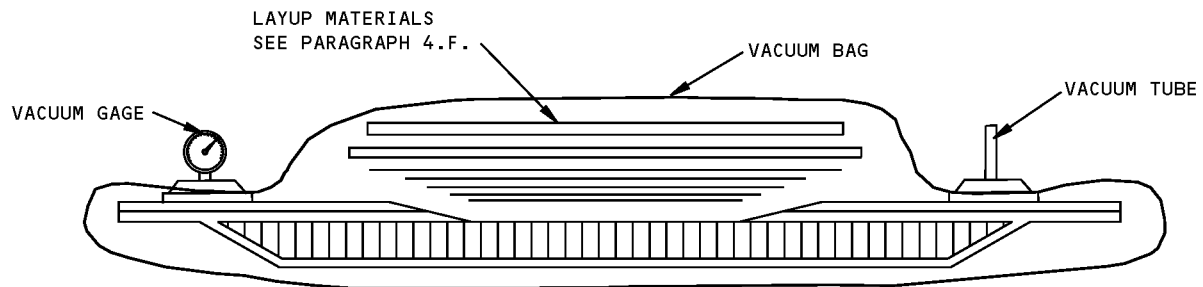
B THIS TYPE OF COMPONENT MAY BE COMPLETELY SEALED IN A VACUUM BAG OR MAY BE SEALED ON ONE SIDE ONLY

Vacuum Bagging Restrictions
Figure 16 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**



ACCEPTABLE - VACUUM BAG SEALED TO ONE SIDE ONLY



ACCEPTABLE - VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

**Vacuum Bagging Restrictions
Figure 16 (Sheet 2 of 2)**



757-200

STRUCTURAL REPAIR MANUAL

GENERAL - GLASS FABRIC REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH REPAIRS - 350°F (177°C) CURE

1. Applicability

- A. Repairs contained herein are to components made from epoxy resin reinforced with several layers of fiberglass fabric. The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands and at fitting locations. Repairs described use 350°F (177°C) cure materials (prepreg layup).

CAUTION: TO GET AN ACCEPTABLE QUALITY REPAIR, DO AS FOLLOWS:

- REFER TO THE APPLICABLE COMPONENT WHICH YOU ARE GOING TO REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE YOU USE THESE REPAIR INSTRUCTIONS.
- USE THE CORRECT MATERIALS FOR THE TYPE OF COMPONENT AND REPAIR THAT IS MADE.
- USE THE MATERIALS THAT AGREE WITH THE SPECIFICATIONS IN THE SRM.
- ACCURATELY FOLLOW THE SRM PROCEDURES AT EACH STEP OF THE REPAIR. IF YOU DO NOT DO THIS, IT CAN CAUSE A REPAIR THAT IS NOT SATISFACTORY AND IS NOT APPROVED.

350°F (177°C) CURE REPAIRS ARE RESTRICTED TO REPAIRS IN SPECIFIC AREAS OF COMPONENTS.

THESE REPAIRS ARE PERMANENT WHEN APPLIED USING THE REPAIR MANUAL PROCEDURES TO COMPONENTS ORIGINALLY MADE FROM 350°F (177°C) CURE MATERIALS.

350°F (177°C) TEMPERATURE MUST NOT BE APPLIED TO AREAS SEALED WITH BMS 5-95 SEALANT, UNLESS SEALANT CAN BE REPLACED FOLLOWING REPAIR.

- B. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage
Paragraph 4.B./GENERAL	Remove Water and Dry Out Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedures
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair

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Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 5.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.H./GENERAL	Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminated Panels
Paragraph 5.L./GENERAL	Repair of Surface Dents
Paragraph 5.M./GENERAL	Repair of Aluminum Foil

2. General

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR RUBBER GLOVES, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

- A. Use suitable holding fixtures per Paragraph 4.F./GENERAL to prevent distortion and delamination of the structure.
- B. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- C. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- D. Store rolls or precut kits of prepreg and adhesive material below 10°F in sealed moisture proof bags. An identification label must accompany the material inside the bag, with the following information: BMS type, class, grade, supplier name, batch number, roll number, prepreg lot number and date of kit preparation. Record storage time in and out of refrigeration.
- E. Refer to 51-70-02, GENERAL for the locations of principal composite components.



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- F. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- G. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
- H. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- I. Refer to 51-70-14, GENERAL for repair of flame spray and conductive coatings.
- J. Refer to 51-30-06, GENERAL for composite repair material ordering data.

3. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-05, GENERAL	Repair Sealing
51-30	REPAIR MATERIALS
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-60	CONTROL SURFACE BALANCING
51-70-02, GENERAL	Locations of the Principal Composite Components
51-70-06, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
51-70-17, GENERAL	Repairs to 250°F (121°C) and 350°F (177°C) Cured Graphite/Aramid/Fiberglass Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Structure - 200°F (93°C) to 230°F (110°C) Wet Layup Repair Method
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
DOCUMENT D6-49327	Certification of Autoclaves for Metal Bonding and Curing of Composite Structure
DOCUMENT D6-56273	Qualification of Heat Blankets for Hot Bonding
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Repair Procedures Common to Various Repairs

A. Determine Damage.

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- (1) Examine visually for extent of damage.
- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic or thermographic methods. Remove contaminants. Refer to Paragraph 4.B./GENERAL for water removal instructions.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental nondestructive inspection (NDI) methods or by tap test. For tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will give a dull sound. Solid bonded areas will give a sharp ring. Refer to NDT Part 1, 51-05-01.

B. Remove Water and Dry Out Damaged Area.

STRUCTURAL REPAIR MANUAL

- (1) Remove water from honeycomb sandwich (Figure 11/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum and oil-free compressed air.
 - (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
 - (c) Apply a fiberglass or metal fine mesh screen over the exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
 - (g) If the far side is accessible, apply thermocouple and heating blanket to the far side of the honeycomb sandwich panel.

NOTE: If the far side is accessible, it is acceptable to heat the area using a heating blanket only on the far side. An additional heating blanket and vacuum application may be used on the near side at the location shown in Figure 11/GENERAL to accelerate water removal. If the far side is inaccessible, use of a heating blanket on the near side is required.

- (h) When the far side is inaccessible or when using an additional heating blanket, place the heating blanket over the bleeder cloth on the near side.
 - (i) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
 - (j) Evacuate the layup to a vacuum of 22 in/Hg (75 kPa) minimum.
 - (k) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
 - (l) Remove layup materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
 - (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
 - (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

CAUTION: REMOVE (FOR ALL TYPES OF CURE) OR ISOLATE (HEAT BLANKET ONLY) ALUMINUM STRUCTURE TO PREVENT LOSS OF STRENGTH IN THE ALUMINUM PARTS. ALL ALUMINUM ALLOYS, EXCEPT 2219, MUST BE KEPT BELOW 200°F (93°C). ALUMINUM 2219 CAN BE KEPT UP TO 400°F (204°C).

REMOVE SEALANTS, PAINTS AND PRIMERS IN THOSE AREAS WHERE THE TEMPERATURE COULD REACH ABOVE THE MAXIMUM ALLOWABLE TEMPERATURE. REFER TO 51-20-01, GENERAL FOR THE MAXIMUM ALLOWABLE TEMPERATURES.

C. Remove Damage and Prepare Damaged Area.

- (1) Damage removal.
 - (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.

STRUCTURAL REPAIR MANUAL

- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. For crush splice repairs (Paragraph 4.D./GENERAL), leave one to three core cells (0.4 in. (10.2 mm) maximum) visible between core cavity and skin (Figure 15/GENERAL). The core area removed should extend at least 0.5 in. (12.7 mm) further than visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side. In cores greater than 1.0 in. (25.4 mm) thick, partially remove core (at least 0.5 in. (12.7 mm) deep) sufficient to clean up damage.
- (c) In areas where contamination cannot be removed by cleaning or drying per Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 4.C.(1)(a)/GENERAL.
- (e) When core is removed from inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 9/GENERAL AND FIGURE 13/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(2) Preparation of damaged area (Figure 13/GENERAL).

- (a) Determine the number of plies that have been cut. Mask off the area around the cutout allowing 0.5 in. (12.7 mm) minimum overlap for each ply replacement, plus 0.5 in. (12.7 mm) extra for each repair ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the applicable component structure identification or engineering drawing.

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
 - 1) Remove the paint finish or Tedlar film in the masked off area using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper.

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- 2) If the damage area has a layer of aluminum foil, cut back the foil enough to allow a new foil layer to be at least 1.0 in. (25.4 mm) larger all around than the largest repair ply (Figure 17/GENERAL).
 - a) Strip the aluminum foil by peeling or abrading. Do not damage the underlying composite fibers.
 - b) Carefully abrade to remove the primer on the aluminum foil to a border 1.0 in. (25.4 mm) larger all around than the repair area that was just stripped of foil.
 - c) Taper sand or step sand each ply per Paragraph 4.C.(2)(b)3)/GENERAL below.
 - d) Lightly abrade and solvent wipe the primer on the aluminum foil to a border 1.0 in. (25.4 mm) larger all around than the band of foil exposed by primer removal in Paragraph 4.C.(2)(b)2b)/GENERAL.
 - e) Apply a chemical conversion coating to the foil exposed by primer removal in Paragraph 4.C.(2)(b)2b)/GENERAL.
 - 3) Taper sand each ply or simply abrade the surface around the cleaned up damage a minimum of 0.5 in. (12.7 mm) per ply. Refer to Figure 13/GENERAL.
 - 4) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
 - 5) Abrade surfaces around repair using No. 150 or finer Scotch-Brite abrasive.
- (c) External surface of panel (critical aerodynamic surfaces).
- 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over a minimum distance of 0.5 in. (12.7 mm) for each existing ply of the laminate. Step sanding is optional to taper sanding on honeycomb sandwich structure in areas of noncritical aerodynamic smoothness. Refer to 51-10-01, GENERAL for locations of areas of critical aerodynamic smoothness. Always taper sand on solid laminate structures.
- NOTE:** For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.
- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 0.5 in. (12.7 mm) border using No. 150 or finer sandpaper.
- (d) Edgeband of panel.
- 1) Taper sand panel edgeband according to Paragraph 4.C.(2)(c)/GENERAL.
- NOTE:** Edgeband is the solid laminate around the outer periphery of the honeycomb panel.
- (e) Cleaning of repair area.
- 1) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.



757-200 STRUCTURAL REPAIR MANUAL

(WARNING PRECEDES)

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

(1) Fabricate core plug.

- (a) Fabricate core plug. Refer to specific component structural identification to determine type of core called out on engineering drawing.
- (b) For butt splicing, the honeycomb core should fit flush with the original core and with the ribbon direction aligned. Trim the core plug no more than 0.05 in. (1.27 mm) smaller than the cut out. The core plug is to have a tight interference fit in the core cavity after it is wrapped with the foaming adhesive.
- (c) For crush splicing, the honeycomb core plug should be made two to four cells larger than the repair cavity and be made from core material which is a maximum of two grades denser than the original core.

NOTE: Crush splicing applies to fiberglass core (BMS 8-124, Class I) only.

- (d) Trim core plug to full or partial depth of original core as given in Paragraph 4.C.(1)(b)/GENERAL and shown in Figure 2/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive film between core plug and undamaged core or skin (Figure 2/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL).

(2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED THE IMMERSION CRITERIA THAT FOLLOWS. DAMAGE TO CORE MATERIAL WILL OCCUR. DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99) bath for 60 seconds.
- (b) Locally contaminated areas can be washed with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).

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- (3) Install core plug (Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, Figure 8/GENERAL, Figure 13/GENERAL).

NOTE: Most of the materials used in this procedure have limited life and require controlled storage conditions. Refer to the applicable material specifications for the maximum time out of the controlled storage and for the uncontrolled storage conditions.

Before opening the adhesive film wrapper, condition refrigerated adhesives to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of adhesive horizontally through its axis free from other rolls or objects.

CAUTION: WHEN HANDLING ADHESIVE FILM WEAR CLEAN WHITE GLOVES TO PREVENT CONTAMINATION.

DO NOT TOUCH THE ADHESIVE FILM WITH BARE HANDS OR OTHER PARTS OF THE BODY.

DO NOT FOLD, STRETCH OR OTHERWISE THIN THE ADHESIVE FILM.

- (a) For partial core replacement, cut two pieces of BMS 8-145, Type I adhesive film and one piece of BMS 8-139, Style 120 fiberglass prepreg fabric to fit the repair hole. Place in position as shown in Figure 2/GENERAL.
- (b) For full depth core replacement, where damage does not extend through both skins, trim a piece of BMS 8-145, Type I adhesive film to fit repair hole. Place on the inside surface of the undamaged skin (Figure 2/GENERAL, Figure 3/GENERAL, Figure 7/GENERAL, Figure 13/GENERAL).
- (c) If both skins are damaged, tape a metal caul plate (such as 0.032 in. (0.81 mm) thick aluminum) against the exterior surface of the far side skin and repair as for damage to one skin only. Repair the other surface in a subsequent repair cycle.
- (d) For butt splicing, wrap the edges of the core plug with BMS 5-90, Type III or IV, Class 350, Grade 50 foaming adhesive and install in the repair cavity. Align the honeycomb ribbon with the original core ribbon direction.
- (e) For crush splicing, prepare and install the core plug per Figure 15/GENERAL. Align the honeycomb core ribbon with the original core ribbon direction.
- (f) Put the layup materials and equipment in place per Figure 3 (Sheet 2).
 - 1) If the damage extends through both face skins, vacuum bag both sides of the panel (or the entire part) using the layup shown in Figure 3 (Sheet 2).
 - 2) If the replacement core plug is less than or equal to 0.5 in. (12.7 mm) thick, use the heating blanket on the near side and locate at least two separate thermocouples on the panel surface at the bondline.
 - 3) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and both sides are accessible, use heating blankets on both sides. Locate at least two separate thermocouples on the near side at the bondline and one on the far side corresponding to the center of the repair.

STRUCTURAL REPAIR MANUAL

- 4) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and only one side is accessible, use the heating blanket on the near side and put at least two separate thermocouples into the repair hole so the thermocouples touch the repair materials at the bottom of the repair hole.

NOTE: The ends of these thermocouples will be cured into the adhesive. Cut the thermocouples leaving the embedded ends behind before applying the repair plies. Only the portion of the thermocouple embedded in the core can be left in the repair. The thermocouples cannot come between the repair plies and the sanded surfaces of the original plies.

- (g) Evacuate the repair area to a vacuum of 22 in/Hg (75 kPa) minimum.
- (h) Cure a minimum of 120 minutes at 345 to 365°F (174 to 185°C) (Figure 14/GENERAL).
- (i) Allow the repair area to cool under vacuum until the temperature of the repair area is 125°F (52°C) or less. Then release restraints (if applicable) and remove layup materials and equipment.
- (j) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
- (k) Vacuum to remove sanding residue from core cells.

NOTE: The core plug and the repair plies can be cured at the same time if the temperature can be adequately monitored by thermocouples placed on the outside surfaces of the panel (refer to Paragraph 4.D.(3)(f)2)/GENERAL, Paragraph 4.D.(3)(f)3)/GENERAL, and Paragraph 4.D.(3)(f)4)/GENERAL). If the thermocouples must be embedded in the repair core adhesive, then the core plug must be cured separately to avoid curing the thermocouple between the repair plies and the sanded surface of the original plies.

CAUTION: DO NOT CURE MORE THAN TEN (10) PLIES DURING ONE CURE CYCLE FOR HEAT BLANKET AND OVEN CURES. IF THE REPAIR HAS MORE THAN 10 PLIES, DIVIDE THE REPAIR PLIES EVENLY INTO MULTIPLE CURE CYCLES. IF YOU DO NOT OBEY, POROSITY AND BULGES CAN OCCUR AND THE SUBSEQUENT REPAIR WILL BE UNSATISFACTORY.

E. Prepare and Apply Preimpregnated (Prepreg) Repair Plies.

NOTE: Before opening the prepreg material or adhesive film wrapper, condition refrigerated materials to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of material horizontally through its axis free from other rolls or objects.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

CAUTION: THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

- (1) Prepare prepreg glass fabric repair plies (BMS 8-139).

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- (a) Refer to the specific component structural identification to determine type and orientation of glass fabric used in original structure. Repair existing plies of original structure with BMS 8-139, Style 1581 (Figure 12/GENERAL).

- (b) From BMS 8-139, Type 1581 preimpregnated material, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(1)(c)/GENERAL for substitution of prepreg glass fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not indicated by individual repair, one extra ply is required and is to have the same orientation as the original surface ply.

See Figure 13/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) Substitution of prepreg glass fabric plies (Figure 12/GENERAL).

- 1) If BMS 8-139, Style 1581 prepreg material is not available, three plies of BMS 8-139, Style 120 prepreg material may be substituted for each ply of Style 1581 prepreg material required.

- (2) Apply the repair plies (Figure 2/GENERAL and Figure 13/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies.

CAUTION: ENSURE THAT PARTING FILM AND POLYETHYLENE SEPARATOR ARE REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Make a temporary vacuum bag system.

NOTE: This vacuum bag is used to compact the repair plies and prevent contamination of the repair. Do not use this vacuum bag system for the repair cure.

- 1) Put one layer of perforated parting film above the repair.
- 2) Put one layer of glass fabric cloth as a surface breather above the repair.
- 3) Apply the vacuum sealing compound around the repair area.
- 4) Put the vacuum bag material over the repair area. Seal the edges with the vacuum sealing compound.
- 5) Attach a vacuum line above the surface breather.

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- (b) Cut two plies of BMS 8-145, Type I adhesive film, 0.125 in. (3.2 mm) larger than the largest patch ply which also covers the entire repair area.

NOTE: The second ply of adhesive film will be used as a nonstructural sanding ply. As an option, substitute a ply of BMS 8-139, Style 1581 fiberglass prepreg cut to the same size as the adhesive ply. The fiberglass ply is less likely to entrap air during the cure.

This nonstructural sanding ply is the final ply and covers the entire repair. After curing, this ply may be sanded as required to obtain a smooth surface for refinishing. Be careful not to sand through this nonstructural sanding ply into the structural repair plies below it.

Repairs to aluminum foil will require both plies of adhesive film and one ply of BMS 8-139, Type 1581 fiberglass prepreg.

- (c) Place one layer of adhesive film over the entire repair area.
(d) Install the repair plies and, if necessary, the sanding ply also.

NOTE: Add filler plies as necessary to get a smooth repair. Do not use more than four filler plies on one repair area.

- 1) Install the smallest repair ply first.
- 2) Make sure that the warp direction of each repair ply that you put in the repair is correct and that the overlap is correct.
- 3) Install the next ply. Make sure that it is smooth with no wrinkles.
- 4) Remove the separator sheet.
- 5) Boeing recommends that you do the steps that follow:
 - a) Compact the repair plies with a temporary vacuum system as follows for repairs that have five or more repair plies:
 - 1 minute for each ply (one ply at a time), or
 - 2 minutes for each two plies (two plies at a time), or
 - 6 minutes for each three plies (three plies at a time)
 - b) Do Paragraph 4.E.(2)(d)2)/GENERAL, Paragraph 4.E.(2)(d)3)/GENERAL, Paragraph 4.E.(2)(d)4)/GENERAL, and Paragraph 4.E.(2)(d)5)/GENERAL again for all of the repair plies as necessary to complete the layout.
- (e) Apply a cover ply of BMS 8-139, Style 1581 fiberglass prepreg or the second ply of adhesive film over the replaced plies. If the repair includes repair to aluminum foil, use the second ply of adhesive film.
- (f) If the repair includes repair of aluminum foil, repair the foil per Paragraph 5.M./GENERAL before proceeding with the bagging and cure of the part.

F. Layup and Bagging Procedure.

- (1) Place one layer of perforated FEP parting film over the replacement plies and extending a minimum of 1 in. (25 mm) beyond the largest patch ply.
- (2) Put on the thermocouples.
 - (a) If you use an autoclave or an oven, then do the step that follows:

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- 1) Put one or more thermocouples at the location where the temperature will increase the fastest and one or more thermocouples where the temperature will increase the slowest.

NOTE: Boeing recommends that you put one or more thermocouples at the thick areas of the part and tool and the thin areas of the part and tool. Use more than two thermocouples when more than 900 in² (0.58 m²) of a panel surface is repaired. Insulation is not necessary in the repair area for autoclave or oven cures.

- (b) If you use a heat blanket, then do the step that follows:

- 1) Secure three thermocouples (spaced evenly around the repair) to the panel at the edge of the repair and secure them to the temperature recording device.

- (3) Place a layer of dry peel ply over the perforated FEP.

NOTE: The peel ply must be cut large enough to make contact with the surface breather.

- (4) Place one layer of solid FEP parting film over the layup extending to 0.5 in. (12.7 mm) short of the edge of the dry peel ply.

- (5) If you use a heat blanket, then place it over the repair area.

NOTE: The heat blanket must extend a minimum of 2 in. (5 cm) beyond the edge of the patch.

When you use a heat blanket that is longer than 12 in. (30 cm) on one side, it is recommended that you use an aluminum pressure plate (0.040 in. (1.0 mm) thick max) to minimize localized heating.

If you use two or more pads, then you must also use a pressure plate.

- (a) If the area to be repaired is near or attached to aluminum structure that was not removed in Paragraph 4.C./GENERAL, do the steps that follow:

- 1) Isolate the aluminum structure from the areas that will get hot.
- 2) Add one or more thermocouples to put on the aluminum structure. Make sure that the temperature does not go above 200°F (93°C).
- 3) You can put insulation around all other metals to prevent cold locations in the repair.

- (6) Place a layer of Airweave SS or Style 120 glass fabric over the solid FEP as a surface breather, or, if you use a heat blanket, then place four to six layers of breather material over the heat blanket to act as an insulator and a surface breather.

NOTE: The surface breather material and the dry peel ply must make contact.

- (7) Lay the vacuum line over the edge of the breather material.
- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.

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CAUTION: HOLLOW COMPOSITE COMPONENTS SUCH AS RUDDERS, ELEVATORS, AND AILERONS MUST NOT BE COMPLETELY VACUUM BAGGED BECAUSE THEY MAY COLLAPSE UNDER 22 IN/HG (75 KPA) VACUUM. ATTACH VACUUM BAG TO ONE SIDE OF COMPONENT ONLY OR ATTACH SEPARATE VACUUM BAGS TO EACH SIDE TO ENSURE THAT ATMOSPHERIC PRESSURE INSIDE OF THE COMPONENT IS MAINTAINED DURING REPAIR. COMPONENTS CONSISTING OF A SINGLE PANEL MADE OF FULL DEPTH HONEYCOMB CORE WITH LAMINATE FACE SHEETS AND EDGE BANDS MAY BE COMPLETELY VACUUM BAGGED. SEE FIGURE 16/GENERAL.

- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. In some cases, it is optional to vacuum bag the entire part.

NOTE: The entire repair surface must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts sagging and distortion could occur due to the weight of the part.

- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
- (11) Check the vacuum bag for leak paths.
- G. Cure the repair. Do Paragraph 4.G.(1)/GENERAL for the autoclave procedure, Paragraph 4.G.(2)/GENERAL for the oven cure procedure, or do Paragraph 4.G.(3)/GENERAL for the heat blanket/heat lamp cure procedure.

- (1) For the autoclave cure procedure, see Figure 14/GENERAL, Detail I and do the steps that follow:

NOTE: Boeing recommends that you use a certified autoclave when you do the procedure that follows. DOCUMENT D6-49327, Certification of Autoclaves, is a procedure that Boeing uses, and you can use this as a guide to certify your autoclave.

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Pressurize the autoclave to 40 to 50 psig (276 to 345 kPa gauge). Open the vacuum bag to the atmosphere when the autoclave pressure is above 20 psig (138 kPa gauge).

NOTE: Boeing recommends that you fill and pressurize the autoclave with an inert gas such as CO₂ or N₂ when you cure a repair above 250°F (121°C).

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- (c) Increase the temperature of the autoclave until it is at 130°F (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 1°F to 5°F (0.5°C to 3°C) for each minute until all thermocouples are in the cure temperature range.

NOTE: Boeing recommends that you increase the temperature at a rate of 1°F to 3°F (0.5°C to 1.7°C) when the stack of repair plies are more than 0.25 inch (6 mm) thick.

- (d) Hold the cure temperature for the specified time as given in Figure 14/GENERAL, Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature range during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (e) Keep the vacuum bag connection to the atmosphere open and the autoclave pressurized until after the cure is complete and the temperature of the part has decreased to 125°F (52°C).
- (f) Decrease the autoclave temperature at a maximum rate of 5°F (3°C) for each minute.
- (g) When the temperature is less than 125°F (52°C), release the autoclave pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONNEL.

- (2) If you use an oven to cure the repair, see Figure 14/GENERAL, Detail I and do the steps that follow:

NOTE: Use a circulating oven that has equipment that can supply a vacuum and can control the temperatures as given in this procedure.

- (a) During all of the repair procedure, make sure that the part to be repaired is held in the specified part tool. The specified part tool must have the same dimensions (or dimensions that are a small amount larger) as the part to be cured.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured. Boeing recommends that the tool have the same thermal expansion properties as the materials in the part. A tool with the same thermal expansion properties will help keep the part at the correct contour and shape.

- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the oven until it is at 130°F (54°C). When the temperature is at 150°F (54°C), increase the temperatures at a rate of 1°F to 5°F (0.5°C to 3°C) for each minute until all thermocouples are in the cure temperature range.
- (d) Hold the cure temperature for the specified time as given in Figure 14/GENERAL, Detail I.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

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- (e) Decrease the oven temperature at a maximum rate of 5°F (3°C) for each minute.
- (f) When the temperature is less than 125°F (52°C), remove the vacuum pressure.
- (g) Remove the vacuum bag equipment from the part and tool.

WARNING: USE HEAT CURE EQUIPMENT THAT IS PERMITTED BY THE LOCAL FIRE PROTECTION AUTHORITIES. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY TO PERSONNEL.

- (3) For heat blanket cure, see Figure 14/GENERAL, Detail II and do the steps that follow:

NOTE: Boeing recommends that you use a qualified heat blanket when you do the procedure that follows. DOCUMENT D6-56273, Qualification of Heat Blankets for Hot Bonding, is a procedure that Boeing uses, and you can use this as a guide to qualify your heat blanket.

- (a) Make sure there is a minimum of three thermocouples for each heat blanket used. Refer to Paragraph 4.F./GENERAL.
- (b) Apply a vacuum to the vacuum bag until you have a minimum of 22 in/Hg (75 kPa). Start the heatup process. Keep a minimum vacuum of 22 in/Hg (75 kPa) during the full cure cycle.
- (c) Increase the temperature of the heat source until the temperature of the repair is at 130°F (54°C). When the temperature is at 130°F (54°C), increase the temperature at a rate of 1°F to 5°F (0.5°C to 3°C) for each minute until all thermocouples are at the cure temperature.

NOTE: When you use a hot bond console, obey the manufacturer's operation instructions.

- (d) If necessary, put insulation on the cooler areas of the repair area, opposite of the heat source.
- (e) Hold the cure temperature for the specified time as given in Figure 14/GENERAL, Detail II.

NOTE: Cure time does not include the time necessary for the layup and the part to get to the cure temperature. Cure time starts after all of the thermocouple indications are in the cure temperature range. If a thermocouple indication falls below the cure temperature during the cure, extend the cure cycle time by the time necessary to get the thermocouple to the cure temperature.

- (f) Decrease the temperature at a rate maximum of 5°F (3°C) for each minute.
- (g) When the temperature decreases to less than 125°F (52°C), release the vacuum pressure.
- (h) Remove the vacuum bag equipment from the part and tool.

H. Refinish After Repair.

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of top most repair ply as necessary to fair the edge. Do not sand through the nonstructural sanding ply into the structural repair plies below it.
- (2) Apply finish to the repaired surface using the following applicable methods.
 - (a) Where clear Tedlar film surfaces have been removed, seal with a brush coat of Resin Mix 3 (Figure 1/GENERAL). Cure for 6 to 8 hours at room temperature or at elevated temperature per Figure 4/GENERAL.

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- (b) Where gray or white Tedlar film surfaces have been removed, seal with Resin Mix 3 (Figure 1/GENERAL). Cure 6 to 8 hours at room temperature (or per Figure 4/GENERAL) and apply one coat of BMS 10-79 Type II primer and one coat of BMS 10-60, Type II enamel (gray, BAC705; white, BAC7106).
- (c) Where the conductive coating BMS 10-21 has been removed, reapply per AMM 51-24-02.
- (d) Where the abrasion resistant Teflon finish has been removed from the internal surface of the panel edgeband, reapply the finish per AMM 51-24-13.
- (e) Where the original painted surfaces have been removed, restore original finish per AMM 51-21-00/701.
- (f) Where sealant has been removed from around fittings, fasteners or fay surfaces to facilitate repairs, reapply BMS 5-95 sealant per 51-20-05, GENERAL.

I. Perform Post-Repair Requirements.

- (1) Make an inspection of the repair that was done to make sure that the repair is satisfactory. The inspection must include these areas:
 - The area that was hot.
 - A minimum width of 2 in. (5 cm) all around the area that was hot.

If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: Post repair inspection is recommended. Examples of inspection procedures are given in NDT Part 1, 51-01-01. Other inspection methods that have been examined and found satisfactory by the airline can be used.

WARNING: FLIGHT SAFETY DEMANDS THAT CERTAIN CONTROL SURFACES BE PROPERLY BALANCED AT ALL TIMES.

- (2) Following repair of control surface, balance must be checked to determine whether or not rebalancing is required. Rebalance as necessary per CONTROL SURFACE BALANCING, SECTION/51-60.

CAUTION: REPAIRS MADE TO CONTROL SURFACES AND/OR ADJACENT STRUCTURE MUST NOT INTERFERE WITH THE DESIGNED OPERATION OF THE CONTROL SURFACES. DAMAGE TO AIRPLANE STRUCTURE MAY OCCUR.

- (3) Check all repairs for clearance and noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

CAUTION: REPAIRS MUST NOT COVER EXISTING DRAIN HOLES IN PANELS. WATER WILL ACCUMULATE IF DRAIN HOLES ARE COVERED.

- (4) If repair covers the drain hole, drill through the repair at existing location.

NOTE: Drain holes are usually 0.375 in. (9.52 mm) diameter. Refer to AMM 51-41-01.

5. Typical Repairs

NOTE: These repairs apply to all 350°F (177°C) fiberglass fabric reinforced honeycomb components, except radomes, when called out in applicable repair index of specific structure.

CAUTION: ESTABLISH COMPONENT MATERIAL AND REPAIR LIMITS PRIOR TO PROCEEDING WITH ANY REPAIRS.

A. Repair of Delaminations Between Plies.

- (1) Delamination of plies over core area of panel (Figure 5/GENERAL).

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- (a) Determine damage per Paragraph 4.A./GENERAL. Ensure that water and other contamination are removed per Paragraph 4.B./GENERAL.
 - (b) Cut away delaminated plies per Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area per Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband.
- (a) Repair this type of damage per 51-70-17, GENERAL.
- B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel.
- (1) Repair this type of damage per 51-70-17, GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Figure 2/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from the damaged area as given in Paragraph 4.B./GENERAL.
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
 - (5) Sand core plug approximately flush with surrounding material, making allowance for adhesive film and slight core crush during cure.
 - (6) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Figure 6/GENERAL).

NOTE: For repair where access to inner surface is limited, refer to Paragraph 5.F./GENERAL.

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area. Refer to Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL, except do not perform Paragraph 4.D.(3)(e)/GENERAL, Paragraph 4.D.(3)(f)/GENERAL, Paragraph 4.D.(3)(g)/GENERAL, Paragraph 4.D.(3)(h)/GENERAL, Paragraph 4.D.(3)(i)/GENERAL, Paragraph 4.D.(3)(j)/GENERAL, and Paragraph 4.D.(3)(k)/GENERAL.
- (5) Prepare and apply repair plies to one surface of the panel according to Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
- (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
- (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.

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- (8) Prepare and apply repair plies to the other surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

E. Replacement of Honeycomb Core on Damaged Edge of Panel (Figure 7/GENERAL).

- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from the damaged area as given in Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug per Paragraph 4.D./GENERAL.
- (5) Sand core plug approximately flush with surrounding core material, making allowance for adhesive film and slight core crush during cure.
- (6) Clean surfaces according to Paragraph 4.C.(2)(e)/GENERAL.
- (7) Prepare and apply repair plies and complete repairs per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.

F. Repairs Where Access is Limited to One Side of Panel (Figure 8/GENERAL).

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side, and the repair is accomplished in one operation, i.e., core repair and patch overlay repair cured together. Refer to Figure 8/GENERAL when making this repair.

- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
- (2) Ensure that all contamination and water is removed from damaged area as given in Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area per Paragraph 4.C./GENERAL and the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + \{N \times [1.0 \text{ in. (25.4 mm) for each ply}]\} + 1.0 \text{ in. (25.4 mm)}$

d = major diameter of oval hole in inner skin and is limited to 1.5 in. (38.1 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole. Taper sand the outer skin plies per Paragraph 4.C.(2)/GENERAL.
- (4) Fabricate an airtight patch, Figure 8/GENERAL (Details II thru V) to cover the oval hole from the inaccessible side as follows:
 - (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
 - (b) Cover the mold with parting film or release agent.

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- (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 4.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D diameter.
- (d) Bag and cure the patch per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Place thermocouples at the edge of the patch before cure.
- (e) Remove the patch from the mold.
- (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
- (g) Drill a 0.125 in. (3.175 mm) diameter hole in the center of the patch for a Cleco fastener.
- (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
- (i) Fabricate a strip of spring steel 1.0 in. (25 mm) X 10.0 in. (254 mm) and drill a 0.125 in. (3.175 mm) diameter hole in the center for the Cleco fastener.

NOTE: This repair illustrates the use of a spring steel clamp. However, any suitable retaining device may be used.
- (j) Assemble the patch and spring steel together with a 0.125 in. (3.175 mm) diameter Cleco fastener. Refer to Figure 8 (Sheet 2), Detail II.
- (5) Remove Tedlar, if required and abrade the underside of the inner skin to a distance of 0.4 in. (10.2 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean out the repair area with oil-free compressed air. Wipe the surface with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99/SOPM 20-30-99).
- (7) Bend up both ends of the spring steel and apply adhesive BMS 5-109, Type II adhesive paste to the precured patch.
- (8) Holding the spring steel up - insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
- (9) Cure the adhesive per Figure 1/GENERAL. When cure is complete, remove the Cleco fastener and spring. Fill hole for Cleco fastener with BMS-5-109, Type II adhesive paste or BMS 5-95, Class B-1/2 sealant and let it cure.

NOTE: Cure BMS 5-109 adhesive paste as given in Figure 1/GENERAL. Cure BMS 5-95 sealant as given in 51-20-05, GENERAL.
- (10) Clean out the repair area per Paragraph 5.F.(6)/GENERAL.
- (11) Apply adhesive film BMS 8-145, Type I, 0.10 in. (2.5 mm) bigger than diameter D to the surface of the inner skin which fays with the inner skin repair plies.
- (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin.
- (13) Fabricate and clean core plug per Paragraph 4.D.(1)/GENERAL and Paragraph 4.D.(2)/GENERAL.

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- (14) Complete the installation of the core plug per Paragraph 4.D.(3)(b)/GENERAL, Paragraph 4.D.(3)(c)/GENERAL, Paragraph 4.D.(3)(d)/GENERAL, Paragraph 4.D.(3)(e)/GENERAL, Paragraph 4.D.(3)(f)/GENERAL, Paragraph 4.D.(3)(g)/GENERAL, Paragraph 4.D.(3)(h)/GENERAL, Paragraph 4.D.(3)(i)/GENERAL, Paragraph 4.D.(3)(j)/GENERAL, and Paragraph 4.D.(3)(k)/GENERAL.
 - (15) Prepare and apply repair plies to the outer skin surface of the panel and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Figure 9/GENERAL).
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area. Area must be completely dried out. Refer to Paragraph 4.B./GENERAL.
- CAUTION:** DO NOT SAND INTO BOND PLY OR CORE (FIGURE 9/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. BOND PLY IS ADJACENT TO CORE.
- (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
 - (4) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- H. Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels.
- NOTE:** This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.
- (1) Determine extent of damage according to Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
 - (3) Remove damage and prepare area according to Paragraph 4.C./GENERAL.
- NOTE:** Taper sand edges of plies around repair on damaged side of panel.
- (4) Prepare and apply repair plies and complete repair per Paragraph 4.E./GENERAL, Paragraph 4.F./GENERAL, Paragraph 4.G./GENERAL, Paragraph 4.H./GENERAL, and Paragraph 4.I./GENERAL.
- NOTE:** If cleaned up damage penetrates solid laminate, secure a metal caul plate (such as 0.016 in. (0.4 mm) thick aluminum) to far side of panel to support repair plies.
- I. Repair of Punctures, 0.25 in. (6.4 mm) Diameter or Less, in Solid Laminate Panels.
- NOTE:** This repair applies to components made from laminated fiberglass fabric plies and epoxy resin without a honeycomb core.
- (1) Check for delamination per Paragraph 4.A./GENERAL.
 - (2) If no delamination is found, clean up damage to a smooth, rounded shape. Repair per Paragraph 5.B./GENERAL.
 - (3) If delamination is found, repair per Paragraph 5.H./GENERAL.

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J. Repair of Delaminations Between Plies in Solid Laminate Panels.

NOTE: This repair applies to components made from laminated fiberglass fabric plies and epoxy resin without a honeycomb core.

- (1) Repair delaminations using methods described in Paragraph 5.H./GENERAL.

K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels (Figure 10/GENERAL).

- (1) Determine the extent of damage according to Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area per Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage according to Figure 10/GENERAL and Paragraph 4.C.(2)(d)/GENERAL.
- (4) Clean area according to Paragraph 4.C.(2)(e)/GENERAL.
- (5) Prepare and apply repair plies according to Paragraph 4.E./GENERAL and Figure 10/GENERAL.
- (6) Apply vacuum and cure according to Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (7) Refinish the repair according to Paragraph 4.H./GENERAL.
- (8) Drill and countersink fastener holes.
- (9) Perform applicable post-repair requirements per Paragraph 4.I./GENERAL before returning the repaired component to flight service.

L. Repair of Surface Dents.

- (1) Check for delamination and broken fibers per Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair per Paragraph 5.A./GENERAL.
- (3) If broken fibers are found, repair per Paragraph 5.B./GENERAL or Paragraph 5.C./GENERAL.
- (4) If no delamination or broken fibers are found, repair per 51-70-06, GENERAL.

M. Repair of BMS 8-289 Aluminum Foil (Figure 17/GENERAL and Paragraph 4.C.(2)(b2)/GENERAL).

NOTE: Do this repair in addition to the applicable repair of the underlying plies.

- (1) Determine the extent of and remove damage. Apply repair materials to the underlying composite structure per Paragraph 4.A./GENERAL, Paragraph 4.B./GENERAL, Paragraph 4.C./GENERAL, Paragraph 4.D./GENERAL and Paragraph 4.E./GENERAL up to and including the step for applying the repair plies to the surface that had aluminum foil.
- (2) Apply a chemical conversion coating to the nonadhesive side of the splice strip, cover ply, and aluminum surfaces that will contact the splice strip and cover ply.
- (3) Butt-splice a ply of BMS 8-289, Type 0/350/x/x/x over the repair area, adhesive side down, with a 0.25 in. (6.4 mm) maximum gap and no overlap allowance.
- (4) Lay up splice strips of BMS 8-289, Type 0/350/x/x/x Form II, adhesive side up, so that they overlap each side of the splice line by about 1.25 in. (31.8 mm). Form I foil is optional, but it requires a chemical conversion coating on the nonadhesive side and 0.5 in. (12.7 mm) diameter holes on 2.0 in. (50.8 mm) centers.

NOTE: Do not allow the cover ply or splice strip to extend into the edgeband area of the panel. Electrical splicing is not allowed on the laminated edgeband faying surface.



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STRUCTURAL REPAIR MANUAL

- (5) Apply a layer of BMS 8-145, Type I, Grade 03 or 05 adhesive, then a cover ply of BMS 8-139, Style 120 prepreg over the repair so that both plies overlap the outer edge of the splice strip by 1.0 in. (25.4 mm) (do not allow the cover ply or splice strip to extend into the edgeband area of the panel).
- (6) Vacuum bag and cure the repair per Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME ^A
RESIN MIX 3 (SEALER RESIN)	EPIBOND 156A RESIN EPIBOND 156B HARDENER	100 ±2 6 ±0.3	15 TO 25 MINUTES AT 77°F (25°C)	12 HOURS AT 70°F (21°C) OR 1 TO 3 HRS AT 150°F (66°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE	FIBER-RESIN 5318S FIBER-RESIN 5318C	100 ±2 50 ±1	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4 OR 24 HOURS MIN. AT 70°F (21°C)
RESIN MIX 3 EPOX-O WELD (SEALER RESIN) ALTERNATE	TWO COMPONENT KIT	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT		
			45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4 OR 24 HOURS MIN. AT 70°F (21°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE	EPIBOND 156A RESIN EPIBOND 941 HARDENER	100 ±2 10 ±0.5	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 4 OR 15 HOURS MIN. AT 70°F (21°C)
RESIN MIX 3 (SEALER RESIN) ALTERNATE BMS 8-207, TYPE 1, CLASS II 350°F (177°C)	FR-40 RESIN 5413C HARDENER	100 ±1 15 ±0.5	20 MINUTES AT 75°F (24°C) TO 79°F (26°C)	12 HOURS MIN AT ROOM TEMP. (65°F [18°C] MIN) 1 HOUR MIN AT 150°F (66°C) TO 170°F (77°C)
RESIN MIX 9 BMS 8-214, TYPE 1	EPOCAST 31A RESIN EPOCAST 927B HARDENER	100 ±1 19 ±0.5	8 HOURS AT 70°F (21°C)	90 MINUTES AT 350 ±10°F (177 ±6°C)
RESIN MIX 9 (ALTERNATE) BMS 8-301, TYPE 1	EA9390 A/B	100 ±0.5 56 ±0.5	2 HOURS AT 70°F (21°C)	220 MINUTES AT 200 ±10°F (93 ±6°C) 180 MINUTES AT 230 ±10°F (110 ±6°C)
BMS 8-301, CLASS 2 LAMINATING RESIN	FR 7020 PART A RESIN BASE PART B HARDENER EY3804 PART A RESIN BASE PART B HARDENER	100 ±2 58 ±0.5	30 MINUTES AT 75°F	180 MINUTES AT 150°F (68°C) 5 DAYS AT ROOM TEMPERATURE 68°F (20°C)
BMS 5-90 TYPE III, CLASS 350-10-10, GRADE 50 (FOAMING ADHESIVE FILM)	FM-490A MA-562 PL-685		^C ^D	SEE TEXT
BMS 5-90 TYPE IV, CLASS 350-10-10, (FOAMING EXTRUDABLE ADHESIVE)	PL-460		^C ^D	SEE TEXT
BMS 5-109, TYPE II (ADHESIVE PASTE)	EA 9394 PART A EA 9394 PART B OR EA 934 NA PART A EA 934 NA PART B	REFER TO MANUFAC- TURERS' DATA	30 MINUTES	130 MINUTES ±10 MINUTES AT 150°F (66°C) ±20°F (7°C)

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 1 of 2)

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME ^A
BMS 5-154, TYPE II, CLASS 1, GRADE O3	METLBOND 1515-3M O3 PSF ADHESIVE FILM METLBOND 1515-3M-HT O3 PSF ADHESIVE FILM PL 795 O3 PSF ADHESIVE FILM		10 DAYS AT 95°F	SEE TEXT
BMS 5-154, TYPE II, CLASS 2, GRADE O3			10 DAYS AT 95°F (35°C) ^D ^E	SEE TEXT
BMS 5-154, TYPE II, CLASS 1, GRADE O5	METLBOND 1515-3M O5 PSF ADHESIVE FILM METLBOND 1515-3M-HT O5 PSF ADHESIVE FILM PL 795 O5 PSF ADHESIVE FILM		10 DAYS AT 90°F (32°C) ^D ^E	SEE TEXT
BMS 5-154, TYPE II, CLASS 2, GRADE O5	PL 795 O5 PSF ADHESIVE FILM		30 DAYS AT 95°F (35°C) ^D ^E	SEE TEXT
BMS 8-145, TYPE I	FM-355 ADHESIVE FILM AF-131-2 ADHESIVE FILM		10 DAYS AT 90°F (32°C) ^D ^E	SEE TEXT
BMS 8-139 (GLASS PREPREG) CLASS II STYLE: 120 1581 ^B	120-F164-6-F50 1581-F164-6-F50		15 DAYS AT 65°F (18°C) TO 80°F (27°C) 1 DAY AT 81°F (27°C) TO 110°F (43°C) ^D ^E	SEE TEXT

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

	MIXING PROCEDURE
RESIN MIX 3 RESIN MIX 9	ADD HARDENER TO RESIN AND MIX THOROUGHLY
BMS 5-90 BMS 5-154	REMOVE WRAPPER BEFORE USE

NOTES

- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

^A CURE TIME IS THE MINIMUM TIME REQUIRED TO CURE PRIOR TO HANDLING OR SANDING.

^B BMS 8-139, STYLE 1581 WAS FORMERLY TYPE 181.

^C REMOVE THE MATERIAL FROM THE COLD STORAGE AREA. KEEP FOR A MINIMUM OF 30 MINUTES FOR EACH POUND OF WEIGHT BEFORE OPENING THE SEALED BAG.

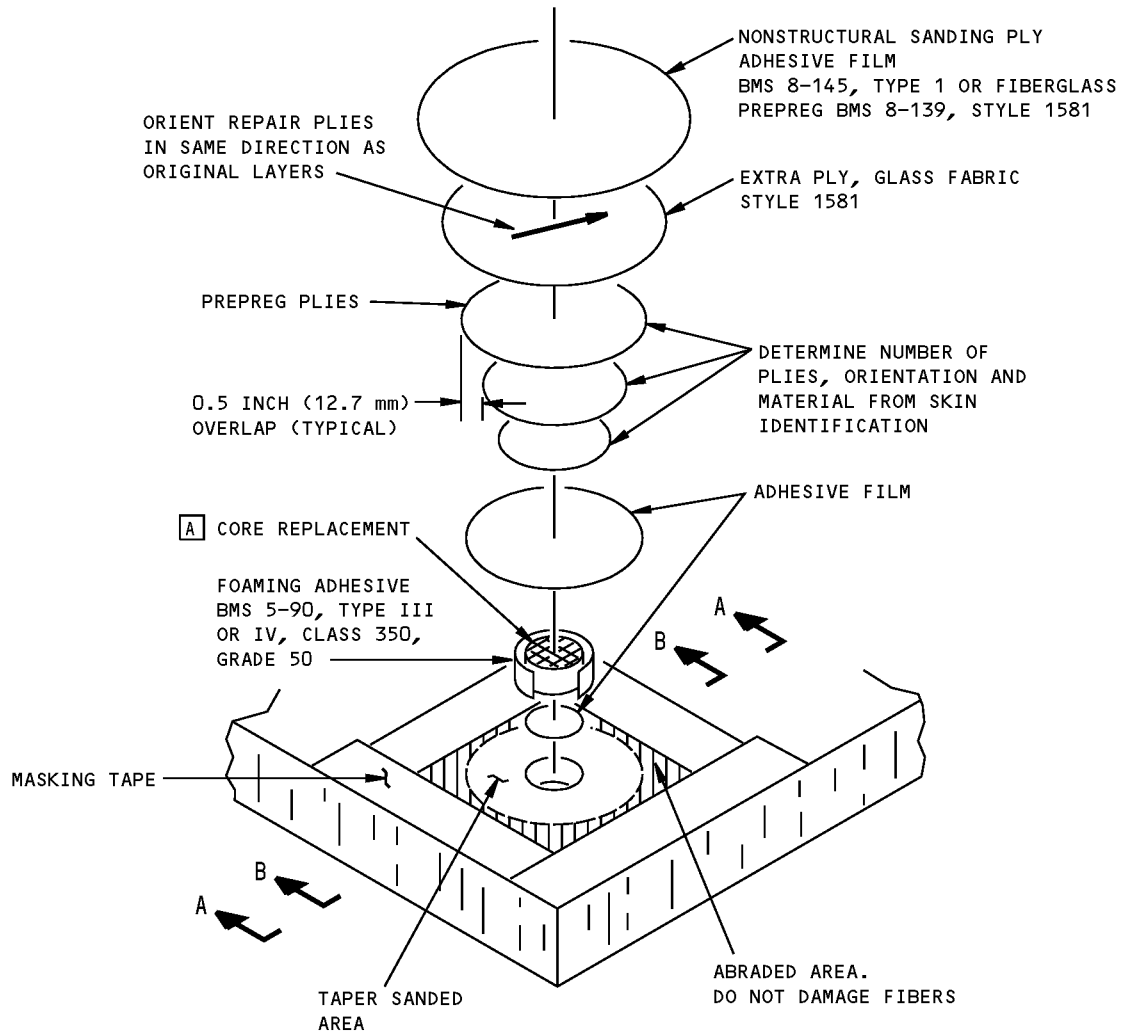
CAUTION: THE MATERIAL SHALL REMAIN SEALED UNTIL IT IS AT ROOM TEMPERATURE, SUCH THAT NO CONDENSATION FORMS ON THE BAG WHEN WIPED DRY.

^D KEEP THE ADHESIVE FILMS AND PREIMPREGNATED MATERIALS BELOW 0°F (-18°C). KEEP ALL THE MATERIALS SEALED IN MOISTURE PROOF BAGS. RECORD THE TIME THE MATERIALS ARE OUT OF STORAGE. IF THE TOTAL TIME OUT OF COLD STORAGE IS NOT MORE THAN THE HANDLING LIFE, THE MATERIAL CAN BE PUT BACK INTO STORAGE.

^E REMOVE THE ADHESIVE FILMS AND PREIMPREGNATED MATERIALS FROM THE COLD STORAGE AREA. THE MATERIAL SHALL REMAIN SEALED UNTIL IT IS AT ROOM TEMPERATURE, SUCH THAT NO CONDENSATION FORMS ON THE BAG WHEN WIPED DRY.

**Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 2 of 2)**

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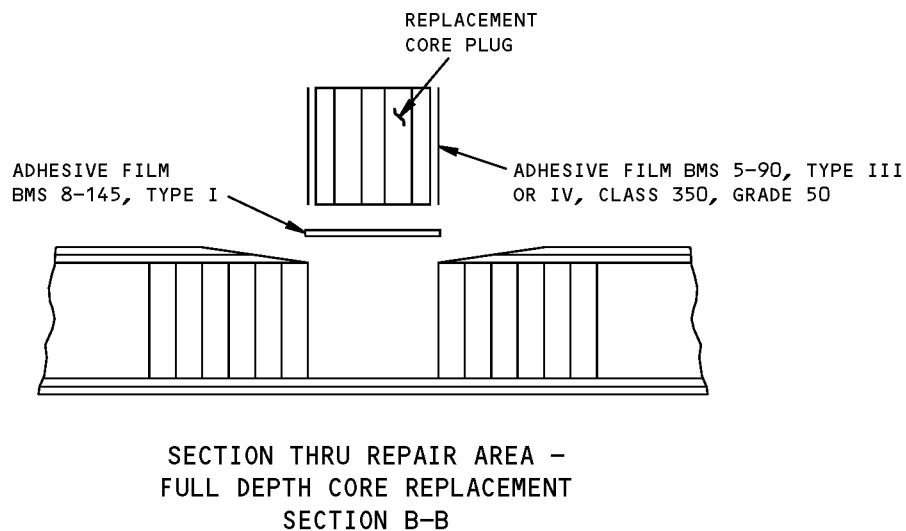
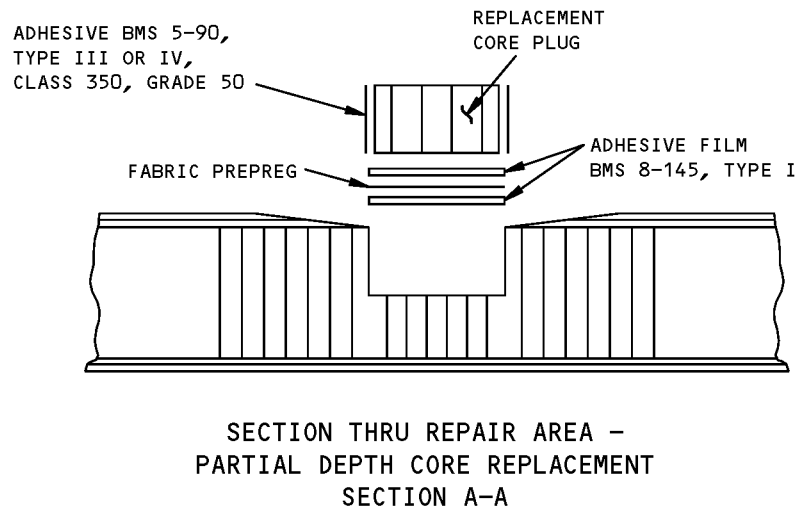


NOTES

- [A] BUTT SPLICING SHOWN. FOR CRUSH SPLICING REFER TO FIG. 15.

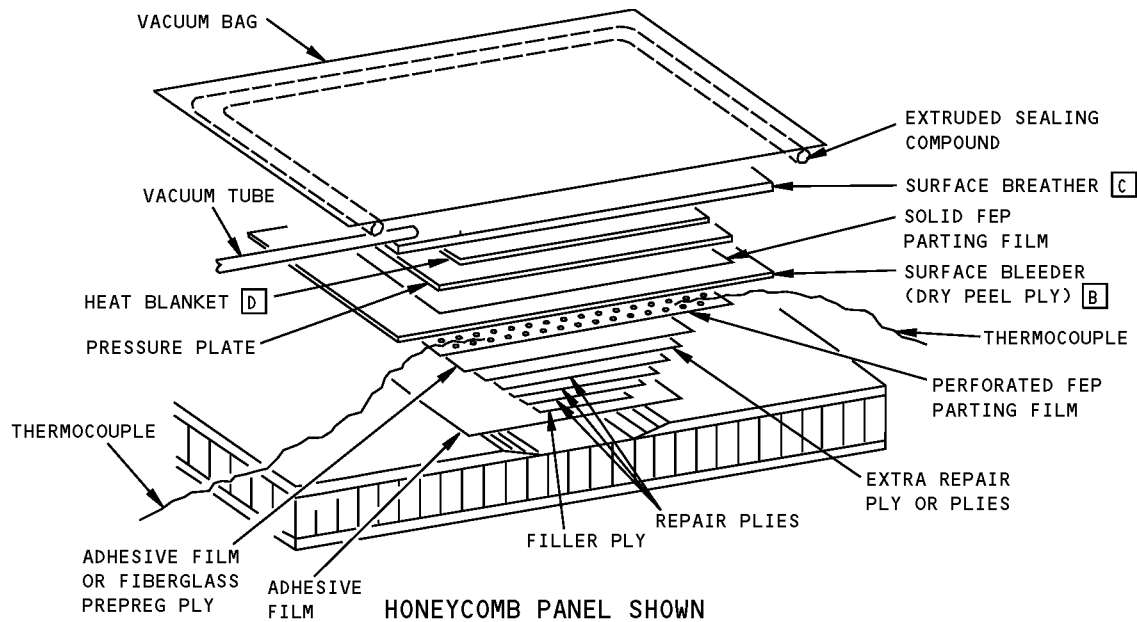
Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 350 Degrees F (177 Degrees C) Cure
Figure 2 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL

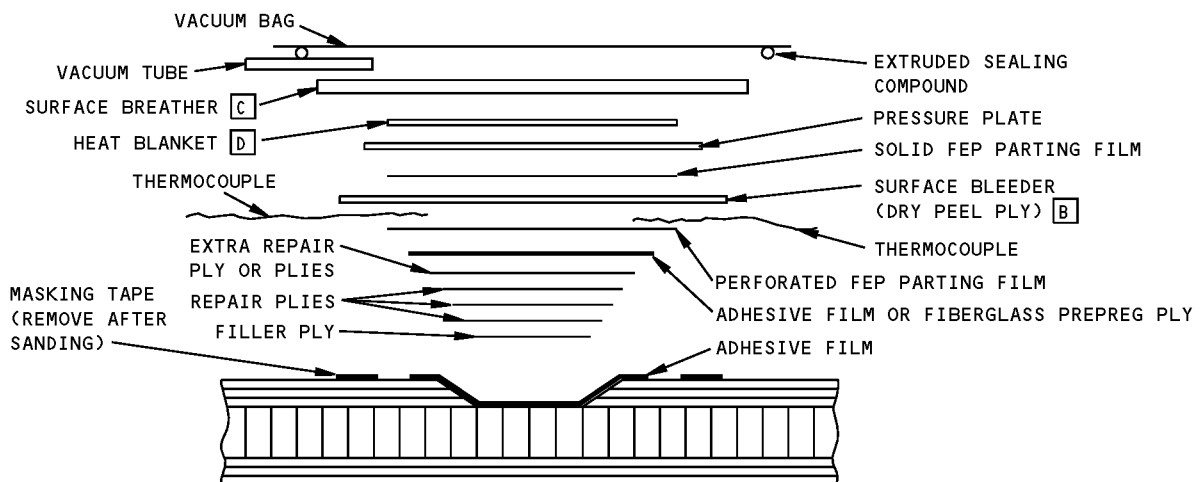


Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage - 350 Degrees F (177 Degrees C) Cure
Figure 2 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL



BAGGING SEQUENCE FOR SKIN PLY REPAIR



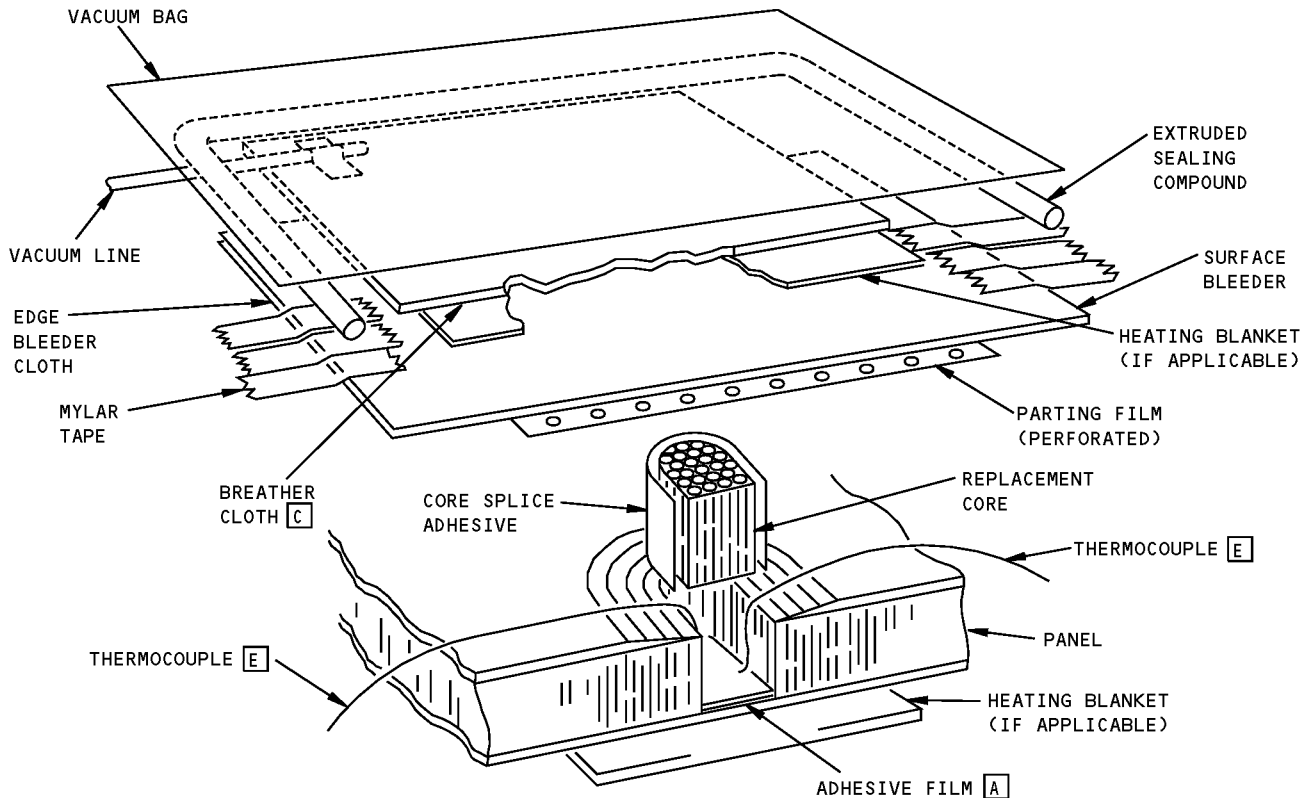
SECTION THRU SKIN PLY REPAIR

NOTES

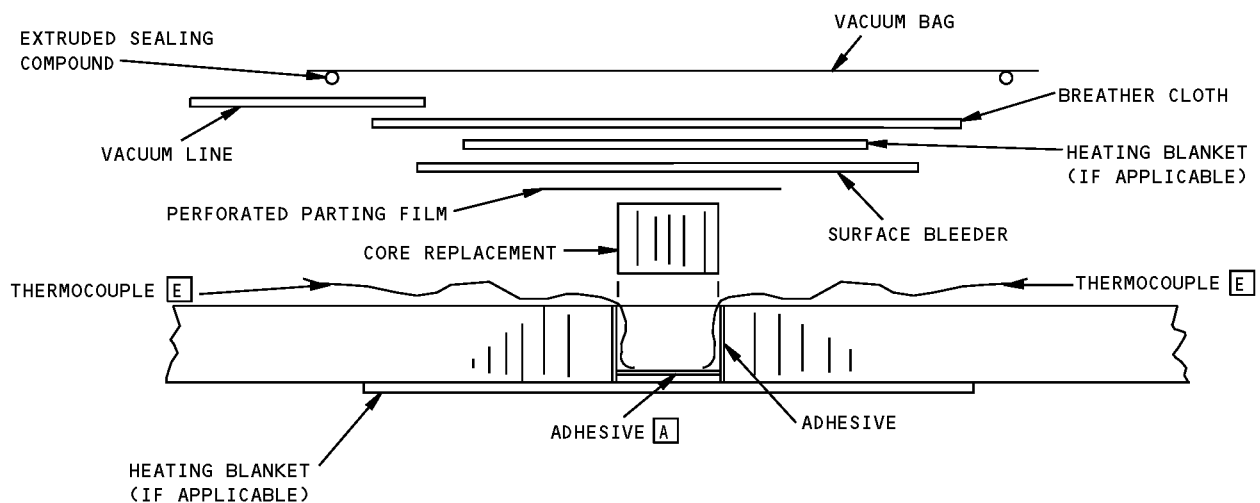
- | | |
|---|--|
| <p>[A] ONE PLY OF ADHESIVE FILM (FOR FULL DEPTH CORE REPLACEMENT, WHERE DAMAGE DOES NOT EXTEND THROUGH BOTH SKINS). FOR PARTIAL CORE REPLACEMENT USE TWO PLIES OF ADHESIVE FILM WITH ONE PLY OF BMS 8-139, CLASS 2 STYLE 120 FIBERGLASS BETWEEN THEM.</p> <p>[B] DRY PEEL PLY MUST MAKE CONTACT WITH THE SURFACE BREATHER MATERIAL.</p> | <p>[C] WHEN USING A HEATING BLANKET, USE 4 TO 6 LAYERS OF BREATHER MATERIAL TO PREVENT DAMAGE TO VACUUM BAG.</p> <p>[D] HEATING BLANKET MUST EXTEND A MINIMUM OF 2 INCHES (50.8 mm) BEYOND EDGE OF REPAIR PATCH.</p> <p>[E] FOR THERMOCOUPLE PLACEMENT, REFER TO PAR. 4.D.(3)(f).</p> |
|---|--|

Application of Pressure During Cure - 350 Degrees F (177 Degrees C) Cure
Figure 3 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



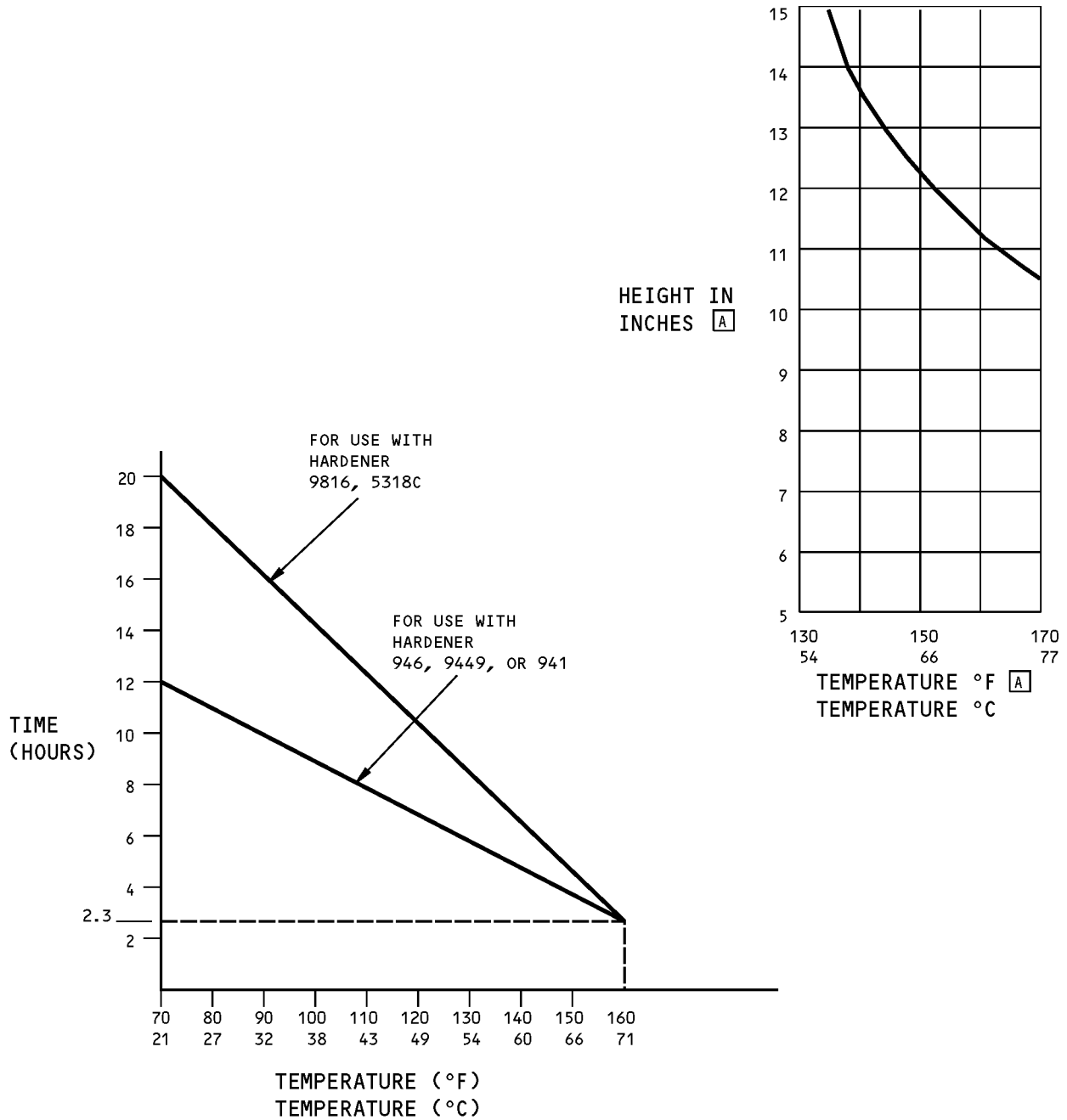
**BAGGING SEQUENCE
FOR CORE REPLACEMENT - 350°F (177°C) CURE**



**SECTION THRU LAYUP
FOR CORE REPLACEMENT - 350°F (177°C) LAYUP ONLY**

**Application of Pressure During Cure - 350 Degrees F (177 Degrees C) Cure
Figure 3 (Sheet 2 of 2)**

757-200 STRUCTURAL REPAIR MANUAL

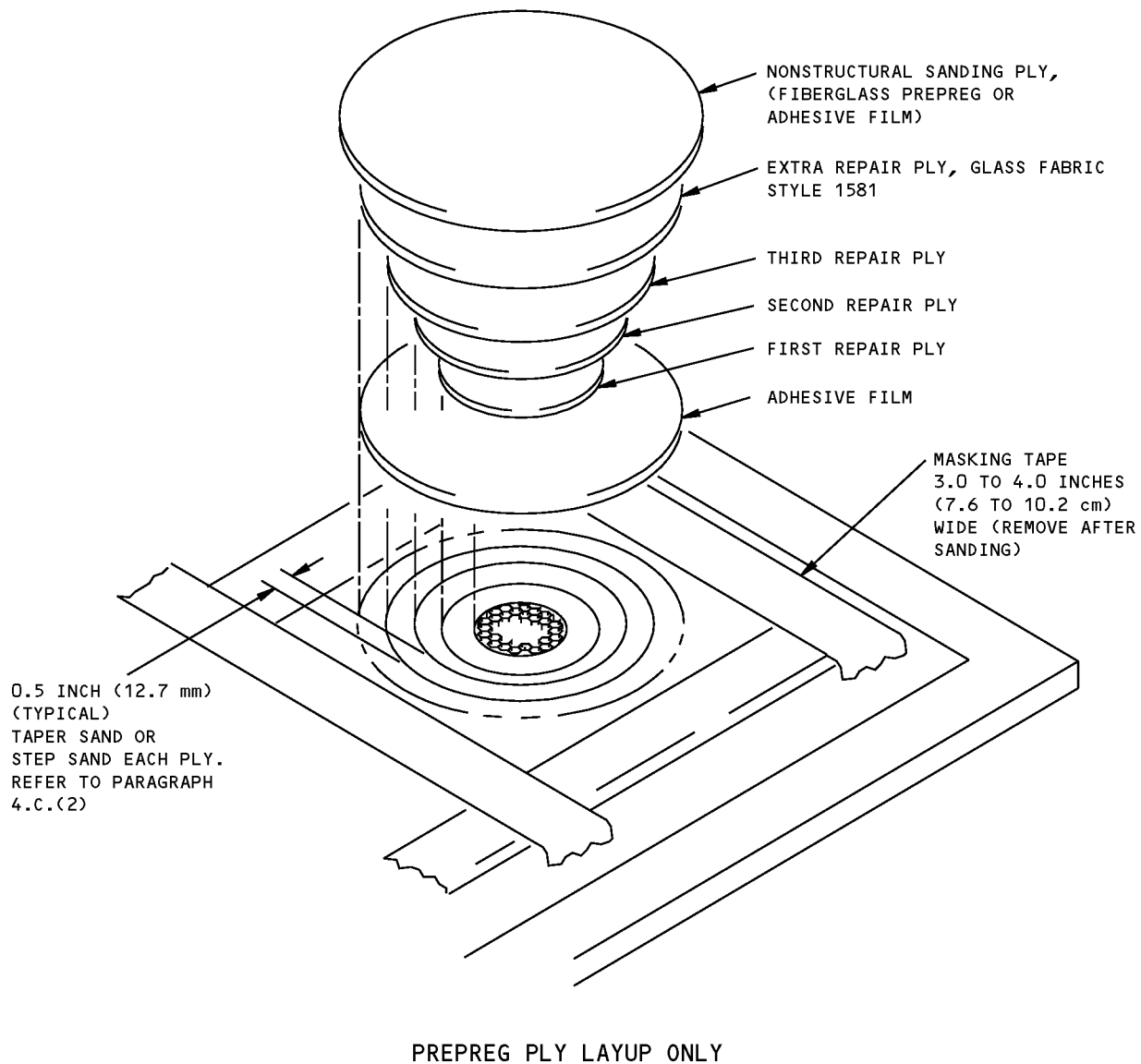


NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE
- A** THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

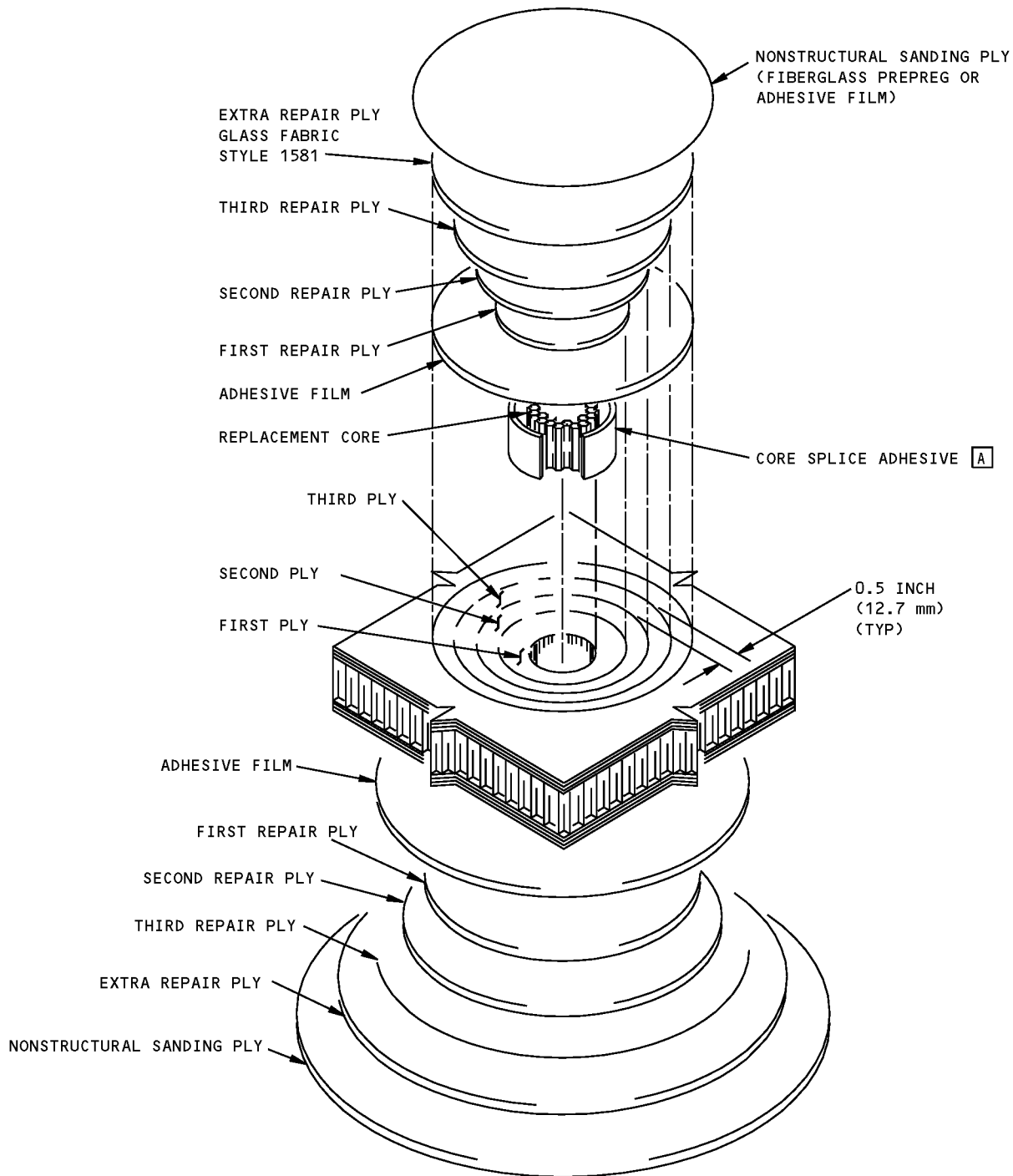
Potting and Laminating Resin Cure Temperature
Figure 4

757-200
STRUCTURAL REPAIR MANUAL



Repair of Damaged External or Internal Skins of a Sandwich Panel - 350 Degrees F (177 Degrees C) Cure
Figure 5

757-200
STRUCTURAL REPAIR MANUAL



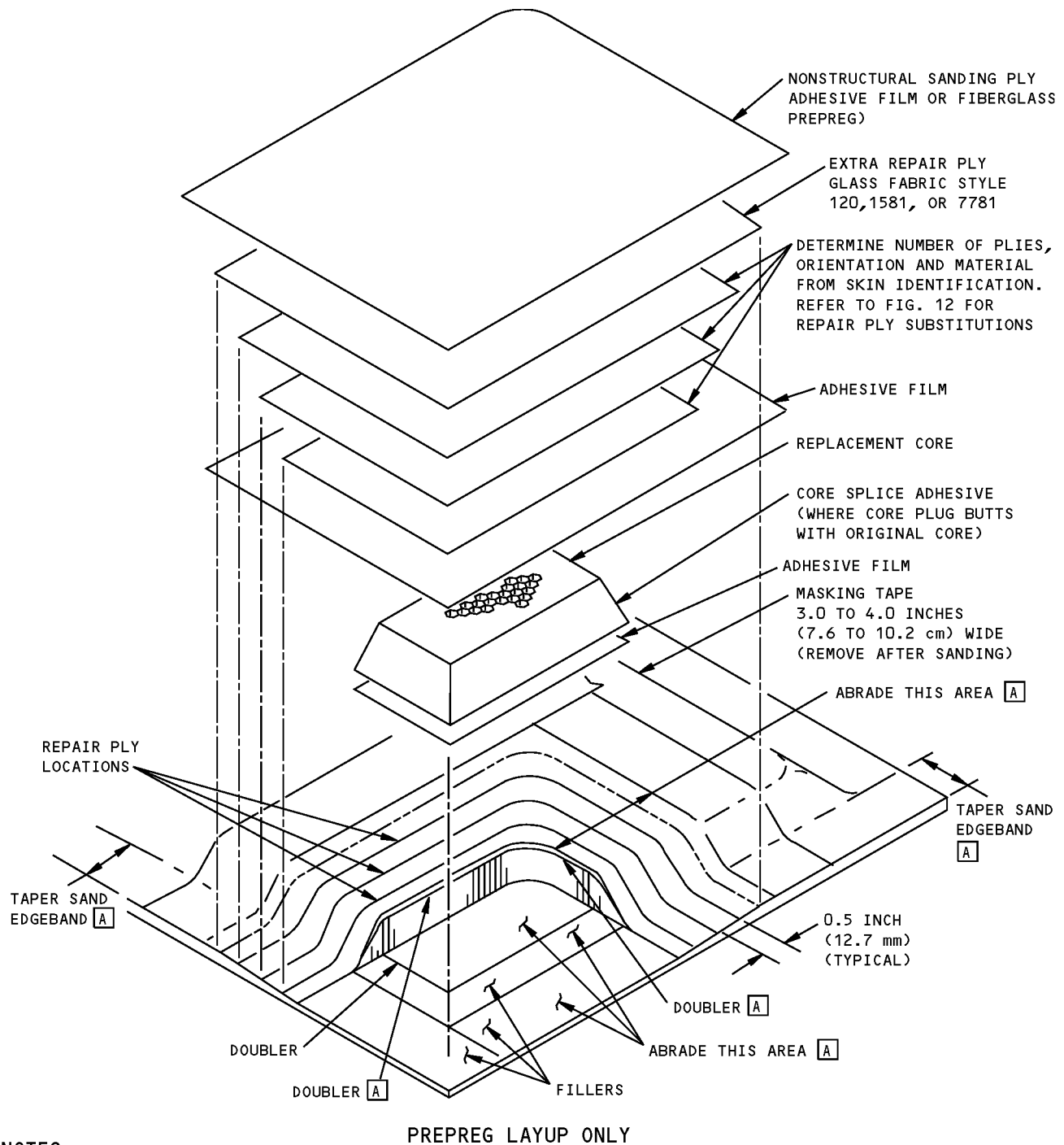
NOTES

PREPREG LAYUP ONLY

- [A] ADHESIVE APPLIED TO CORE PLUG. REFER TO PARAGRAPH 4.D.(3).

Repair of Large Punctures Thru Both Skins of a Sandwich Panel Including Core Damage - 350 Degrees F (177 Degrees C) Cure
Figure 6

757-200 STRUCTURAL REPAIR MANUAL

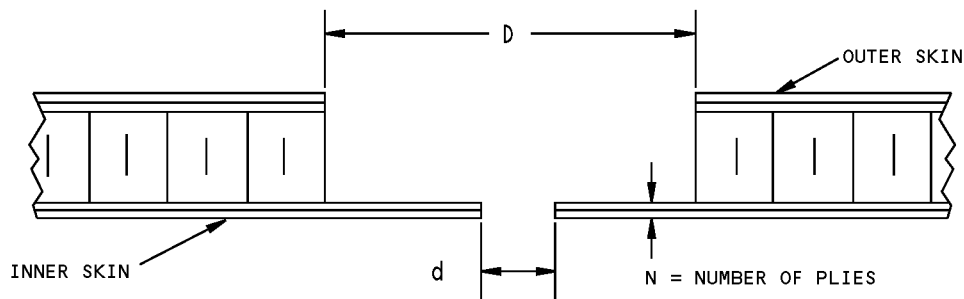
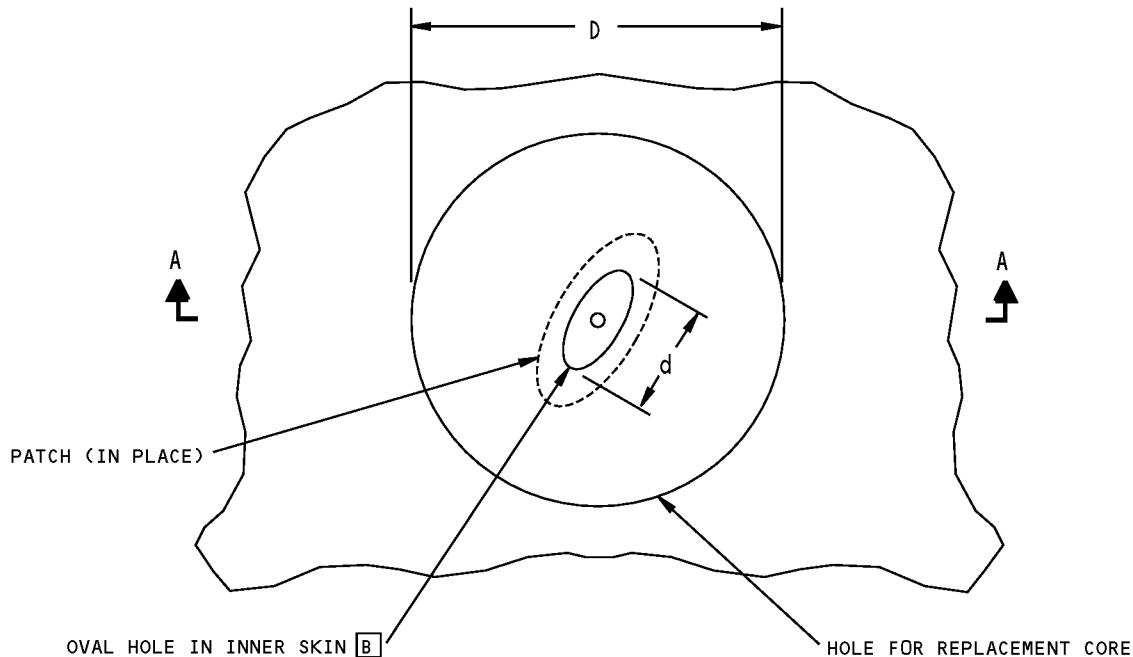


NOTES

- [A] TAPER SANDING IS OPTIONAL TO JUST ABRADING THE SURFACE OF THE SKIN AND DOUBLER PLIES ABOVE AND BELOW THE HONEYCOMB CORE. HOWEVER, TAPER SANDING IS REQUIRED ON THE EDGE BAND.

**Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel - 350 Degrees F (177 Degrees C) Cure
Figure 7**

757-200 STRUCTURAL REPAIR MANUAL



SECTION A-A
(PATCH NOT SHOWN)

DETAIL I

NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED.
- $D = d + (N + [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)})$
- d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN. SIZE LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR
- N = NUMBER OF PLIES
- D = DIAMETER OF HOLE FOR REPLACEMENT CORE

EXAMPLE:

IF $d = 0.50 \text{ INCH (12.7 mm)}$
 THEN, $D = 0.50 \text{ INCH (12.7 mm)} + \{[2 \text{ (PLIES)} \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)}]\}$
 $D = 3.50 \text{ INCHES (88.9 mm) DIAMETER}$

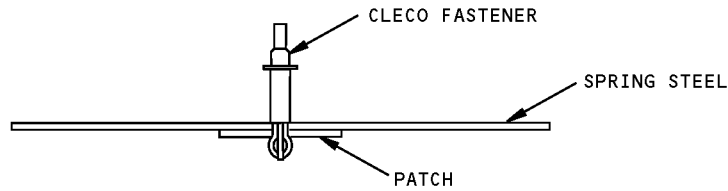
A MAKE TAPER AND OVERLAP, REFER TO FIG. 13.

B MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCHES (38.1 mm) FOR THIS REPAIR.

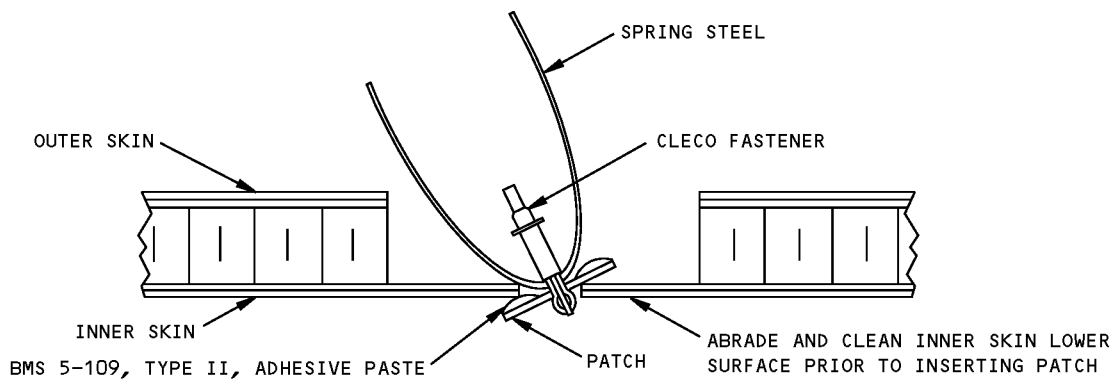
Repair of Damage to External and Internal Skins with Access Limited to One Side - 350 Degrees F (177 Degrees C) Cure

Figure 8 (Sheet 1 of 3)

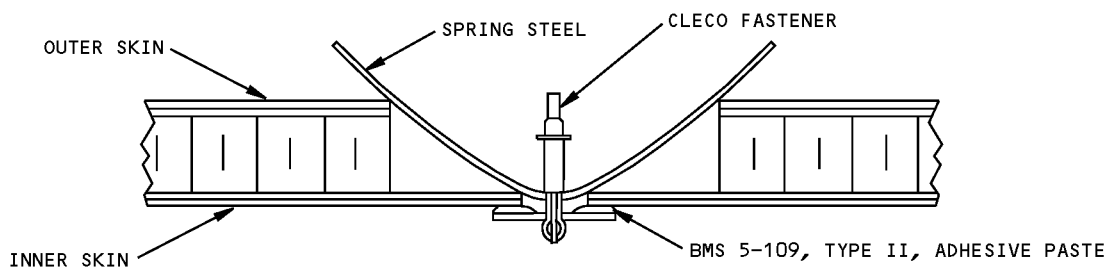
757-200 STRUCTURAL REPAIR MANUAL



ASSEMBLE PATCH AND SPRING STEEL
DETAIL II



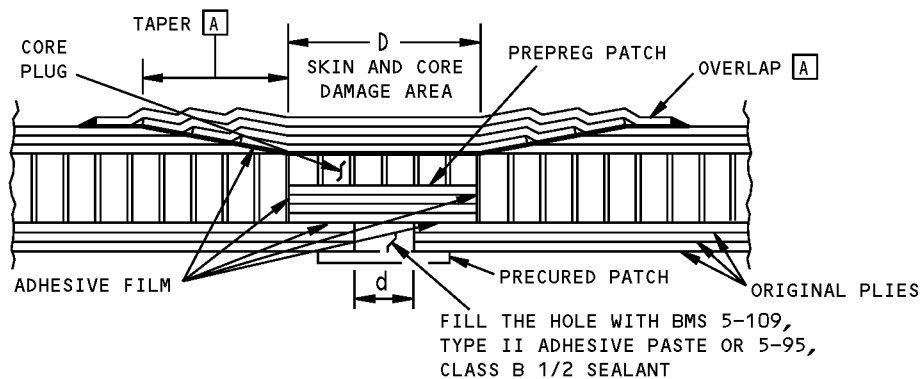
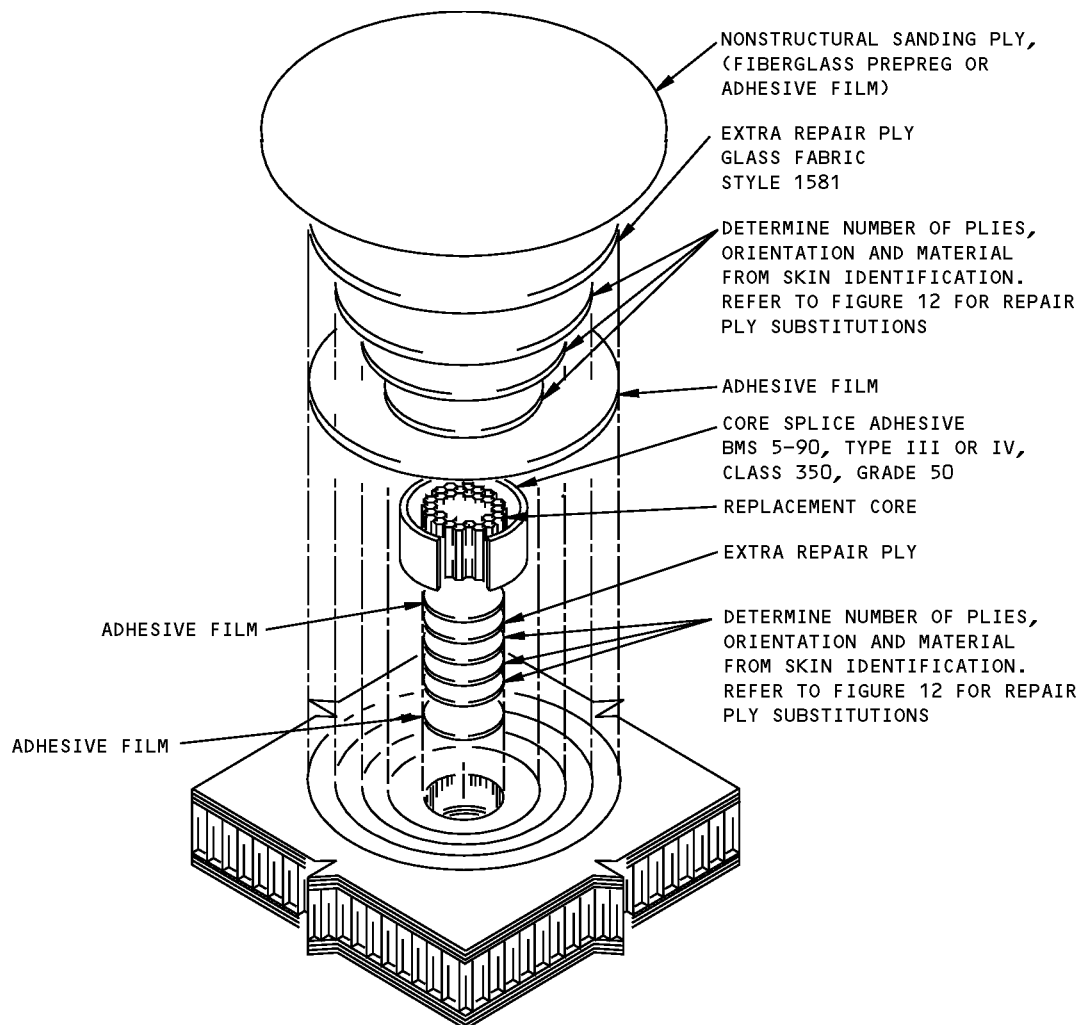
INSERT PATCH INTO OVAL HOLE
DETAIL III



HOLD PATCH IN PLACE WHILE CURING
DETAIL IV

Repair of Damage to External and Internal Skins with Access Limited to One Side - 350 Degrees F (177 Degrees C) Cure
Figure 8 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH REPAIR

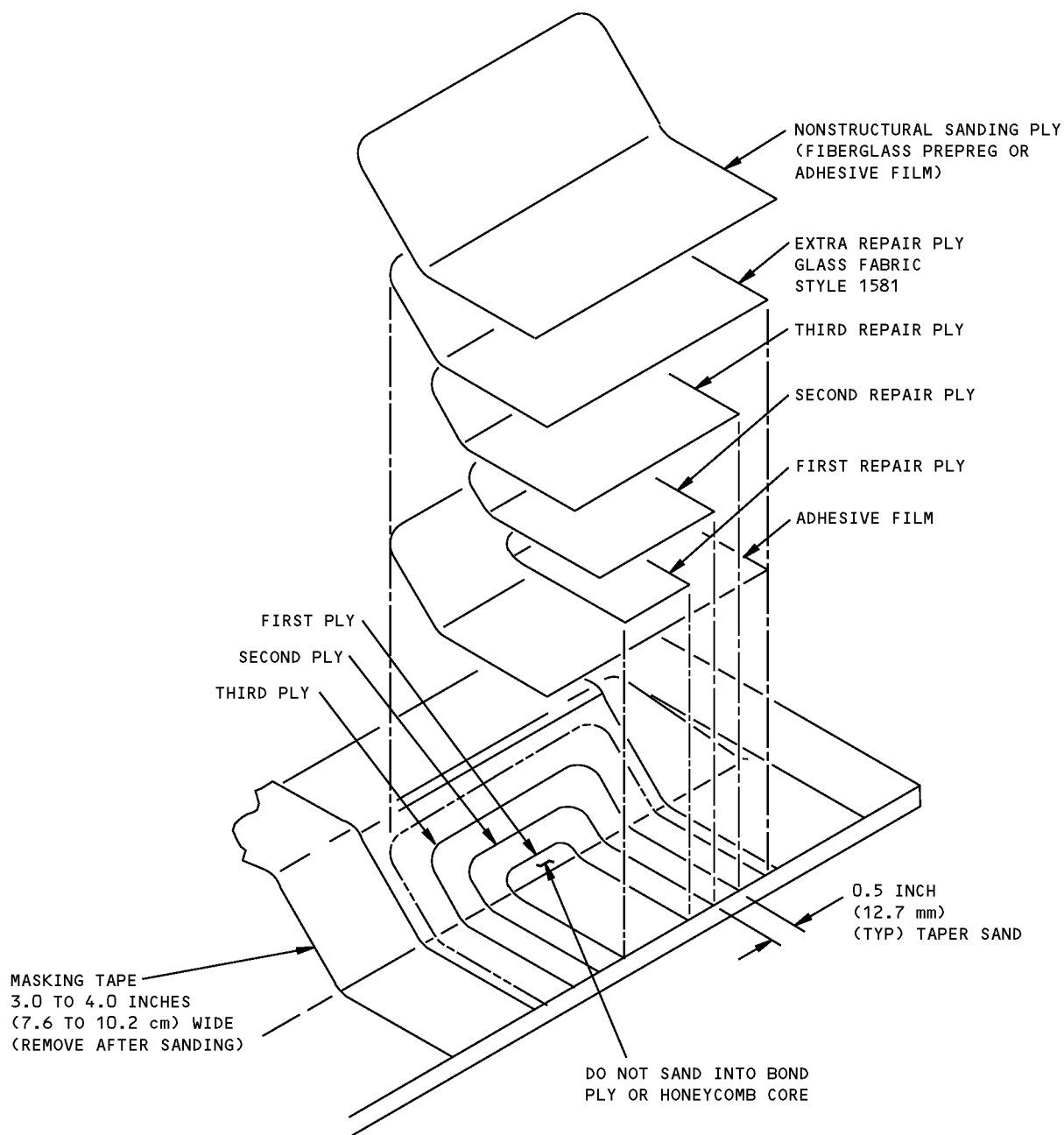
PREPREG LAYUP ONLY

DETAIL V

Repair of Damage to External and Internal Skins with Access Limited to One Side - 350 Degrees F (177 Degrees
C) Cure

Figure 8 (Sheet 3 of 3)

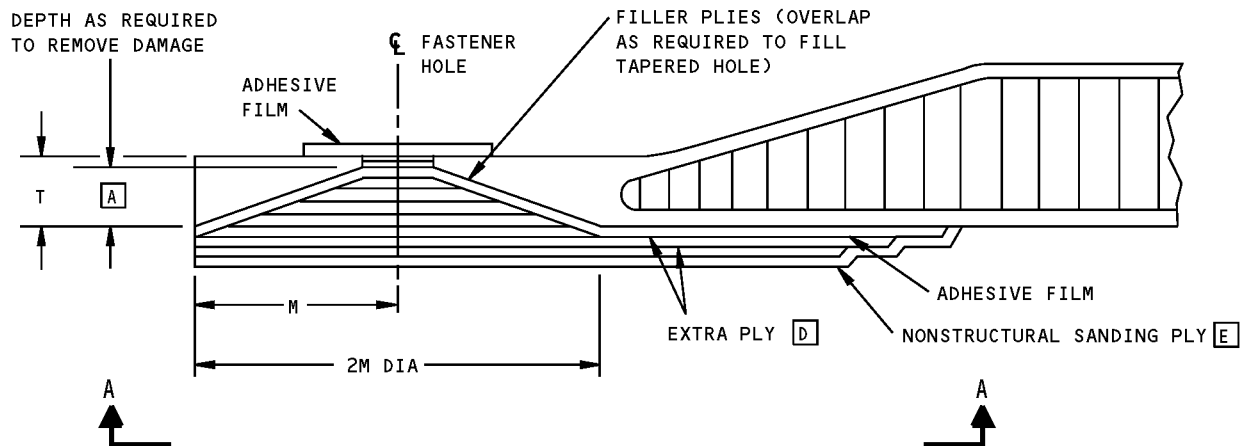
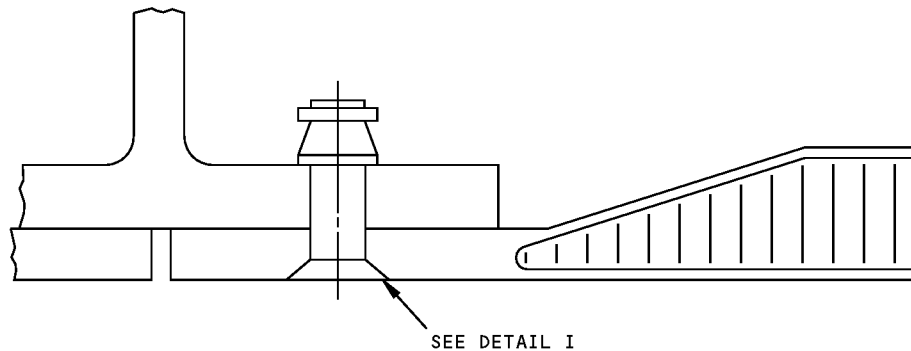
757-200
STRUCTURAL REPAIR MANUAL



PREPREG LAYUP ONLY

Repair of Damaged Skin Plies On A Panel Edge - 350 Degrees F (177 Degrees C) Cure
Figure 9

757-200 STRUCTURAL REPAIR MANUAL



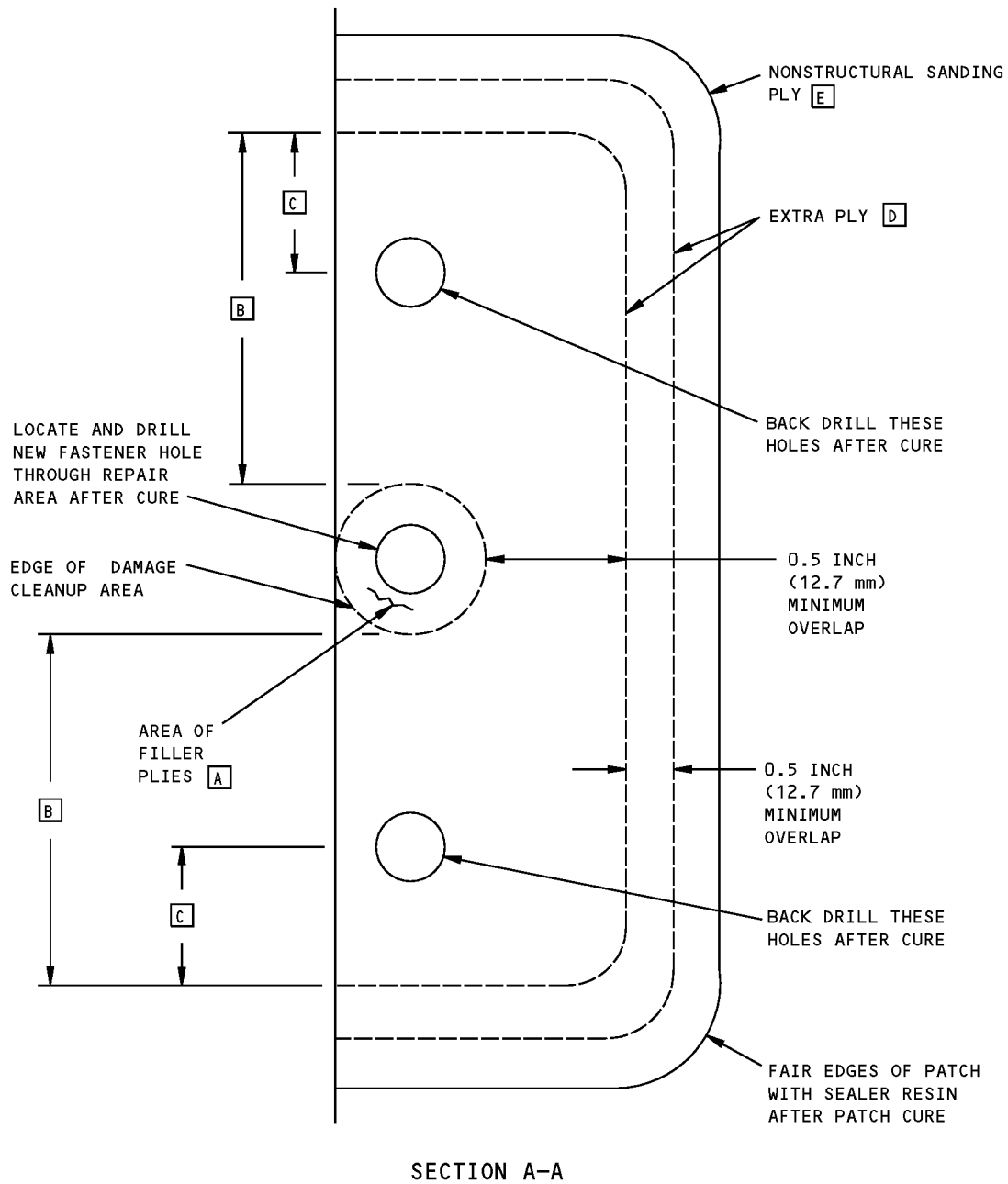
DETAIL I

NOTES

- D EQUALS FASTENER DIAMETER
- $M = 5T$ MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE.
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES.
- [A] APPLY FILLER PLYS AS REQUIRED TO FILL THE DAMAGED AREA.
- [B] EXTEND FIRST EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF DAMAGED AREA.
- [C] EXTEND FIRST EXTRA PLY FAR ENOUGH TO PROVIDE AT LEAST 2D EDGE MARGIN.
- [D] ORIENT EXTRA REPAIR PLYS IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER.
- [E] ADHESIVE FILM BMS 8-145 OR FIBERGLASS PREPREG PLY BMS 8-139.

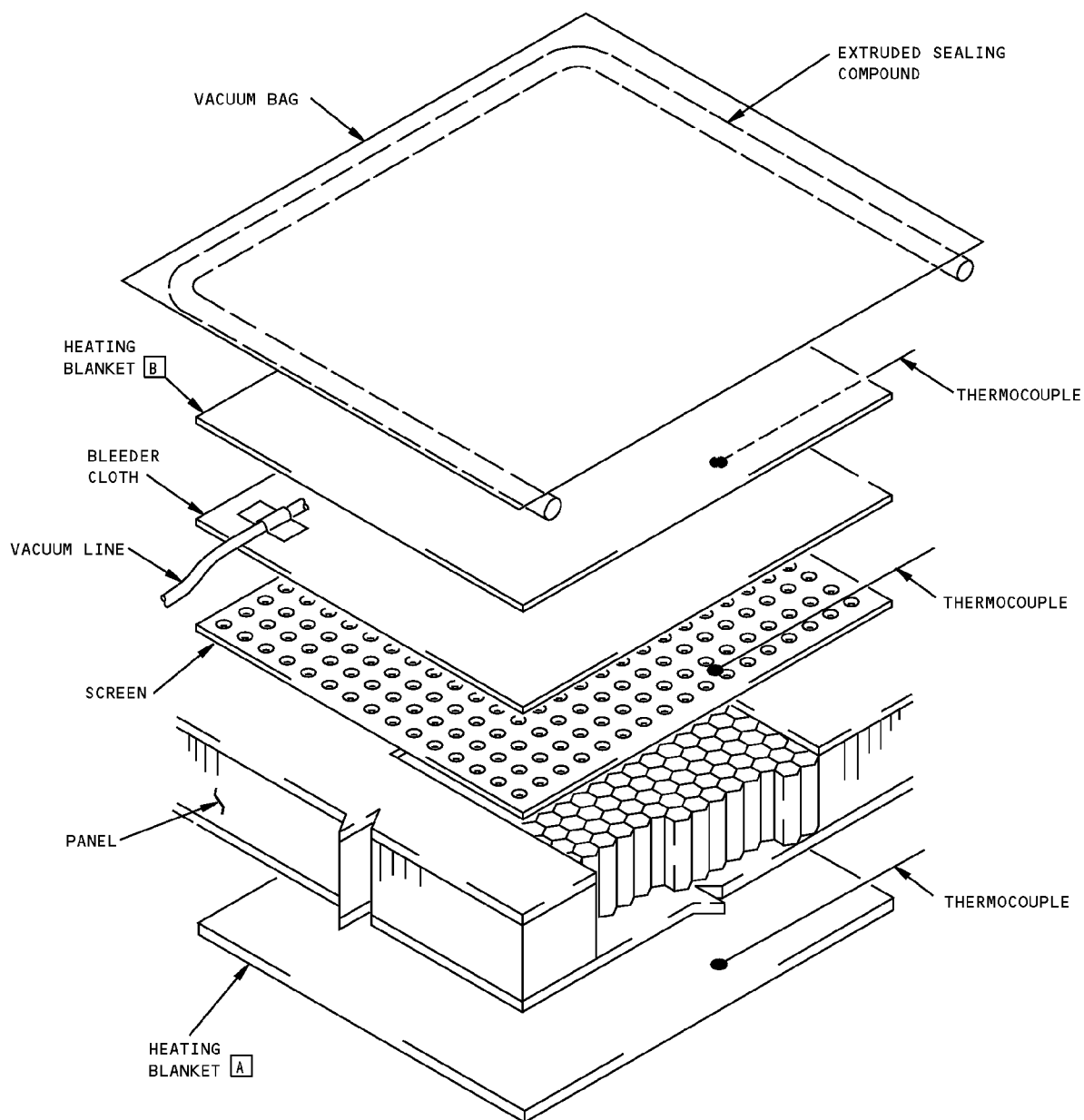
Repair of Damaged Panel Attach Hole - 350 Degrees F (177 Degrees C) Cure
Figure 10 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



Repair of Damaged Panel Attach Hole - 350 Degrees F (177 Degrees C) Cure
Figure 10 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL



NOTES

- [A]** PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B]** ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

Water Removal From Honeycomb Sandwich
Figure 11



757-200

STRUCTURAL REPAIR MANUAL

BMS 8-139 STYLE A	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS
120	BLUE	0.004-0.006	BMS 8-139, STYLE 220
1581 B	BLUE	0.008-0.012	BMS 8-139, STYLE 120 A
7781	BLUE	0.008-0.011	BMS 8-139, STYLE 120 A

BMS 8-139 GLASS FABRIC PREPREG DATA

NOTES

- A STYLE 1581 OR 7781 IS PREFERRED FOR USE AS REPAIR PLIES. THREE PLIES OF STYLE 120 MAY BE SUBSTITUTED FOR EACH PLY OF STYLE 1581 OR 7781.
- B STYLE 1581 WAS FORMERLY KNOWN AS TYPE 181.

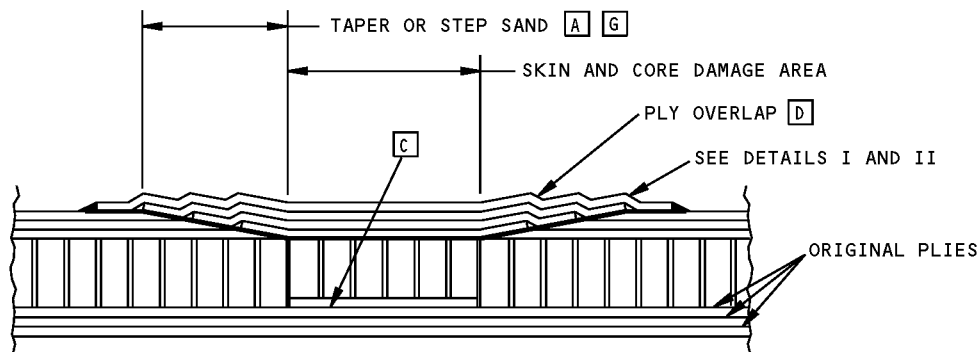
BMS 8-139 Glass Fabric Prepreg Data
Figure 12

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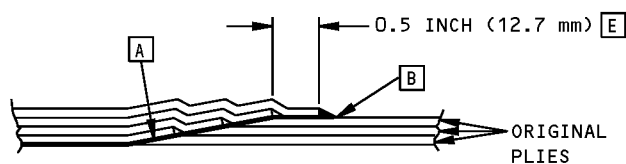
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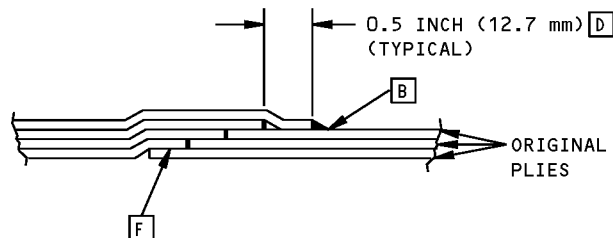
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(PREPREG LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



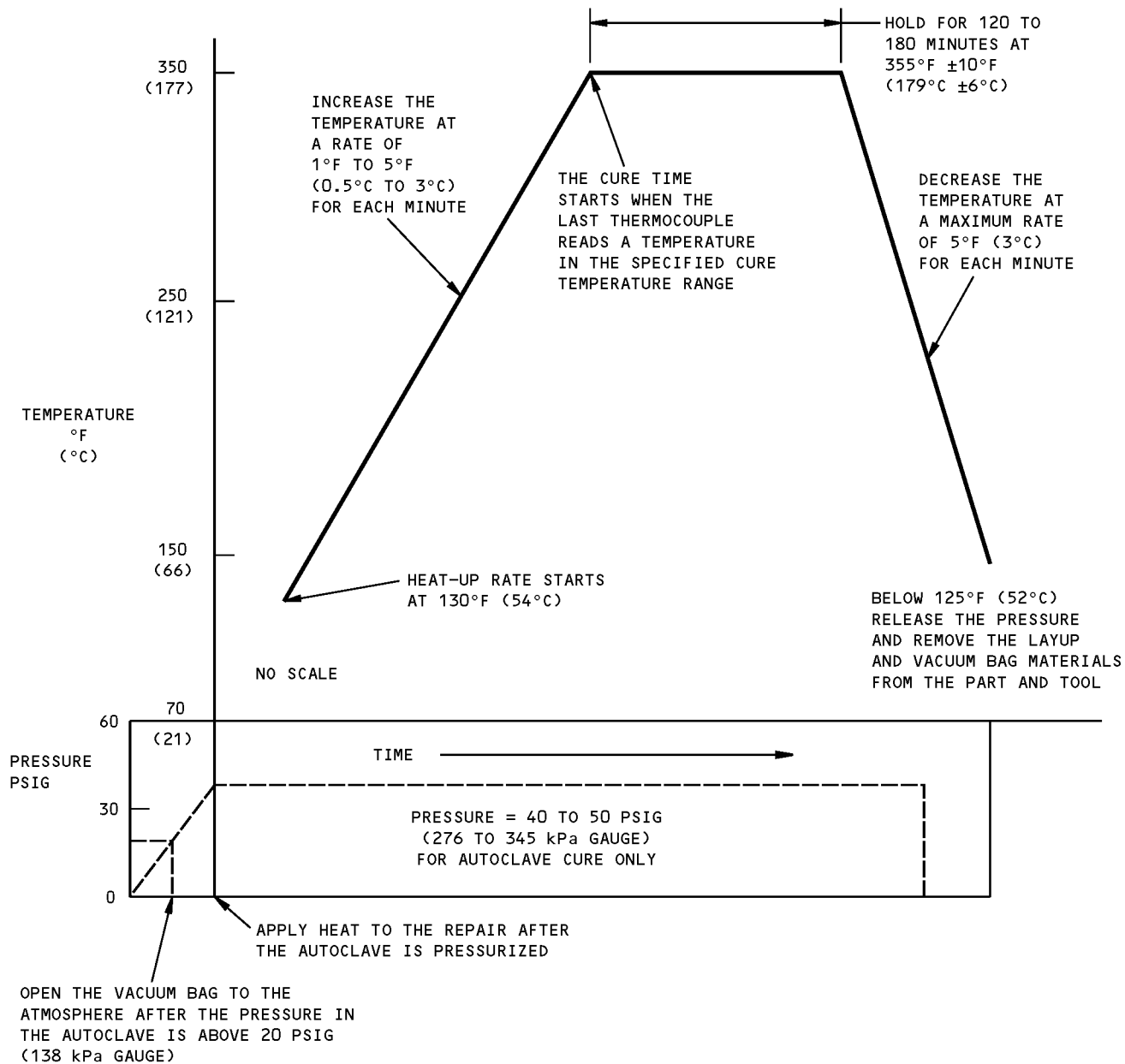
STEP SANDED SKIN
DETAIL II

NOTES

- | | |
|---|--|
| <p>A TAPER SAND AROUND REPAIR AREA OVER DISTANCE OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>B DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING</p> <p>C SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)</p> <p>D EXTRA PLY MUST OVERLAP AT LEAST 0.5 INCH. (12.7 mm) EACH SUCCEEDING PLY MUST OVERLAP AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF PRECEEDING PLY PRECEEDING PLY</p> | <p>E SURFACE PLY FAYING SURFACE MUST BE AT LEAST 0.5 INCH (12.7 mm) PAST EDGE OF TAPER</p> <p>F REMOVE DAMAGED PLIES IN STEPS OF 0.5 INCH (12.7 mm) FOR EACH EXISTING PLY</p> <p>G TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO SRM 51-10-01</p> |
|---|--|

Sanding and Overlap Requirements
Figure 13

757-200 STRUCTURAL REPAIR MANUAL



NOTES

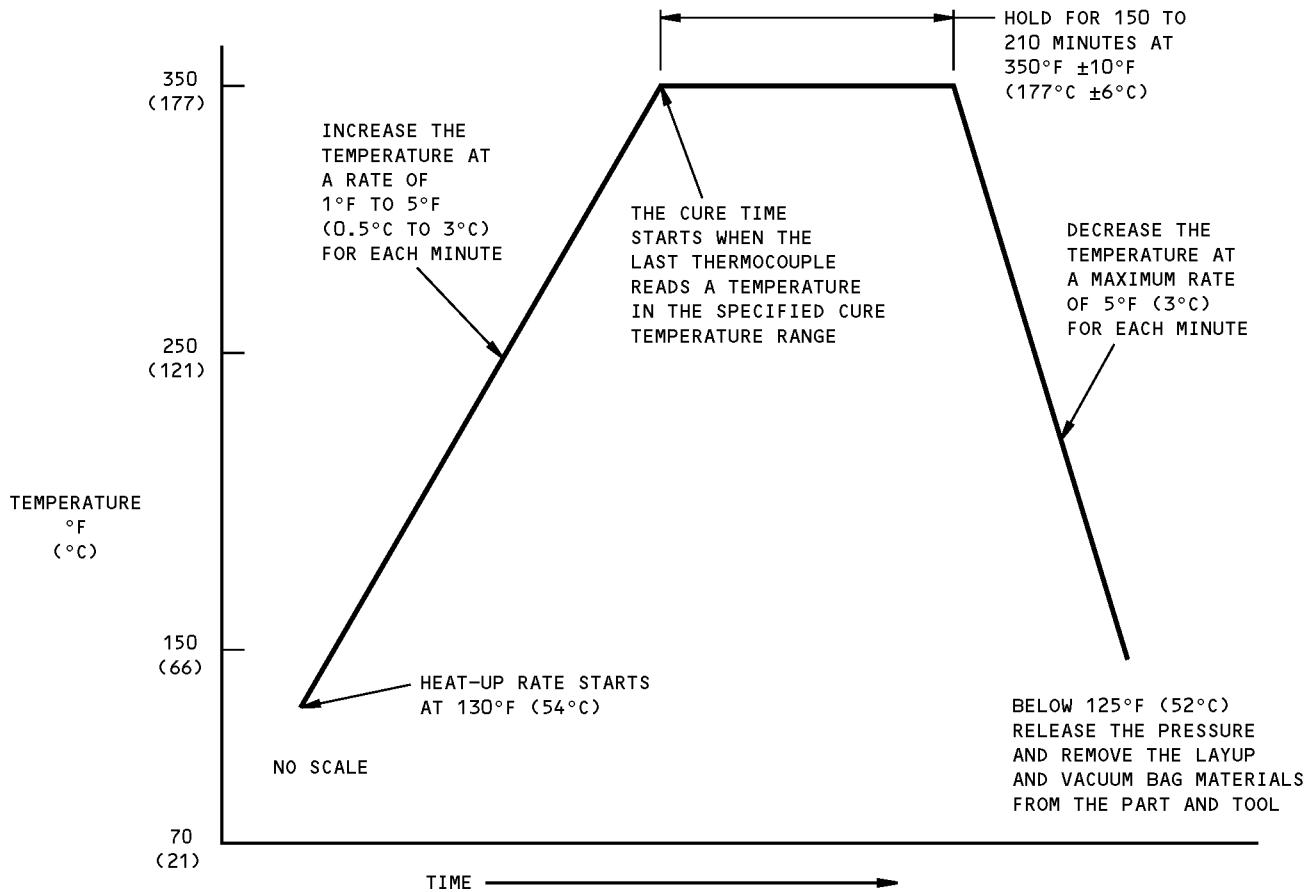
- FOR THE OVEN CURE, KEEP A MINIMUM VACUUM OF 22 in/Hg (75 kPa) DURING THE FULL CURE CYCLE.

350°F (177°C) AUTOCLAVE OR OVEN CURE CYCLE

DETAIL I

Repair Cure Cycles
Figure 14 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



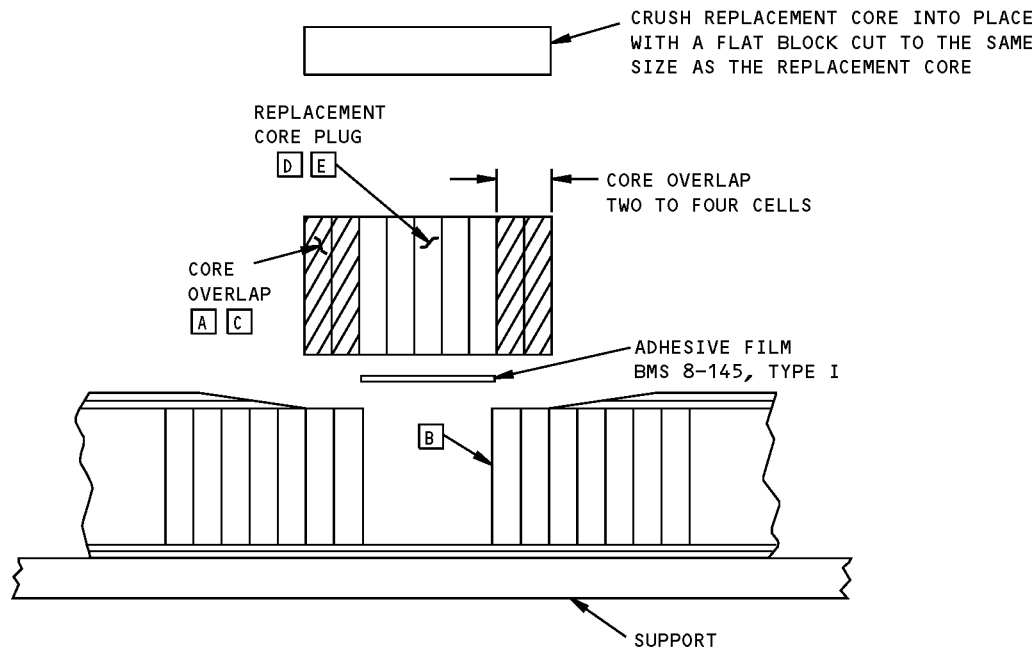
NOTES

- KEEP A MINIMUM VACUUM OF 22 in/Hg (75 kPa) DURING THE FULL CURE CYCLE.

350°F (177°C) HEAT BLANKET CURE CYCLE
DETAIL II

Repair Cure Cycles
Figure 14 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

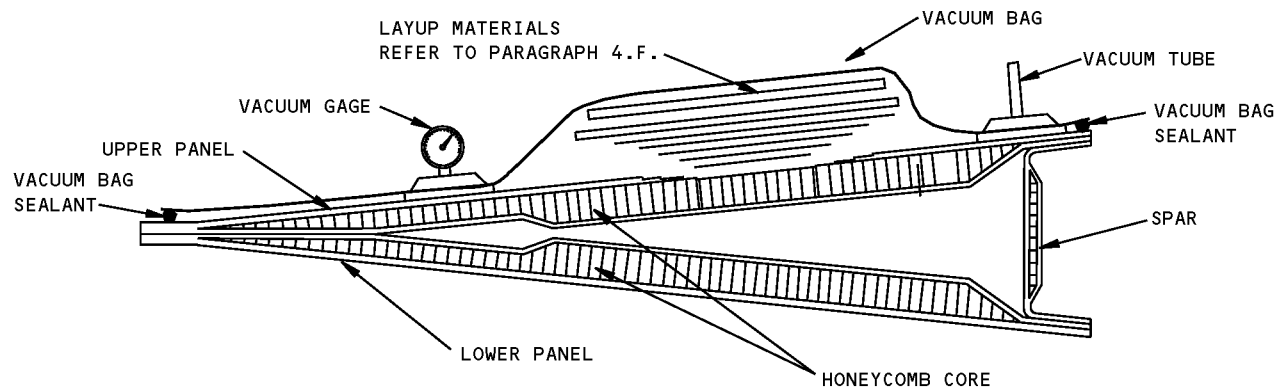


NOTES

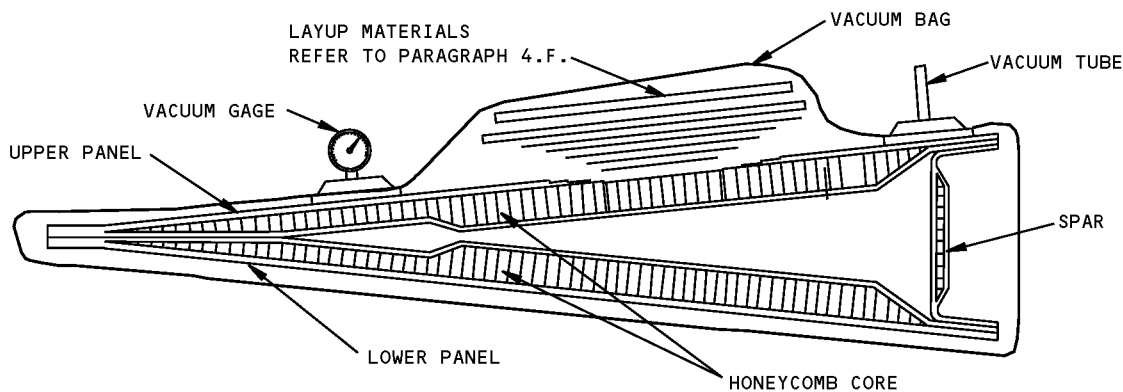
- [A] WHEN CRUSH SPLICING CORE 1.0 INCH (25.4 mm) OR THICKER, THE JOINT MAY BE CHAMFERED.
- [B] PRIOR TO SPLICING, CORE MAY BE STABILIZED WITH SC1008 PHENOLIC RESIN. LIMIT RESIN APPLICATION TO A MAXIMUM OF 1.0 INCH (25.4 mm) BEYOND THE EDGE CORE THAT IS TO BE SPLICED. THINNING RESIN WITH ACETONE IS PERMITTED.
- [C] USE BMS 8-301, CLASS 2 OR BMS 8-124 EPOXY RESIN AFTER SPLICING TO KEEP THE SPLICE FROM SEPARATING.
- [D] ALIGN HONEYCOMB RIBBON OF REPAIR PLUG WITH ORIGINAL CORE
- [E] REPLACEMENT CORE PLUG MUST BE MADE FROM CORE WHICH IS A MAXIMUM OF TWO GRADES DENSER THAN THE ORIGINAL CORE

**Core Crush Splicing Requirements
Figure 15**

757-200 STRUCTURAL REPAIR MANUAL



ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



NOT ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART
MAY CAUSE ASSEMBLY DISTORTION DURING CURE CYCLE

PARTS CONSISTING OF UPPER AND LOWER PANELS A

NOTES

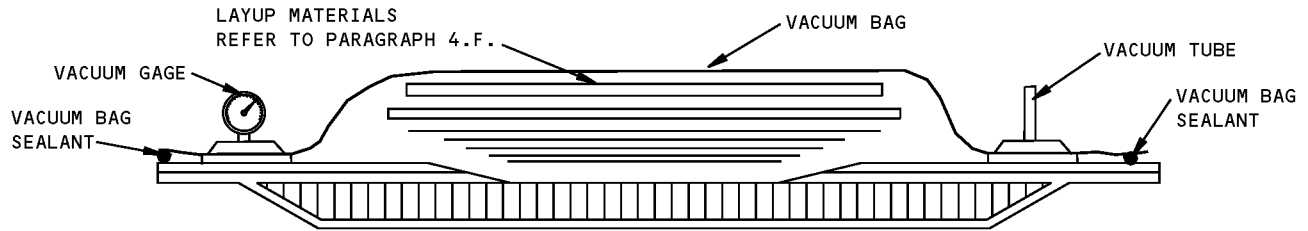
- REFER TO PARAGRAPH 4.F. FOR LAYUP AND BAGGING PROCEDURES

A THIS TYPE OF COMPONENT MUST NOT BE COMPLETELY SEALED IN A VACUUM BAG. DAMAGE TO PART WILL OCCUR. VACUUM BAG ONE SIDE OF COMPONENT ONLY

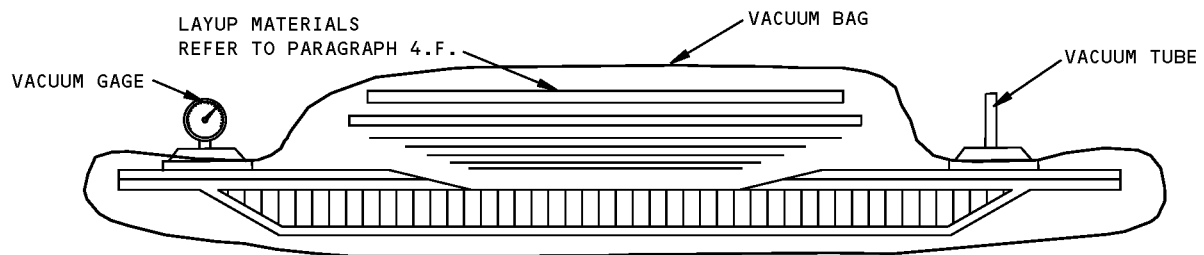
B THIS TYPE OF COMPONENT MAY BE COMPLETELY SEALED IN A VACUUM BAG OR MAY BE SEALED ON ONE SIDE ONLY

Vacuum Bagging Restrictions Figure 16 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**



ACCEPTABLE - VACUUM BAG SEALED TO ONE SIDE ONLY

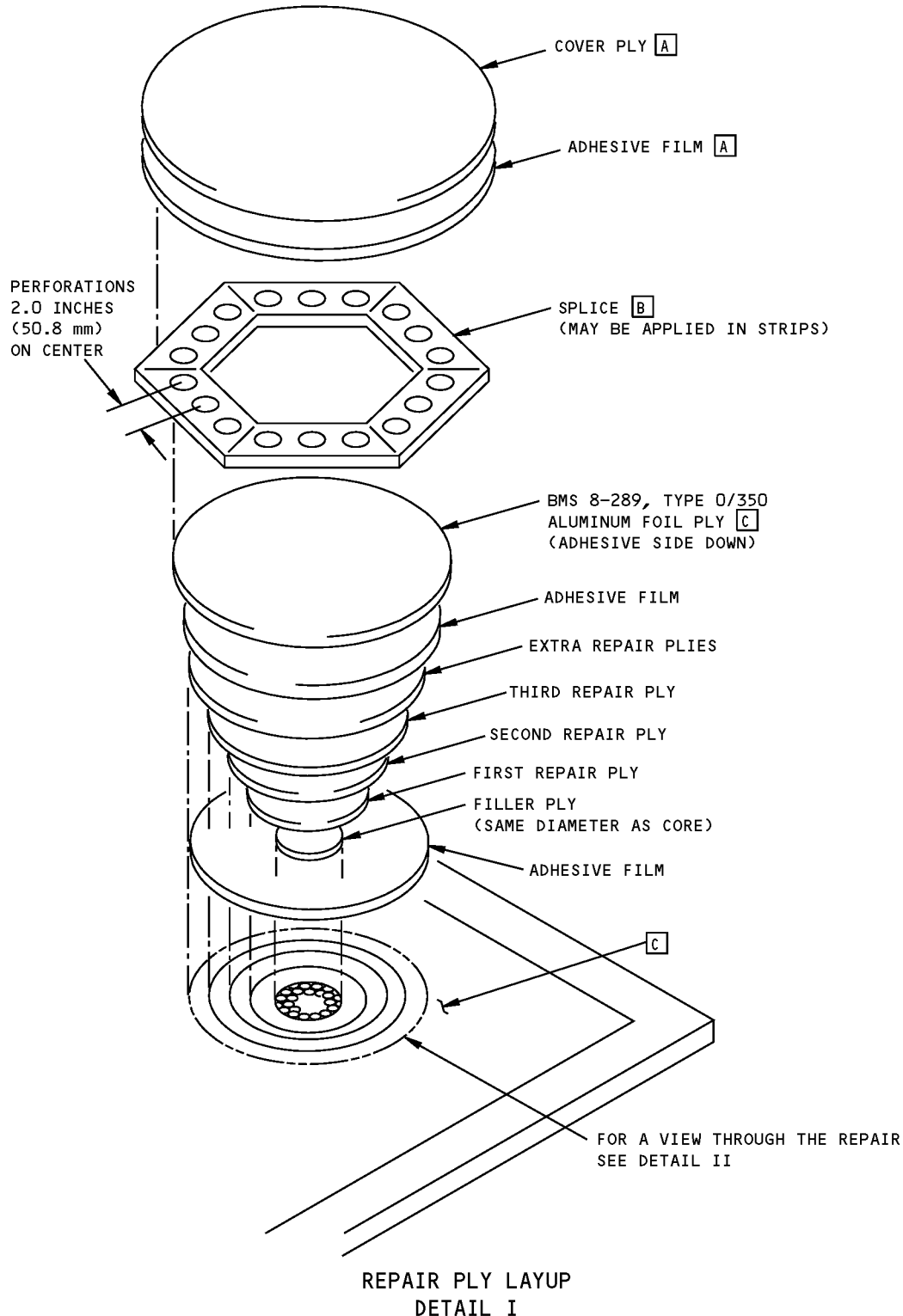


ACCEPTABLE - VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

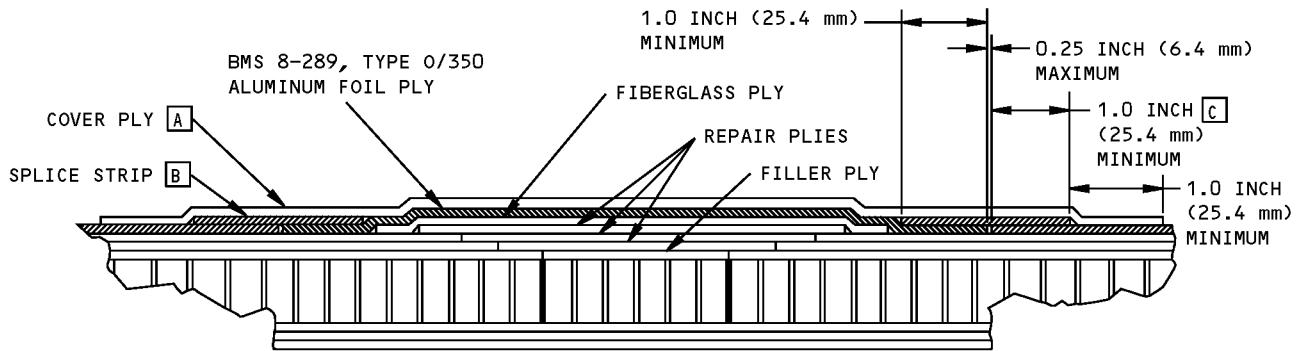
**Vacuum Bagging Restrictions
Figure 16 (Sheet 2 of 2)**

757-200 STRUCTURAL REPAIR MANUAL



Repairs to Aluminum Foil
Figure 17 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



VIEW THRU REPAIR
DETAIL II

MATERIAL	SHIPPING AND STORAGE LIFE		SHELF LIFE [D]	
	MAXIMUM TEMPERATURE [E]	DURATION	MAXIMUM TEMPERATURE	DURATION (HOURS)
BMS 8-289 TYPE O/350 GRADE A	10°F (-12°C)	180 DAYS	95°F (35°C)	240
BMS 8-289 TYPE O/350 GRADE B	95°F (35°C)	5 YEARS	95°F (35°C)	NO LIMIT

STORAGE AND SHELF LIFE OF BMS 8-289

TABLE I

NOTES

- [A] BMS 8-139, STYLE 120, 1581 OR 7781 GLASS FABRIC WITH BMS 5-154, TYPE II, CLASS 1, GRADE O3 OR O5 ADHESIVE FILM UNDERNEATH.
- [B] BMS 8-289, TYPE O/350 FORM II, WITH THE ADHESIVE SIDE UP OR FORM I, CHEMICAL CONVERSION COATED ON THE NON-ADHESIVE SIDE. PERFORATE CENTER-LINE OF FORM I WITH 0.5 INCH (12.7 mm) DIA HOLES, 2.0 INCH (50.8 mm) ON CENTER.
- [C] APPLY A CHEMICAL CONVERSION COATING

- [D] SHELF LIFE HOURS ACCUMULATE FROM THE DATE OF REMOVAL FROM REFRIGERATION UNTIL START OF THE REPAIR CURE CYCLE.
- [E] STORAGE LIFE SHALL BE AS SHOWN IN TABLE I UNLESS PRODUCT IS GUARANTEED BY THE SUPPLIER FOR 360 DAYS STORAGE AT 95°F (35°C).

Repairs to Aluminum Foil
Figure 17 (Sheet 2 of 2)



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - METAL-TO-METAL STRUCTURAL REPAIR ADHESIVE BOND PROCEDURES

1. References

Reference	Title
51-70-10, REPAIR GENERAL	Aluminum Skin/Aluminum Honeycomb Panel Repairs

2. Obsolete Data

- A. The data in this section was revised to show the newest technology and has been moved to 51-70-10, REPAIR GENERAL



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - ALUMINUM HONEYCOMB STRUCTURE REPAIRS

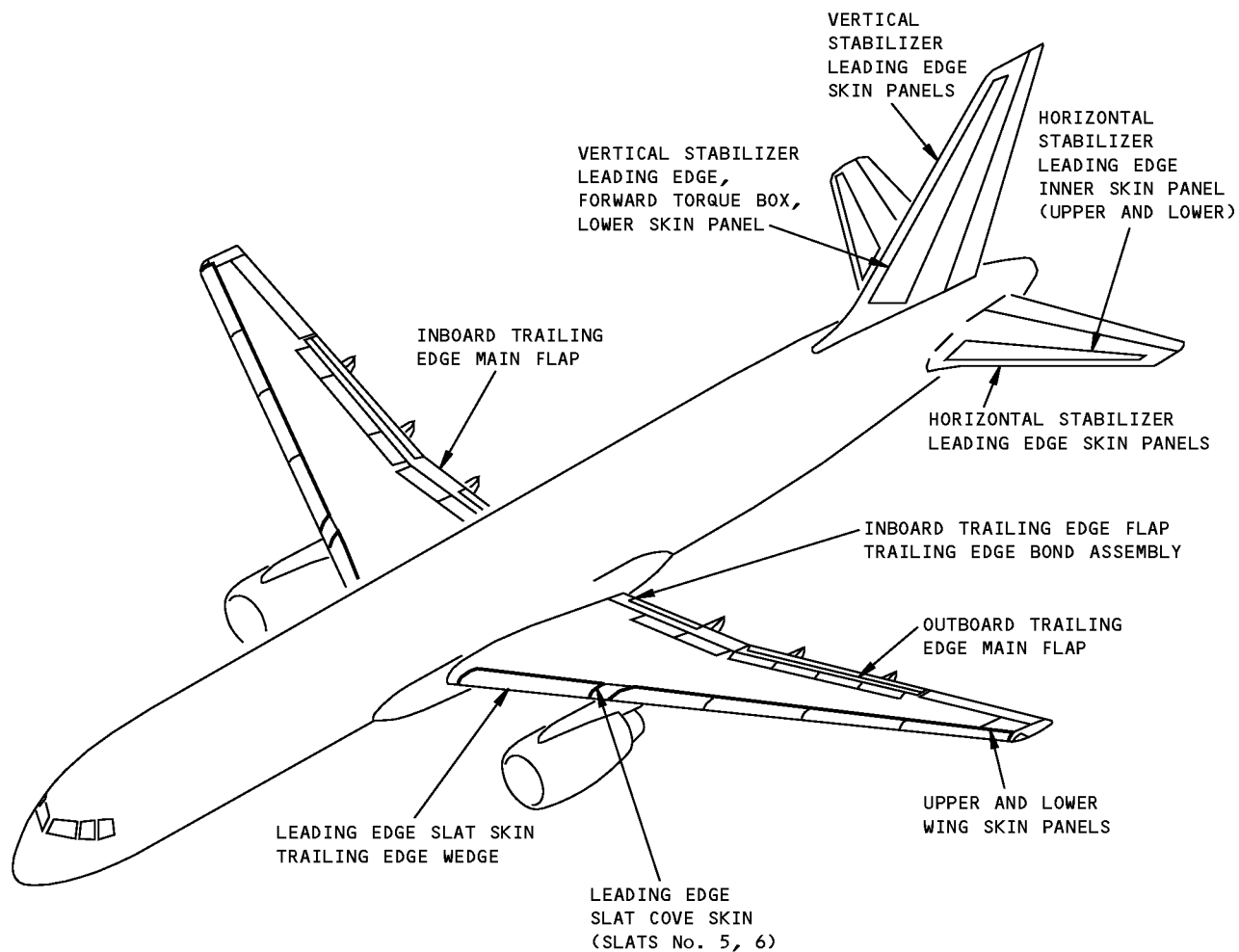
1. References

Reference	Title
51-70-10, REPAIR GENERAL	Aluminum Skin/Aluminum Honeycomb Panel Repairs

2. Obsolete Data

- A. This data was revised to show the newest technology and was moved to 51-70-10, REPAIR GENERAL.
- B. Refer to Figure 1/GENERAL and Figure 2/GENERAL for the locations of aluminum honeycomb structure.

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STRUCTURAL REPAIR MANUAL



Locations of 250 Degrees F (121 Degrees C) Cure Bonded Aluminum Skin/Aluminum Honeycomb Sandwich Panels

Figure 1 (Sheet 1 of 2)



757-200 STRUCTURAL REPAIR MANUAL

NOTES

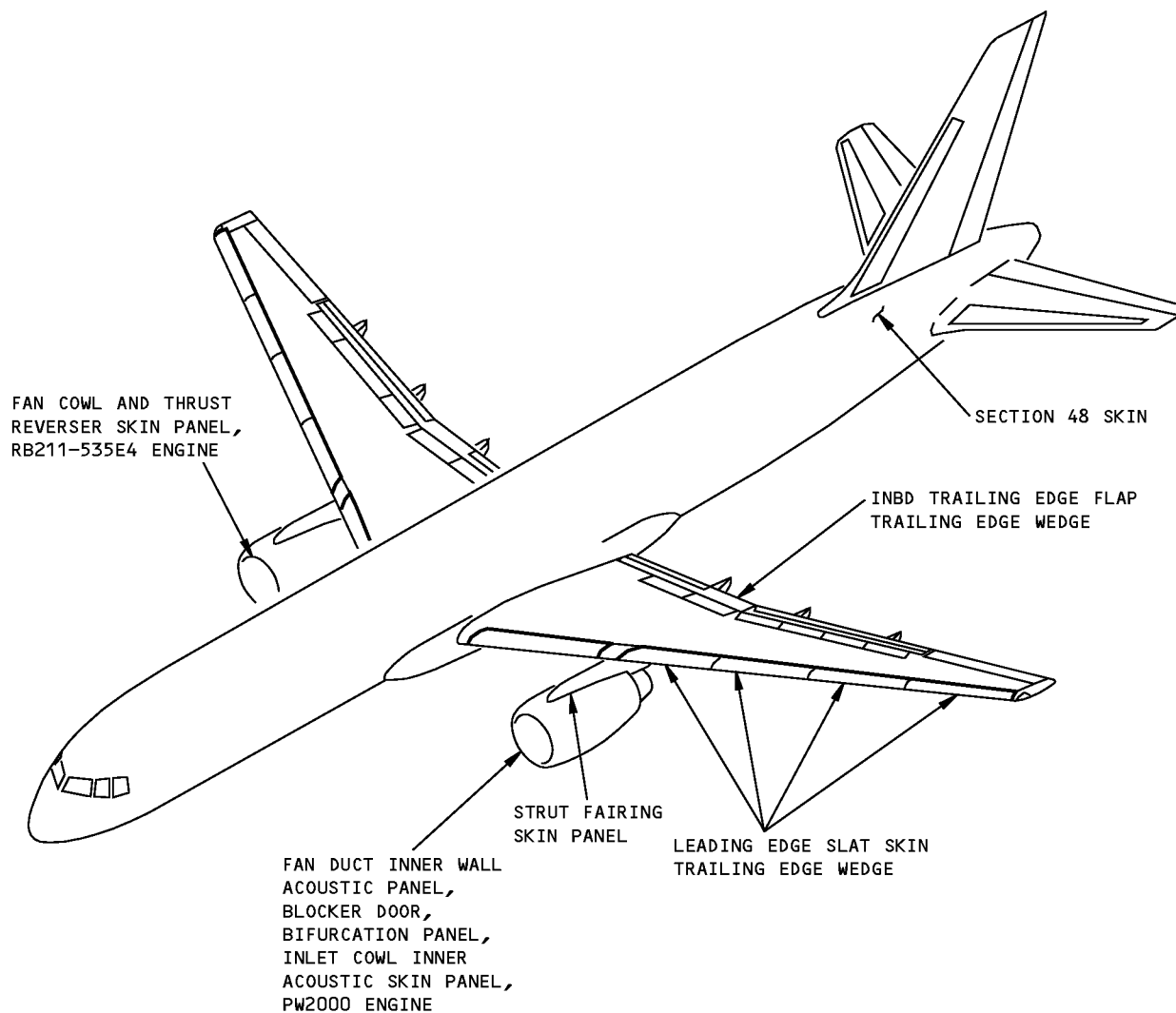
- REFER TO SPECIFIC IDENTIFICATION SUBJECT FOR PICTORIAL REPRESENTATION.
- REFER TO SPECIFIC COMPONENT REPAIR SUBJECT FOR AUTHORIZED REPAIRS AND REPAIR LIMITS.
- REFER TO SPECIFIC ALLOWABLE DAMAGE SUBJECT FOR ALLOWABLE DAMAGE DATA.

COMPONENT DESCRIPTION	REFERENCE DRAWING(S)	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
HORIZONTAL STABILIZER SKIN PANELS		
LEADING EDGE		55-10-01
INBOARD	184N1001	
CENTER	184N1002	
OUTBOARD	184N1003	
INNER SKIN PANEL		
UPPER, INBOARD	185N3001	
UPPER, OUTBOARD	185N3002	
LOWER, INBOARD	185N4001	
LOWER, OUTBOARD	185N4002	
VERTICAL STABILIZER SKIN PANELS		
LEADING EDGE		55-30-01
LOWER	174N1101	
CENTER	174N1102	
UPPER	174N1103	
FORWARD TORQUE BOX		
LOWER PANEL	175N2001	
WING LEADING EDGE SLAT SKIN		57-43-01
COVE PANEL		
INBOARD	114N3029	
CENTER	114N3030	
OUTBOARD	114N3031	
TRAILING EDGE WEDGE		57-43-02
SLAT No. 5 and 6	114N3056	
WING TRAILING EDGE FLAPS		57-53-01
MAIN FLAP, OUTBOARD		
UPPER	113N3400	
LOWER	113N3450	
MAIN FLAP, INBOARD		
UPPER	113N2401	
LOWER	113N2402	
TRAILING EDGE WEDGE BOND ASSY		
INBOARD	113N2324	57-53-02
WING OUTBOARD SKIN PANEL		
UPPER	112N3501	57-20-01
	112N3502	
LOWER	112N4501	
	112N4502	
	112N4504	

LOCATION OF ALUMINUM SKIN/ALUMINUM HONEYCOMB COMPONENTS
MANUFACTURED AT 250°F (121°C) CURE TEMPERATURE
TABLE I

Locations of 250 Degrees F (121 Degrees C) Cure Bonded Aluminum Skin/Aluminum Honeycomb Sandwich Panels
Figure 1 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL



Locations of 350 Degrees F (177 Degrees C) Cure Bonded Aluminum Skin/Aluminum Honeycomb Sandwich Panels

Figure 2 (Sheet 1 of 2)



757-200
STRUCTURAL REPAIR MANUAL

COMPONENT DESCRIPTION	DRAWING	SPECIFIC COMPONENT REPAIR, ALLOWABLE DAMAGE, AND IDENTIFICATION SUBJECTS
PW 2000 ENGINE		
STRUT FAIRING SKIN PANELS		
AFT STRUT FAIRING PANEL, LOWER	313N3050	54-51-70
PRESSURE RELIEF DOOR	313N3103	
INLET COWL SKIN PANEL INNER ACOUSTIC	314N3011	54-11-01
FAN DUCT INNER WALL ACOUSTIC PANEL	315N3101 315N3502	54-31-01
BLOCKER DOOR	315N3507 315N3508 315N3509	54-31-01
BIFURCATION WALL PANEL UPPER LOWER	315N3301 315N3401	54-31-01
RB211-535E4 ENGINE		
FAN COWL SKIN PANELS	LJ75503	54-20-01
THRUST REVERSER COWL SKIN PANEL	LJ75087	54-30-01
SECTION 48 SKIN PANELS	148N3710 148N3730 148N3750 148N3770	53-80-01
WING LEADING EDGE SLAT SKIN		
TRAILING EDGE WEDGE		57-43-02
SLAT No. 1 and 10	114N4171	
SLAT No. 2 and 9	114N4172	
SLAT No. 3 and 8	114N4173	
SLAT No. 4 and 7	114N4174	
WING TRAILING EDGE FLAPS	113N2603	57-53-01
TRAILING EDGE WEDGE INBOARD FLAP		

LOCATION OF ALUMINUM SKIN/ ALUMINUM HONEYCOMB COMPONENTS
MANUFACTURED AT 350°F (177°C) CURE TEMPERATURE
TABLE II

Locations of 350 Degrees F (177 Degrees C) Cure Bonded Aluminum Skin/Aluminum Honeycomb Sandwich Panels
Figure 2 (Sheet 2 of 2)



757-200 STRUCTURAL REPAIR MANUAL

REPAIR GENERAL - ALUMINUM SKIN/ALUMINUM HONEYCOMB PANEL REPAIRS

1. Applicability

- A. This subject gives instructions for repairs to bonded aluminum alloy skin and aluminum honeycomb core sandwich structure that was manufactured at 250°F (121°C) or 350°F (177°C).
- B. Only use this procedure if an SRM repair section or an approved repair plan refers to this subject.
 - (1) Do not use this SRM procedure to rebuild or remanufacture bonded airplane structure. Different approved data will be necessary.
 - (2) A specific SRM repair section in Chapters 52 through 57, or a Boeing Service Bulletin, or other approved engineering data can have data that is different than what is shown in this procedure. You are permitted to use approved engineering data that permits a different process or repair size or repair configuration.

2. General

- A. Refer to the SRM component repair section for:
 - The identification of the materials and the references to the engineering drawings
 - The allowable damage data
 - The references to this subject
 - The types of repairs that are permitted and/or the repair size limits (When applicable)
 - Other data that is not given in this subject
- B. In this subject are the instructions for:
 - Damage removal
 - Surface preparation procedures for aluminum alloys
 - Application of adhesive primers
 - Application of film and paste adhesives
 - Aluminum honeycomb core splicing
 - Vacuum bag procedures
 - Cure procedures
 - Bond inspection procedures
 - Repair procedures

3. References

Reference	Title
51-00-06, GENERAL	Structural Repair Definitions
51-10-02, GENERAL	Inspection and Removal of Damage
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-20-05, GENERAL	Repair Sealing
51-30-01, GENERAL	Sheet Metal Materials
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
AMM 51-21-10/701	Decorative Exterior Finishes - Cleaning/Painting
BAC 5514	Common Bonding Requirements for Structural Adhesives
BAC 5514-589	Application of Corrosion Inhibiting Adhesive Primer
BAC 5555	Phosphoric Acid Anodizing of Aluminum For Structural Bonding
DOCUMENT BSS 7217	Air Cleanliness, Shop Compressed Air

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(Continued)

Reference	Title
DOCUMENT D6-49327	Certification of Autoclaves for Metal Bonding and Curing of Composite Structure
DOCUMENT D6-56273	Qualification of Heat Blankets for Hot Bonding
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-04-00	Ultrasonic
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-03	Standard Overhaul Practices Manual
SOPM 20-30-97	Solvents For Final Cleaning Before Structural Bonding (Series 97)

4. Definitions

A. Boegel (AC130)

- (1) A type of complex inorganic polymer from the sol-gel family of chemical compounds.

B. Damage

- (1) Change to the surface of a part that is caused by deterioration, corrosion, disbonds, erosion, dents, gouges, cracks, scratches, punctures and holes.

C. Disbond

- (1) The failure of a bond adhesive that causes separation between a skin and core or doubler.

D. Durability

- (1) A low crack growth rate, a strong bond, and good corrosion protection.

E. Engineering Review

- (1) Approval by a professional engineer with the experience, qualifications and authority to make decisions on structural repairs. The engineer will make sure that the repair design has the necessary airworthiness requirements (the repaired part has the necessary strength, durability, damage tolerance (if necessary), and will function on the airplane correctly). Boeing can also give an engineering review, if necessary.

F. One-Stage Cure

- (1) The core and skins are bonded together at the same time. (One application of heat).

G. Rebuild/Remanufacture

- (1) The damage is too large to use repair procedures and materials (manufacturing procedures are necessary). Permission from Boeing and your local regulatory agency can be necessary because of intellectual property, certification, quality control, and safety rules.

NOTE: With permission, you can use the Boeing engineer drawings, material specifications, and process specifications.

H. Repair Parts

- (1) Doublers, triplers, fillers, tapered shims, replacement skin and/or replacement honeycomb core are repair parts. Primers, adhesives, and positioning fabric are not repair parts.

I. Two-Stage Cure

- (1) When the repair parts are bonded in two cure steps (Two separate applications of heat).
 - (a) The first stage: The core is bonded into the repair and then cured with one side of the core open. (Before the last skin is put on and then cured).
 - (b) The second stage: The last skin (one or more doublers) is put on and then cured.



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J. More sources of definitions

(1) 51-00-06, GENERAL.

(2) 51-10-02, GENERAL.

5. Repair Summary

A. Refer to Table 201/REPAIR GENERAL for an index of the paragraphs and figures.

Table 201: Repair General Index

REFERENCE	TITLE
Paragraph 6./REPAIR GENERAL	Find the Limits of the Damage
Paragraph 7./REPAIR GENERAL	Remove the Damage
Paragraph 8./REPAIR GENERAL	Make the repair parts
Paragraph 9./REPAIR GENERAL	Installation of the Honeycomb Repair Core
Paragraph 10./REPAIR GENERAL	Inspect the fit of the repair parts.
Paragraph 11./REPAIR GENERAL	Use of the Surface Preparation Procedures
Paragraph 12./REPAIR GENERAL	The Phosphoric Acid Containment System (PACS) Procedure
Paragraph 13./REPAIR GENERAL	The Phosphoric Acid Non-Tank Anodizing (PANTA) Procedure
Paragraph 14./REPAIR GENERAL	The Boegel (AC-130) Prebond Treatment Procedure
Paragraph 15./REPAIR GENERAL	Application of BMS5-89 or BMS5-137 Adhesive Primer to the Bond Surface
Paragraph 16./REPAIR GENERAL	Hydrofluoric Acid (HF) - Alodine Procedure
Paragraph 17./REPAIR GENERAL	Application of BAC5710, Type 60 Adhesive Primer
Paragraph 18./REPAIR GENERAL	Application of BMS5-101 and BMS5-137 Film Adhesive
Paragraph 19./REPAIR GENERAL	Application of BMS5-92 or BMS5-141 Paste Adhesive
Paragraph 20./REPAIR GENERAL	Cure the bond
Paragraph 21./REPAIR GENERAL	Do an examination of the bonded repair
Paragraph 22./REPAIR GENERAL	Clean, seal, and finish.
Figure 201/REPAIR GENERAL	Repair Options
Figure 202/REPAIR GENERAL	Flow Chart of the Repair Steps
Figure 203/REPAIR GENERAL	Damage Removal
Figure 204/REPAIR GENERAL	Phosphoric Acid Containment System (PACS)
Figure 205/REPAIR GENERAL	Phosphoric Acid Non-Tank Anodize (PANTA) Layup
Figure 206/REPAIR GENERAL	Polarized Light Test - Verification of Anodic Oxide Film
Figure 207/REPAIR GENERAL	Sanding Procedure Used for Boegel
Figure 208/REPAIR GENERAL	Repair Doubler Specifications for Flush Repairs
Figure 209/REPAIR GENERAL	Repair Doubler Specifications for External Patch Repairs
Figure 210/REPAIR GENERAL	Installation of the Repair Core
Figure 211/REPAIR GENERAL	Cure Time for BMS5-92, Two-part Paste Adhesive
Figure 212/REPAIR GENERAL	Cure Time for BMS5-141 Paste Adhesive
Figure 213/REPAIR GENERAL	Installation of the Repair Doubler
Figure 214/REPAIR GENERAL	Thermocouple Locations
Figure 215/REPAIR GENERAL	Layup of Vacuum Bagging Materials

REPAIR GENERAL

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- B. The illustrations and instructions in this repair show different examples of repairs and types of damage. You can do repairs that put together one or more of these examples. Use the correct repair procedures for each type of example. For example, if a circular shaped repair is shown, you can use a non-circular shape as an alternative.
- C. This subject contains four surface preparation procedures:
- (1) The Phosphoric Acid Containment System (PACS) procedure
 - (2) The Phosphoric Acid Non-Tank Anodize (PANTA) procedure
 - (3) The Boegel (AC-130) Prebond Treatment procedure
 - (4) The Hydrofluoric Acid (HF) - Alodine procedure
- D. There are three adhesive primer application procedures:
- (1) BMS5-89 Type I or Type II application procedure.
 - (2) BMS5-137 Type I, Class 2, 3, or 4 application procedure.
 - (3) BAC5710, Type 60 application procedure.
- E. There are five metal-to-metal bond adhesives used in this subject.
- (1) BMS5-101, Type II film adhesive, cured at 225°F to 260°F (107°C to 127°C)
 - (2) BMS5-137, Type II film adhesive, cured at 300°F to 320°F (149°C to 160°C) or 340°F to 360°F (171°C to 182°C).
 - (3) BMS5-92, Type I paste adhesive, cured at 70°F to 260°F (21°C to 127°C)
 - (4) BMS5-92, Type V paste adhesive, cured at 70°F to 180°F (21°C to 82°C)
 - (5) BMS5-141 paste adhesive, cured at 70°F to 200°F (21°C to 93°C)
- F. To make a satisfactory repair, you must do what follows:
- (1) Use the correct materials.
 - (2) Remove all the water and other contamination from the part.
 - (3) Do the bond procedures in a clean, dry location.
 - (4) Make the bond surfaces clean.
 - (5) Do a satisfactory surface preparation.
 - (6) Make sure that all of the parts have the correct shape and dimensions.
 - (7) Make sure that the repair parts have the correct flatness or curvature. The parts must install correctly when you apply light finger pressure.
 - (8) Make sure that the adhesive bondline thickness is correct.
 - (9) Remove some of the air and gases from the honeycomb core before you start a cure cycle. (Vacuum bagged repair procedure).
 - (10) Use sufficient pressure, time, and temperature to cure the repair.
- G. Identify the material containers with a label that contains the data that follows:
- BMS Specification
 - Type and Class
 - Supplier Name
 - Batch Number
 - Date of preparation
 - Shelf life or expiration date

STRUCTURAL REPAIR MANUAL

- H. Make sure that you do the bond procedures in a clean, dry location (a location that does not have contamination from exhaust fumes, rain, or other unwanted materials). Make sure that shop compressed air does not have water, oil, or other contamination. Use Boeing Specification Support Standard BSS7217 "Air Cleanliness, Shop Compressed Air" (or the equivalent specification) to see if the shop compressed air is satisfactory.

NOTE: You can make a tent to seal the area from contamination.

- I. A phosphoric acid tank anodize procedure is a permitted alternative to the PAA non-tank procedures given in this section. Make sure that your tank facilities, chemicals, and procedures are satisfactory. Refer to Boeing Process Specification BAC5555, "Phosphoric Acid Anodizing of Aluminum for Structural Bonding" (or the equivalent specification).
- J. If you use a heat blanket, make sure that it is qualified and will operate correctly. D6-56273, "Qualification of Heat Blankets for Hot Bonding", is a procedure that Boeing uses. You can refer to this procedure or use an equivalent procedure to qualify your heat blanket.
- K. If you use an autoclave, make sure that your autoclave facilities and procedures are satisfactory. Refer to Boeing Process Specification BAC5514, "Common Bonding Requirements for Structural Adhesives" and D6-49327, "Certification of Autoclaves for Metal Bonding and Curing Composite Structure" (or the equivalent specifications).
- L. If you use an oven, make sure that it has equipment that can circulate the heated air, supply a vacuum and control the temperature.

NOTE: Make sure that you have equipment that can monitor and record the temperature of the thermocouples.

WARNING: USE MECHANICAL AIRFLOW AND BREATHING PROTECTION WHEN YOU WORK IN A CLOSED SPACE OR AREA. MAKE SURE THAT THE FRESH AIR SUPPLY IS NOT BLOCKED. IF YOU GET FLUIDS IN YOUR EYES, FLUSH WITH WATER IMMEDIATELY AND GET MEDICAL AID.

- M. Read the manufacturer's safety data sheet (MSDS) for each of the materials you use in this procedure. Wear protective clothing and equipment if it is specified in the MSDS.
- N. Keep all resin and adhesive materials in the storage condition specified in the manufacturer's instructions or the Boeing specifications (as applicable). Do not keep the materials out of storage for longer than necessary.
- O. Read each CAUTION in this procedure. They will help to prevent damage to the repair and prevent more damage to the airplane part.
- P. Read each WARNING in this procedure. They will help to prevent injury to you and others.
- Q. Refer to Figure 201/REPAIR GENERAL, Repair Options to help you make a decision on the correct repair procedure.
- (1) If the panel to be repaired was initially manufactured at 250°F (121°C), and you want to do a permanent repair with a film adhesive, then use BMS5-101, Type II film adhesive and an applicable BMS5-89 adhesive primer and cure the repair for 90 minutes at 250°F (121°C).

NOTE: Refer to all of the applicable steps in this repair section for the 250°F (121°C) cure process.

- (2) If the panel to be repaired was initially manufactured at 350°F (177°C), and you want to do a permanent repair with a film adhesive, then do one of the steps that follow:
- Use BMS5-137, Type II film adhesive and an applicable BMS5-137 adhesive primer and cure the repair for 90 minutes in an autoclave at 350°F (177°C), or



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- Use BMS5-137 Type II, Class 1 (EA 9657) film adhesive and an applicable BMS5-137, Type I adhesive primer and cure the repair for 5 hours with a vacuum bag at 310°F (154°C).

NOTE: Refer to all of the applicable steps in this repair section for the 310°F (154°C) and 350°F (177°C) cure processes.

- (3) If the damage is small, you can do an interim repair [250°F (121°C) and 350°F (177°C) manufactured panels]. Interim repair options are as follows:
- Do an HF Alodine surface preparation (you are permitted to use with a film or paste adhesive), or
 - Use a paste adhesive (you are permitted to use with all types of adhesive primers).

NOTE: Refer to all of the applicable steps in this repair section for the interim repair processes.

- R. Refer to Figure 202/REPAIR GENERAL, Flow Chart of the Repair Steps before you start the repair procedure.
- S. Refer to Figure 202/REPAIR GENERAL and make a repair selection.

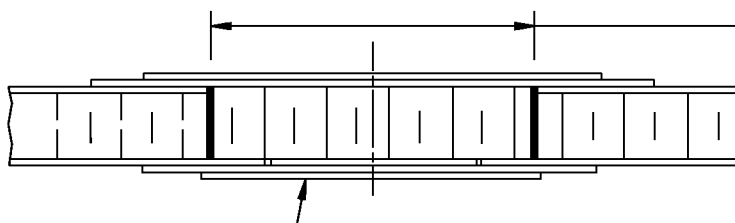
Table 202: Repair Examples

REPAIR 1	Repair of a Disbond at an Edge of Aluminum Honeycomb Structure
REPAIR 2	Repairs to Small Damage
REPAIR 3	Septumized Core Repairs
REPAIR 4	Repairs to Large Damage

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SURFACE PREPARATION	REPAIR TYPE	PASTE ADHESIVES 9	FILM ADHESIVES	
			VACUUM BAG CURE 1	AUTOCCLAVE CURE 2
		MAXIMUM DAMAGE SIZE 3 7		
HF ALODINE	INTERIM 4	2.0 INCHES (50 mm) LENGTH OR DIAMETER	2.0 INCHES (50 mm) LENGTH OR DIAMETER	2.0 INCHES (50 mm) LENGTH OR DIAMETER
BOEGEL (AC-130)	INTERIM 4	2.0 INCHES (50 mm) LENGTH OR DIAMETER	NOT APPLICABLE	NOT APPLICABLE
	PERMANENT	5	64 SQUARE INCHES (400 SQUARE cm) 6	200 SQUARE INCHES (0.13 SQUARE METERS)
TANK PAA, PACS, PANTA	INTERIM 4	2.0 INCHES (50 mm) LENGTH OR DIAMETER	NOT APPLICABLE	NOT APPLICABLE
	PERMANENT	5	64 SQUARE INCHES (400 SQUARE cm) 6	200 SQUARE INCHES (0.13 SQUARE METERS) OR SEE DETAIL A

TABLE A



THIS SIDE CAN BE REPAIRED ALSO, IF DAMAGE IS 200 SQUARE INCHES (0.13 SQUARE METERS) OR LESS

ONE SIDE CAN HAVE A REPAIR FOR A DAMAGED SKIN AND CORE THAT IS LARGER THAN 200 SQUARE INCHES (0.13 SQUARE METERS) IF THE LONGEST DAMAGE DIMENSION IS LESS THAN 50% OF THE LARGEST SKIN DIMENSION. REFER TO REPAIR 4 FOR EXAMPLES OF LARGE REPAIRS THAT ARE PERMITTED.

PERMITTED DAMAGE SIZES THAT CAN BE REPAIRED TO SURFACES PREPARED WITH TANK PAA (BAC5555), PACS OR PANTA AND CURED IN AN AUTOCLAVE 8



Repair Options
Figure 201 (Sheet 1 of 2)

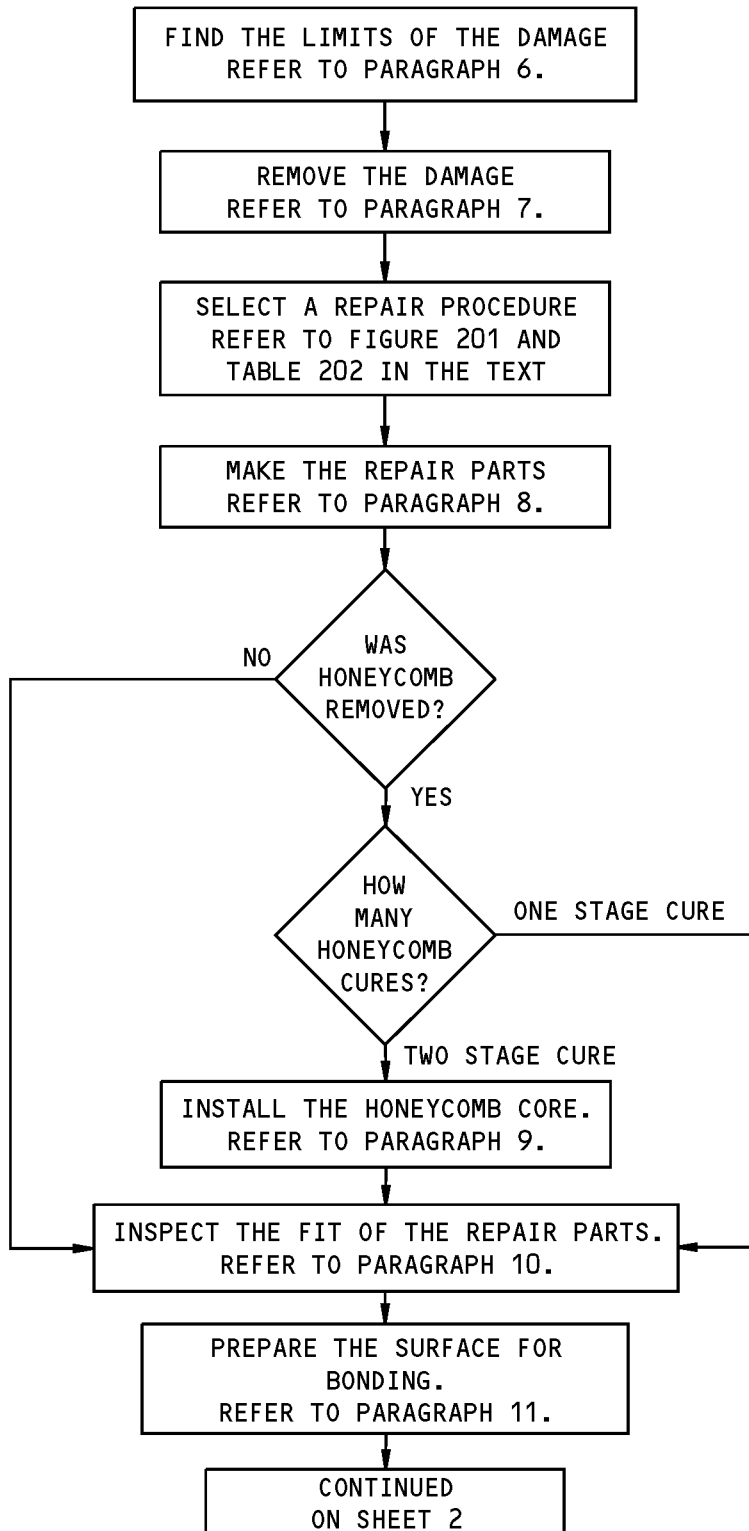


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NOTES

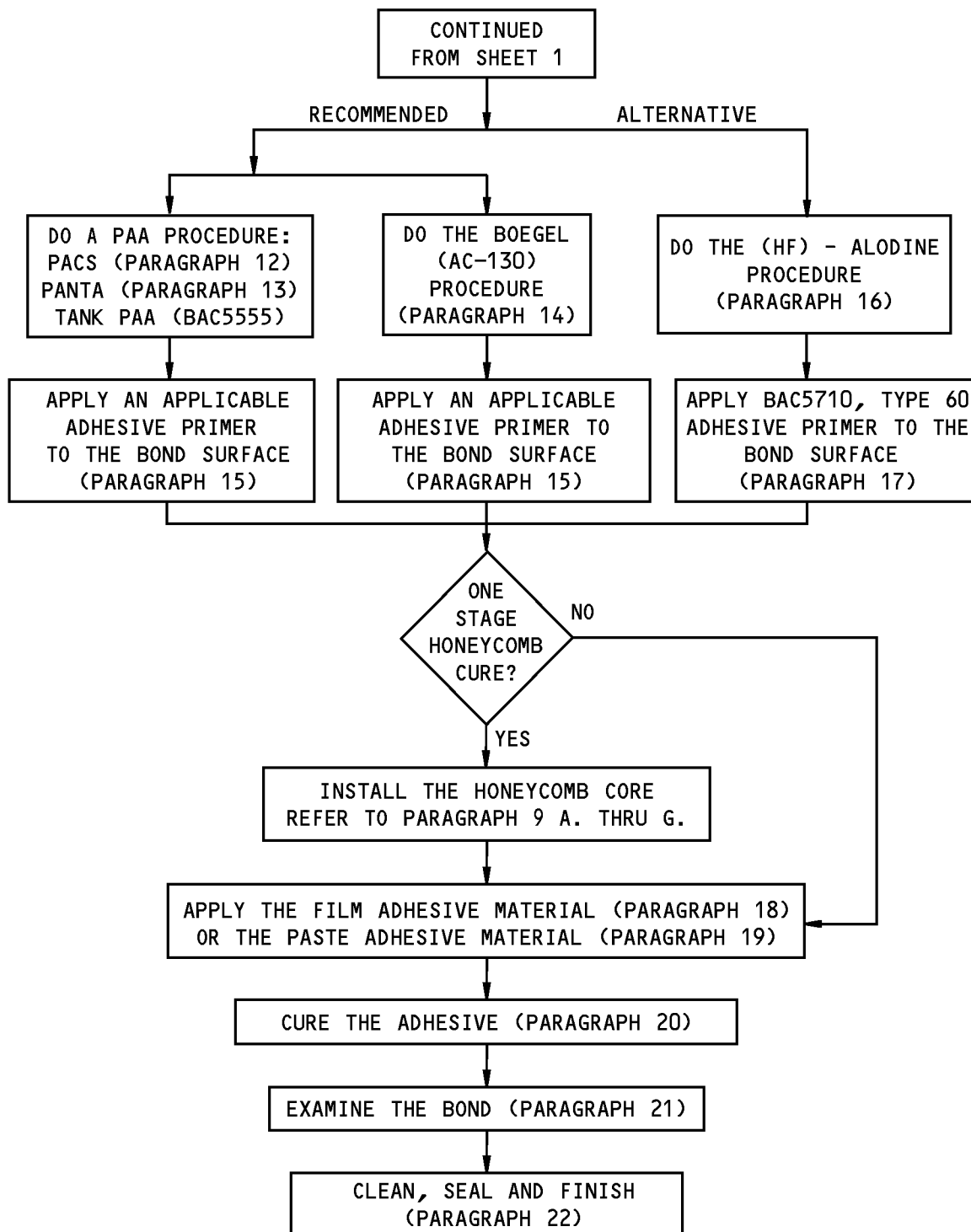
- 1 OVEN, HEAT BLANKET, HEAT LAMPS OR FORCED HOT AIR ARE PERMITTED.
REFER TO PARAGRAPH 20.
- 2 AUTOCLAVE MUST BE PRESSURIZED AS SPECIFIED IN PARAGRAPH 20.
- 3 AFTER YOU FIND AND REMOVE THE DAMAGE AS SPECIFIED IN PARAGRAPH 7. MAXIMUM DAMAGE SIZE IS APPLICABLE FOR EACH DAMAGED SKIN AND CORE.
IF YOU DO A FLUSH REPAIR: THE CUTOUT ON THE SIDE THAT WILL HAVE THE EXTERNAL DOUBLER MUST BE LESS THAN OR EQUAL TO THE SIZES IN THIS TABLE.
- 4 REFER TO SRM 51-00-06 FOR STRUCTURAL REPAIR DEFINITIONS. INTERIM REPAIRS MUST BE INSPECTED EACH 24 MONTHS OR LESS, OR EACH 3500 FLIGHT CYCLES OR LESS (NO LATER THAN THE INTERVAL THAT OCCURS FIRST).
- 5 THE MAXIMUM PERMITTED DAMAGE LENGTH (OR DIAMETER) IS 1.0 INCH (25 mm) OR THE ALLOWABLE DAMAGE LIMIT (THE SMALLER OF THE TWO). 9
- 6 YOU CAN INCREASE THE MAXIMUM SIZE TO 200 SQUARE INCHES (0.13 SQUARE METERS) IF YOU DO THE STEPS THAT FOLLOW:
 - DO A TWO STAGE CURE REPAIR PROCEDURE (WHEN HONEYCOMB CORE IS DAMAGED)
 - USE BMS 5-121 POSITIONING FABRIC WITH BMS 5-101 TYPE II FILM ADHESIVE OR USE BMS 5-137 TYPE II FILM ADHESIVE.
- 7 UNLESS SPECIFIED DIFFERENTLY IN THE SPECIFIC COMPONENT REPAIR SECTION.
- 8 LARGER DAMAGE CAN BE REPAIRED IF YOU DO ALL OF THE FOLLOWING:
 - GET AN ENGINEERING REVIEW
 - USE APPROVED ENGINEERING DRAWINGS FOR THE COMPONENT
 - USE APPROVED MATERIALS AND MANUFACTURING PROCESSES SPECIFIED IN THE COMPONENT ENGINEERING DRAWINGS.
- 9 BMS 5-92, TYPE V AND BMS 5-141 ARE PERMITTED IN BOTH INTERIM AND PERMANENT REPAIRS. BMS 5-92, TYPE I IS ONLY PERMITTED IN INTERIM REPAIRS.

Repair Options
Figure 201 (Sheet 2 of 2)

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**Flow Chart of the Repair Steps
Figure 202 (Sheet 1 of 2)**

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Flow Chart of the Repair Steps
Figure 202 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

6. Find the Limits of the Damage

A. Examine the damage in the repair area.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (1) Clean the damaged area with a soft cloth moist with cleaning solvent. Refer to SOPM 20-30-03 for the applicable cleaning solvent and general cleaning procedures.

CAUTION: USE NON-DESTRUCTIVE PROCEDURES TO MAKE SURE THAT THERE IS NO WATER TRAPPED IN THE PART BEFORE YOU APPLY HEAT TO CURE THE ADHESIVES. DAMAGE TO THE PART WILL OCCUR IF THE WATER IS NOT REMOVED.

- (2) Do a visual and NDI examination of the damaged area to find disbonds and other types of damage to the structure.

NOTE: Refer to NDT Part 1, 51-04-00 for instrumented NDI procedures, or NDT Part 1, 51-05-01 for tap test procedures.

B. Examine the initial adhesive primer (if applicable).

- (1) It is not necessary to remove the initial adhesive primer from the bond surface if the primer has the conditions that follow:

- (a) There is no contamination from paints, oils, chemicals, or other unwanted materials.
- (b) You are repairing a part that was initially manufactured with BMS5-101 film adhesive and you will be using BMS5-101 film adhesive to repair the damage.
- (c) You are repairing a part that was initially manufactured with BMS5-137 film adhesive and you will be using BMS5-137 to repair the damage.
- (d) Metal-to-metal bonding - there are no scratches or missing primer that:
 - 1) Show more than 0.1 square inch (65 square mm) of bare metal.
 - 2) Are more than 0.5 inch (13 mm) in length.
 - 3) Are less than 0.5 inch (13 mm) from an edge.
 - 4) Are less than 3.0 inches (75 mm) (edge-to-edge) apart.
- (e) Core-to-skin bonding - there are no scratches or missing primer that:
 - 1) Show more than 2.0 square inches (13 square cm) of bare metal at each location.
 - 2) Show more than a cumulative total area of bare metal of 4.0 square inches (26 square cm).
 - 3) Are less than 6.0 inches (150 mm) (edge-to-edge) apart.

NOTE: A group of bare metal areas in a 2.0 square inch (13 square cm) area can be specified as one bare metal area. A group must then be 6.0 inches (150 mm) (edge-to-edge) from a different bare area or group.

- (2) In these small areas where there is bare metal or missing primer, do the steps that follow:

- (a) Clean the bare metal. Refer to SOPM 20-30-03 for the applicable solvents.
- (b) Apply adhesive primer to the bare metal as given in Paragraph 15./REPAIR GENERAL or Paragraph 17./REPAIR GENERAL.



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- (3) If more adhesive primer is damaged or removed than is permitted, then do step (a) or step (b), below, as applicable.
 - (a) If the damaged primer is on an outside surface (not a surface where there was honeycomb core removed) then you can remove the primer and do one of the surface preparations specified in Paragraph 11./REPAIR GENERAL. Then apply an applicable adhesive primer as specified in Paragraph 15./REPAIR GENERAL or Paragraph 17./REPAIR GENERAL.
 - (b) If the damaged primer is on an inside surface (where honeycomb core was removed), then do the steps that follow:
 - 1) Remove the damaged primer. Do not remove more primer than is necessary.
 - 2) Do a Boegel surface preparation procedure as specified in Paragraph 14./REPAIR GENERAL.
 - 3) Apply an applicable adhesive primer as specified in Paragraph 15./REPAIR GENERAL.

7. **Remove the Damage**

NOTE: Use a table or special tool to keep the part in the correct shape if you remove large areas of damage.

A. Remove the damaged skin from the repair area.

NOTE: As an alternative, you can do a surface preparation and apply the adhesive primer on the surface before you remove the damage. Make sure that you prepare an area that is larger than the necessary minimum bond area. This will give you a sufficient bond area if the removed damage is larger than the NDI indication.

WARNING: DO NOT USE EQUIPMENT THAT CAN CAUSE AN ARC OR A SPARK IN AN AREA WHERE THE IGNITION OF FUMES IS POSSIBLE. IF YOU DO, AN EXPLOSION CAN BE THE RESULT.

- (1) If the aluminum skin is damaged or has disbonded areas, do the procedure that follows:
 - (a) Cut and remove the damaged skin in the disbonded areas.
 - (b) Separate the bonded structures (if applicable and necessary). Refer to Figure 203/REPAIR GENERAL for the steps that follow:
 - 1) Make the wedge(s).
 - 2) Use polyester tape to attach an approximately 0.02-0.06 inch (0.5-1.5 mm) thick metal or plastic sheet adjacent to the bonded area.

WARNING: USE DRY ICE OR COMPRESSED CARBON DIOXIDE GAS ONLY IN AN AREA WHERE THERE IS A SATISFACTORY FLOW OF AIR. HIGH LEVELS OF CARBON DIOXIDE CAN CAUSE INJURY. WEAR PROTECTIVE GLOVES. IF DRY ICE TOUCHES YOUR SKIN OR EYES, GET MEDICAL AID IMMEDIATELY.

- 3) Push the wedge(s) between the bonded structures. Lightly tap the wedge(s) if necessary.
 - a) If problems occur, you can apply heat, dry ice (solid carbon dioxide), compressed carbon dioxide gas, or liquid nitrogen to the bond area.

NOTE: Very cold temperature will make the adhesive resin brittle and easier to separate the skins.

STRUCTURAL REPAIR MANUAL

- (c) Do a check to see if the bond is weak along the perimeter of the area to be repaired.

NOTE: Instrumented Non-destructive Inspection (NDI) procedures will not always find a bond that is weak but not broken.

- 1) Pull carefully on the edge of the skin to see if the bond will break.
 - 2) If the bond is easily broken, then continue to remove the skin until the bonds are not easily broken.
- (2) Remove all the nicks, scratches, gouges, burrs, sharp edges, corrosion and other unwanted material to a smooth surface. If you remove more than 10% of a sheet thickness, do one of the steps that follow:
- (a) If the depth of the removed damage is less than 80% of the sheet thickness, refer to REPAIR 2.
 - (b) If the depth of the removed damage is more than 80% of the sheet thickness, cut out the damage. Refer to REPAIR 4.

NOTE: A facesheet (skin) can have more than one sheet bonded together. Be careful not to cause damage to the sheet(s) below the damaged sheet(s).

- (3) Examine the damaged area for signs of water, oil, fuel, dirt or other contamination in the honeycomb. Remove all fluids, dirt and other contamination.
- (a) Use a vacuum or oil-free compressed air to remove water.
 - (b) Dry the honeycomb core. You can heat the core or use hot air at the wet area for 1 hour (minimum) at 150°F (77°C). Make sure that the temperature does not increase more than 5°F (3°C) a minute. Dry again if necessary.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (c) If a honeycomb core has oil in it, then spray on MEK, MIBK, MPK, or acetone solvent to remove the contamination. Be careful to prevent damage to the adhesive on the opposite skin. Immediately remove the solvent from the core. Let the core become completely dry.
- (4) If you are repairing a crack you can do a stop-drill procedure or cut out the damage with a 0.25 inch (6 mm) minimum diameter router bit. Refer to 51-10-02, GENERAL and REPAIR 2 for the stop drill procedure.
- (5) For small damage that has a 1.0 inch (25 mm) diameter or less, cut out the damage to a circular shape. Then put BMS5-28 Type 6 or 7 potting compound or BMS5-101 Type III liquid pourcoat adhesive in the hole. Refer to Table 203/REPAIR GENERAL and REPAIR 2.
- B. If the aluminum honeycomb core is damaged, do one of the procedures that follow:

NOTE: If the opposite skin is not damaged, be careful to not cut into the opposite aluminum skin. Also, do not cause the bond area to get hot when you use the router.

- (1) Full depth core damage:
 - (a) Remove all of the damaged core.

STRUCTURAL REPAIR MANUAL

- (b) Lightly abrade the adhesive surface at the bottom of the hole (where the core was).

NOTE: It is not necessary to remove all of the adhesive from the opposite facesheet unless it is in an unsatisfactory condition. The adhesive is unsatisfactory if it has damage from water or other fluids, or if bare metal shows.

- (c) Use a vacuum cleaning device to remove dust and particles of the core from the adhesive surface.
- (2) For core damage of partial depth, use a septum. See REPAIR 3 for repairs that use a septum.
- C. Make all the corners of large cutouts in skins and honeycomb sandwich facesheets a minimum of 1.0 inch (25 mm) radius.
- D. If you removed skin from above an open core (no core replacement), use a vacuum to remove dust and particles from the open core.
- E. Refer to the component engineering drawings or use NDI procedures to find the locations of internal doublers and other repairs. Refer to REPAIR 4 for the doubler thicknesses and overlaps to use when cutouts are near a panel edgeband.

8. Make the repair parts

WARNING: USE ONLY EXPLOSION-PROOF EQUIPMENT WHEN YOU DO THESE TYPES OF REPAIRS. IF YOU DO NOT, PERSONAL INJURY AND DAMAGE TO ADJACENT EQUIPMENT CAN BE THE RESULT. WHEN YOU WORK WITH FLAMABLE MATERIALS, HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION.

- A. Make the repair doublers and fillers from material that is the same or an equivalent alloy material and heat treatment as the initial skin. Refer to 51-30-01, GENERAL for the approved substitution materials.

- (1) Do not make doublers and fillers from 7000 series aluminum that are clad on both sides. You can use 7000 series aluminum repair parts that are non-clad on one or both sides. Refer to the SRM Identification section, Boeing drawings, or do the clad penetration test as specified in 51-10-02, GENERAL.

NOTE: This procedure will only let you bond on a non-clad side of a 7000 series aluminum part. Do not use 7000 series aluminum fillers and internal doublers if a side is clad.

- (2) As an alternative to the surface preparation and primer application steps in Paragraph 11./REPAIR GENERAL through Paragraph 17./REPAIR GENERAL, you can make your repair doublers and fillers from pre-primed aluminum (aluminum that has the correct surface preparation and adhesive primer on it).
- (3) For flush repairs, refer to Figure 208/REPAIR GENERAL for the thickness and dimensions of the repair parts.
- (4) For external doubler (non-flush) repairs, refer to Figure 209/REPAIR GENERAL for the thickness and dimensions of the repair parts. Make a chamfer around the edges of external repair doublers that are 0.032 or thicker gage. Refer to Figure 213/REPAIR GENERAL.
- (5) Remove all the nicks, scratches, gouges, burrs, sharp edges, and other unwanted material from the repair doublers and fillers.

- B. If a core repair plug is necessary, do the steps that follow:

- (1) Use the same Boeing Material Specification (BMS) material or equivalent BMS-type and alloy as the initial core material.

NOTE: You can increase the durability of the repair if you purchase and use core that is phosphoric acid anodized (BMS4-4 Class NPA, for example).



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- (a) You can use the same grade or a one grade higher density core than the initial core material.
- (b) If necessary, you can make a full depth core from two pieces that are less than full depth. Refer to REPAIR 3 for a repair that uses a septum to make a full depth core from two pieces.
- (c) If necessary, you can make a partial depth core if you use a septum. Refer to REPAIR 3 for a repair that uses a septum to make a partial depth core.
- (2) Make the repair core so that it has the same shape and size as the hole. Make sure that the core can be installed with the same ribbon direction as the initial core. Refer to Figure 210/REPAIR GENERAL for flushness and alignment specifications.

NOTE: The repair core will compress and move down during the cure.

- (3) Put the repair core into the hole.
- (4) Measure the gap between the outer edges of the initial core and the repair core. Make sure that the gap is less than 0.1 inch (2.5 mm). If the gap is too large, then make another repair core that has the correct fit.
- (5) If necessary, cut or abrade the top of the core plug until the core height is -0.00 to $+0.005$ inch (-0.00 to $+0.13$ mm) above:

NOTE: If the two stage cure procedure will be used, you can wait until after the first stage is completed to sand the core.

- (a) The surface of the adjacent core (when the skin has been removed from above an area of core that will not be replaced), or
- (b) The undamaged skin (when the edge the undamaged core is adjacent to the edge of the undamaged skin).
- (6) Carefully remove the repair core plug from the hole.
- (7) Remove all the burrs and other unwanted material from the repair core.
- (8) Use a vacuum cleaning device to remove all the dust and particles from the repair core.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- C. Clean the repair doublers and fillers that do not have primer applied to the surface.
- D. Clean the aluminum honeycomb repair core, if used. Make sure that all unwanted materials are removed. Do a vapor de-grease as given in SOPM 20-30-03 or flush the honeycomb core with Series 97 solvent as given in SOPM 20-30-97.

NOTE: To flush the core with solvent, put the core fully into the solvent and leave it for a minimum of 30 seconds. Remove it and let it dry fully. The time to dry fully is approximately 1 hour.

- E. Prepare the core mating surfaces.

- (1) Abrade the adhesive layer at the bottom of the hole in the initial core to make the surface rough. Use Scotch Brite, Type A, No. 180 or finer pads (or the equivalent).

NOTE: If the adhesive is damaged, then look to see if the adhesive primer is also damaged. Refer to Paragraph 6.B./REPAIR GENERAL.

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- (2) Clean the mating surfaces of the initial core, repair core, and the facesheet at the bottom of the hole with a cleaning solvent. Refer to SOPM 20-30-03 for the applicable solvents.
- (3) Continue to clean the surfaces until a new moist cloth is clean after it is used. Remove the solvent before it can dry.
- (4) Do an inspection of the cleaned repair area. The area must show no signs of a glossy surface.

9. Installation of the Honeycomb Repair Core

NOTE: The steps that follow are applicable for the one-stage and two-stage cure procedures.

- A. If you do the one-stage cure repair, then do a surface preparation as specified in Paragraph 11./REPAIR GENERAL. Then do the honeycomb installation procedure.
- B. If you cut out damage through the top and bottom facesheets, then put the repair doubler(s) and filler(s) on one of the facesheets before you install the core. Refer to Figure 208/REPAIR GENERAL and Figure 209/REPAIR GENERAL.
- C. If you are doing a core repair that is less than full depth, or if you make a thick core from two thin cores, then use a septum. Refer to REPAIR 3 for septumized core repairs.
- D. To bond the repair core mating surfaces, you can use foaming adhesive, two-part paste adhesive, or potting compound. Refer to Table 203/REPAIR GENERAL for data on the adhesive materials.

Table 203: Cure Instructions for the Adhesives and Potting Compounds to Make a Core Repair

RESIN TYPE (RESIN USE)	POT LIFE	CURE TIME	CURE TEMPERATURE
BMS5-28, Type 6 or 7 (Potting Compound)	60 Minutes	90 Minutes	250° to 270°F (121° to 132°C)
		80 Minutes	290° to 310°F (143° to 154°C)
		60 Minutes	340° to 360°F (171° to 182°C)
BMS5-90, Type III, Class 250 (Foaming Adhesive)	Not Applicable	90 Minutes	225° to 260°F (107° to 127°C)
		80 Minutes	280° to 310°F (138° to 154°C)
		60 Minutes	325° to 350°F (163° to 177° C)
BMS5-92, Type I, or V (Two-part Paste Adhesive)	Figure 211/REPAIR GENERAL	Figure 211/REPAIR GENERAL	Figure 211/REPAIR GENERAL
BMS5-101, Type III (Liquid Pour Coat Adhesive)	Not Applicable	90 Minutes	225° to 260°F (107° to 127°C)
BMS5-141 (Two-Part Paste Adhesive)	60 Minutes	Figure 212/REPAIR GENERAL	Figure 212/REPAIR GENERAL

NOTE: Before you open the film adhesive or a foaming adhesive container, let the adhesive stay at a temperature of 60°F to 80°F (16°C to 26°C). You can use the adhesive after there is no condensation.

- E. To bond the core to the facesheet or repair doubler, you can use a film adhesive or a two-part paste adhesive. Refer to Paragraph 18./REPAIR GENERAL or Paragraph 19./REPAIR GENERAL for data on the adhesive materials.
- F. Core Installation Options.

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- (1) The procedure in Paragraph 9.G.(1)/REPAIR GENERAL shows how to install the repair core with film adhesive, and BMS5-90, Type III, Class 1, Grade 50 or 100 foaming adhesive.
- (2) The procedure in Paragraph 9.G.(2)/REPAIR GENERAL shows how to install the repair core with Type II, film adhesive, and BMS5-28 Type 6 of 7 potting compound.
- (3) The procedure in Paragraph 9.G.(3)/REPAIR GENERAL shows how to install the repair core with BMS5-92 or BMS5-141 two-part paste adhesive.
- (4) The procedure in Paragraph 9.G.(4)/REPAIR GENERAL shows how to seal a square edge with BMS5-101, Type III liquid pourcoat adhesive.

G. Core installation procedures.

NOTE: If you will not be able to apply heat to each side of the honeycomb panel, then put a thermocouple in the bottom of the hole. See the example in Figure 210/REPAIR GENERAL for the two stage honeycomb repair configuration and Figure 215/REPAIR GENERAL Detail A for the one stage honeycomb repair configuration.

- (1) Foaming adhesive core splice procedure. Do the steps that follow to install a repair core with film adhesive, and with BMS5-90, Type III, Class 1, Grade 50 or Grade 100 foaming adhesive.

- (a) Prepare the facesheet before you bond the core.

- 1) Use one of the film adhesive Grades that follow:

NOTE: Use BMS5-101, Type II film adhesive for 250°F (121°C) cure applications. Use BMS5-137, Type II, Class 1 (EA 9657 only) film adhesive for 310°F (154°C) cure applications. Use BMS5-137, Type II, Class 1 (all qualified products can be used) for 350°F (177°C) cure applications.

- three plies of Grade 5, or
- two plies of Grade 10, or
- one ply of Grade 15

- 2) Cut the film adhesive to the same dimensions as the bottom surface of the repair core.

- 3) Put the ply (or plies) of film adhesive at the bottom of the hole in the initial core.

- a) Remove the separator sheet from each film adhesive ply.

- b) If one-side tacky (OST) adhesive is used, (adhesive that has the mat carrier cloth on one of the outer surfaces), put the non-tacky (cloth) side against the bottom of the repair core.

- 4) Push the adhesive smoothly and tightly in place. Do not trap air between the adhesive plies and the skin or repair doubler at the bottom of the hole.

- (b) Cut a piece of BMS5-90, Type III or IV Class 1, Grade 50 or Grade 100 foaming adhesive.

NOTE: BMS5-90 Type IV extrudable adhesive is an alternative that can be used in a pressurized autoclave.

- 1) Cut the adhesive to a sufficient length to wind fully around the inner cell wall splice surfaces (of the hole in the initial core).

NOTE: Cut the BMS5-90, Type III, foaming adhesive to make each end attach in a butt-joint. You are also permitted to have a maximum 1/8 inch (3 mm) overlap.

- 2) If the adhesive has a separator sheet on each side, then remove one of them now. Keep the tacky side against the cell walls in the hole.

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- 3) Wind the foaming adhesive around the inside of the hole in the initial core. Make sure that the adhesive touches all of the core splice surfaces.
- 4) Remove the separator sheet from the open side of the adhesive.

NOTE: The adhesive must fill a minimum of 3/4 of the clearance between the initial core and the repair core. If necessary, you can apply more than one layer of the BMS5-90 adhesive material to the repair core.

- (c) Align the ribbon direction of the repair core in the same direction as the core to be repaired. Put the repair core inside the hole.

NOTE: The maximum error permitted is ± 5 degrees in the vertical direction and the ribbon direction. Refer to Figure 210/REPAIR GENERAL.

- 1) Make sure that the repair core plug is pushed into the adhesive at the bottom of the hole.
- (2) Potting compound core splice procedure. Do the steps that follow to install a repair core with the adhesive film and BMS5-28, Type 6 or 7 potting compound.

- (a) Prepare the facesheet for bonding the core.

- 1) Use one of the film adhesive Grades that follow:

NOTE: Use BMS5-101, Type II film adhesive for 250°F (121°C) cure applications. Use BMS5-137, Type II, Class 1 (EA 9657 only) film adhesive for 310°F (154°C) cure applications. Use BMS5-137, Type II, Class 1 (all qualified products can be used) for 350°F (177°C) cure applications.

- three plies of Grade 5, or
- two plies of Grade 10, or
- one ply of Grade 15.

- 2) Cut the film adhesive to the same dimension as the bottom surface of the repair core.
- 3) Put the ply (or plies) of film adhesive at the bottom of the hole in the initial core.

- a) Remove the separator sheet from each film adhesive ply.
- b) If one-side tacky (OST) adhesive is used, (adhesive that has the mat carrier cloth on one of the outer surfaces), put the non-tacky (cloth) side against the bottom of the repair core.

- (b) Apply a sufficient quantity of BMS5-28, Type 6 or 7 potting compound to the mating sides of the initial and repair cores. The potting compound must fill all of the area between the repair core and the core to be repaired.

- (c) Align the ribbon direction of the repair core in the same direction as the core to be repaired. Put the repair core inside the hole.

NOTE: The maximum error permitted is ± 5 degrees in the vertical direction and the ribbon direction. Refer to Figure 210/REPAIR GENERAL.

- 1) Make sure that the repair core has a tight interference in the core hole.
- 2) Make sure that the repair core plug is pushed into the adhesive at the bottom of the hole.
- (3) Paste adhesive core splice and core to skin bond procedure. Do the steps that follow to install a repair core with BMS5-92, Type I or V, or BMS5-141 two-part paste adhesive.

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- (a) The edges of the repair core must be a minimum of 2.0 inches (50 mm) from attached fittings. The repair core must also be a minimum of 2.0 inches (50 mm) from the outer edges of the initial core.
- (b) Prepare the facesheet for bonding the core. Apply a 0.04 to 0.08 inch (1.0 to 2.0 mm) thick layer of adhesive to the first surface that the core will be bonded to.

NOTE: Example: at the bottom of the hole in the initial core. As an alternative, you can wet two plies of BMS9-3 Type H-2 or H-3 dry glass fabric with the paste adhesive and put them in the bottom of the hole.

- (c) Apply a sufficient quantity of adhesive to the mating sides of the initial and repair cores. The adhesive thickness must fill all of the area between the repair core and the core to be repaired.
- (d) Align the ribbon direction of the repair core in the same direction as the core to be repaired. Put the repair core into the core hole.

NOTE: The maximum error permitted is ± 5 degrees in the vertical direction and the ribbon direction. See Figure 210/REPAIR GENERAL.

- 1) Make sure that the repair core has a tight interference in the core hole.
- 2) Make sure that the repair core plug is pushed into the adhesive at the bottom of the hole.

- (4) Seal procedure for a square edge panel assembly.

NOTE: Figure 202/REPAIR 4 shows examples of square edges of honeycomb core that are sealed.

- (a) If PAA core is used, you can put BMS5-95 sealant on the open edges after the repair to the honeycomb panel is completed.
- (b) On bare, unsealed edges of aluminum core, apply BMS5-101, Type III, liquid pourcoat adhesive to seal the square edge. Do what follows:

- 1) Clean the repair core again.
- 2) Measure 3 to 6 core cells in from the perimeter edge of the repair core. Apply the BMS5-101, Type III liquid pourcoat adhesive on the applicable cells of the repair core. You can dip the core cells into the adhesive or pour the adhesive on to the core cells.

NOTE: If you use the pour procedure, apply the adhesive to one side of the repair core first. Turn the core over and apply other side. Make sure that the adhesive fully covers the cell walls.

- 3) Put the repair core on clean, absorbent, oil-free paper.

NOTE: After the adhesive is applied, you have less than 3 minutes to drain the extra liquid adhesive from the cells.

- a) If there is too much liquid adhesive in the core cells, let the extra adhesive drain away.
 - b) After the extra liquid adhesive has drained away, put the repair core on another clean oil-free paper to help the extra liquid adhesive continue to drain.
- 4) Let the repair core air-dry at ambient temperature on a clean oil-free paper for 30 to 40 minutes.

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- 5) After the air dry time, oven dry the BMS5-101, Type III at 180°F to 190°F (82°C to 88°C) for 30 to 35 minutes before you install the repair core.

NOTE: Protect the core from contamination.

- H. Two-stage honeycomb core cure repair procedure. Refer to Figure 210/REPAIR GENERAL for the steps that follow:

NOTE: If you do a one-stage honeycomb core cure repair procedure, then the steps that follow are not necessary. If the area to be repaired is 64 square inches (410 square cm) or more, then the two-stage cure is necessary. If a verifilm test is necessary, you can do the test at the same time that you cure the core. Refer to Paragraph 10.C./REPAIR GENERAL for the verifilm procedure.

- (1) Bagging procedure:

- (a) Put thermocouples at the edges of the core.
- (b) Find a heat blanket that is larger, than the replacement core.
 - 1) The heat blanket must be sufficient to extend 2.0 inches (50 mm) or more, from the edges of the replacement core.
 - 2) Use the dimensions of the blanket to find the correct dimensions of the layup and vacuum bag materials.
- (c) Cut a layer of perforated FEP release film to the same dimensions as the heat blanket. Put the release film on the open replacement core. Make sure that the edges of the release film are an equal distance from the edges of the replacement core.
- (d) Cut a layer of dry peel ply or fiberglass bleeder material that is 2.0 inches (50 mm) larger, all around, than the dimensions of the heat blanket. Put the peel ply (or bleeder) on the perforated FEP. Make sure that the edges of the peel ply (bleeder) extend 2.0 inches (50 mm) from the edges of the FEP.
- (e) Cut a layer of solid FEP release film, to the same dimension as the heat blanket. Put the release film on the peel ply (bleeder). Make sure that the edges of the release film are an equal distance from the edges of the dry peel ply (bleeder).
- (f) Cut a layer of dry peel ply material that is 2.0 inches (50 mm) larger, all around, than the dimensions of the heat blanket. Put the peel ply on the solid FEP. Make sure that the edges of the peel ply extend 2.0 inches (50 mm) from the edges of the FEP.
- (g) Put the heat blanket on the peel ply. Make sure that the edges of the heat blanket are an equal distance from the edges of the peel ply.
- (h) You can put a thermocouple on the heat blanket (optional). If the heat blanket gets too hot, you can turn off the power before you damage the skin panel.
- (i) If the heat blanket extends more than 3.0 inches (75 mm) from the edge of the cutout, you can do this recommended procedure:

NOTE: If a heat blanket gets too hot, it can cause damage to the repair and to the adhesive in the undamaged skin. To help prevent damage (if the heat blanket gets too hot), do not let the heat blanket touch more skin than is necessary. Insulation between the heat blanket and the skin is recommended.

- 1) Put the edge of the insulation 2.0 to 3.0 inches (50 to 75 mm) from the edge of the cutout in the top facesheet.
- 2) Let the insulation material extend to the end of the heat blanket (at a minimum).

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- (j) Put four to six layers of glass fabric (or two layers of 0.04 inch (1.0 mm) breather fabric, or one layer of 0.1 inch (2.5 mm) breather fabric) above the heat blanket as a breather. Make sure that the breather is sufficient to extend from the edges of the heat blanket.
- (k) Put a vacuum base above the fiberglass breather cloth for each vacuum port and vacuum gage port.
- (l) Put on the vacuum bag sealant.
- (m) Make a hole in the outer vacuum bag at the vacuum base location for each vacuum port and vacuum gage port.
- (n) Put the vacuum bag film on the repair area.
- (o) Connect the vacuum port and vacuum gage ports to their vacuum bases.
- (p) If necessary, put insulation material on the outer surface of the vacuum bag.
- (2) Cure the repair.
 - (a) Refer to Table 203/REPAIR GENERAL for the cure instructions.
 - (b) When the cure time is completed, decrease the temperature at a rate of 5°F (3°C) a minute.
- (3) When the temperature is less than 125°F (52°C), release the vacuum pressure and remove the vacuum bag equipment.
- (4) Remove the thermocouple wires from the repair area.

NOTE: Part of the thermocouple wires can stay in the cured adhesive if you cannot remove them. Cut the thermocouple wires so that the ends of the wires are below the surface of the core.
- (5) Abrade the top of the core until it is flush with the top of the adjacent core or skin (that which applies). Refer to Figure 210/REPAIR GENERAL.
- (6) Use a vacuum cleaning device to remove dust and particles from the open core and the repair area.
- (7) Do a visual inspection of the core splice. If you see areas that are not bonded, then fill the voids with a core splice adhesive or potting compound. Measure the length of the filled areas.
 - (a) If the total cumulative length of the filled areas is more than 2.0 inches (50 mm), then cure the core splice material and do Paragraph 9.H.(5)/REPAIR GENERAL through Paragraph 9.H.(7)/REPAIR GENERAL again.
 - (b) If the total cumulative length of the filled areas is 2.0 inches (50 mm) or less, then do all of the applicable steps that remain in this procedure.

10. Inspect the fit of the repair parts

- A. See if light finger pressure can make all the areas of the repair part touch the surface to be bonded.
- B. Examine and measure the bondline for all repair doublers that have an area of 64 square inches (410 square cm) or more.
 - (1) The verifilm test is a satisfactory procedure to make sure that you have the permitted bondline thickness. Other procedures are permitted if you can make sure that the bondline thickness is satisfactory.
- C. If you do a verifilm test, do the steps that follow:

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- (1) Put a ply of 0.001 or 0.002 inch (0.025 or 0.050 mm) non-perforated FEP release film above the repair area.

NOTE: If there is open honeycomb core, use 0.004-0.007 inch (0.10 to 0.18 mm) thick PVC film. You can use a different material if:

- It does not cause contamination of the core, and
- It will let the honeycomb pattern (from the honeycomb core) show on the adhesive.

- (2) Put on to the release film the same adhesive type that you use to do the repair.

NOTE: If a paste adhesive is used, make sure that you apply the adhesive at a constant thickness. If a film adhesive is used, make sure that you use the same number of plies and the same grade that you use in the repair.

- (3) Put a ply of nonperforated FEP release film or PVC film above the adhesive.
- (4) Put the repair doublers and fillers on the release film the same as you do for the repair.
- (5) Apply a vacuum bag and cure the adhesive as specified in Paragraph 18./REPAIR GENERAL. You are permitted to cure the adhesive for half of the time specified for the repair.
- (6) After the verifilm check is completed, disassemble the parts and do a visual inspection of the cured adhesive.
 - (a) Make sure that you have a bondline thickness for BMS5-101 of between 0.002 and 0.020 inch (0.05 to 0.50 mm). Make sure that you have a bondline thickness for BMS5-137 of between 0.002 and 0.030 inch (0.05 to 0.76 mm).
 - (b) Make sure that the parts did not move during the cure.
 - (c) Make the sure that there are no voids that are larger than 0.10 inch (2.5 mm) in diameter.
 - (d) If there is open honeycomb core, make sure that you can clearly see the honeycomb pattern on the adhesive for all of the open core. Make sure that the core is not crushed.
- (7) If the test is satisfactory, then discard the cured adhesive and the used release film materials. If the test is not satisfactory, then do one or more of the steps that follow:
 - (a) Repeat the verifilm test with an additional ply of Grade 5 or 10 film adhesive. If the test is satisfactory, make sure that you use the same number of plies of adhesive and the same grades when you do the repair.
 - (b) Repeat the verifilm test with weight or pressure added. If the test is satisfactory, make sure that you use the same weight or pressure when you do the repair.
 - (c) Check the shape and fit-up of the repair parts. Adjust if necessary, and then repeat the verifilm test.
 - (d) Ask Boeing for help if necessary.

- D. Apply the adhesive as given in Paragraph 18./REPAIR GENERAL or Paragraph 19./REPAIR GENERAL.

STRUCTURAL REPAIR MANUAL**11. Use of the Surface Preparation Procedures**

CAUTION: DO NOT BOND A CLAD SURFACE OF A CLAD 7000 SERIES ALUMINUM PART. THE RESULT CAN BE CORROSION AT THE BOND INTERFACE OF THE REPAIR.

- A. Do a surface preparation procedure only on aluminum surfaces that are not primed. Remove all unwanted primer and other material before you continue with the procedure.

NOTE: Boeing does not recommend that you use phosphoric acid or Hydrofluoric Acid (HF) Alodine to prepare an interior surface at the bottom of a hole in a honeycomb core. These chemicals are difficult to completely remove, and the residue can cause corrosion. Use the Boegel surface preparation procedure or cut out the skin to the same dimension as the hole and then do a two sided skin repair.

- B. Refer to Figure 201/REPAIR GENERAL for the permitted repair size limit for each surface preparation procedure.

NOTE: These procedures prepare the aluminum surfaces for metal-to-metal bonding and bonding metal face sheets to aluminum honeycomb core.

- C. Phosphoric Acid Anodized (PAA) aluminum gives the best surface preparation for bonding. You can get PAA repair parts from the list that follows:
- (1) Purchase parts that come with the PAA surface and the adhesive primer on them.
 - (2) Do a tank PAA procedure as specified in Boeing Process Specification BAC5555 "Phosphoric Acid Anodizing of Aluminum for Structural Bonding".
 - (3) Do the PACS or PANTA surface preparation procedure.
- D. The PACS and PANTA procedures are PAA alternatives to tank PAA procedures to prepare an aluminum surface for bonding. Refer to Paragraph 12./REPAIR GENERAL for the PACS procedure and Paragraph 13./REPAIR GENERAL for the PANTA procedure.
- E. As an alternative to the PANTA or PACS procedures, you can use the Boegel (AC-130) procedure. Refer to Paragraph 14./REPAIR GENERAL for the Boegel procedure.
- F. The Hydrofluoric Acid (HF) - Alodine procedure can only be used for small, interim repairs. Refer to Paragraph 16./REPAIR GENERAL for the HF-Alodine procedure.

12. The Phosphoric Acid Containment System (PACS) Procedure

NOTE: The Phosphoric Acid Containment System (PACS) procedure is covered by U.S. patent numbers 4,882,016 and 4,988,414 and other patent applications assigned to The Boeing Company. Repair stations that have Boeing licenses and operators of Boeing aircraft are permitted to use this procedure. For data regarding licensing for non-Boeing applications, call the Chief Patent Counsel, The Boeing Company.

- A. The necessary PACS materials are:
- (1) Phosphoric Acid, 75-80% (by weight), as given in Federal Specification A-A-55820
 - (2) Copper Wire
 - (3) Corrosion Resistant Steel (300 Series CRES) Wire Mesh
 - (4) DC Power Supply
 - (5) Vacuum Sealing Compound
 - (6) Nylon Vacuum Bag Film
 - (7) Solvent and Acid Resistant Tape
 - (8) 3M Scotch Brite Pads, Type A, Very Fine



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- (9) Fiberglass Breather Cloth
- (10) Nylon Breather Material
- (11) Aluminum Foil Tape
- (12) Solid FEP
- (13) Blue Litmus Paper
- (14) Acetone or Methyl Propyl Ketone (MPK) Solvent
- (15) Plastic Film (Mylar, acetate, polyester or equivalent plastic material)

WARNING: KEEP ACIDS AWAY FROM HEAT, FIRE, AND SPARKS. ACID FUMES ARE FLAMMABLE AND TOXIC. INJURY TO PERSONNEL CAN BE THE RESULT. DO NOT PERMIT ACIDS TO MIX WITH OTHER MATERIALS. MAKE SURE THAT THE AIR SUPPLY TO THE AREA IS NOT BLOCKED.

WARNING: USE RUBBER GLOVES, PROTECTIVE CLOTHING AND EYE PROTECTION. WHEN YOU WORK WITH PHOSPHORIC ACID. THE ACID CAN BURN YOUR EYES AND SKIN AND CAUSE INJURY. IF THE ACID TOUCHES THESE AREAS, FLUSH WITH A LARGE QUANTITY OF WATER AND GET MEDICAL AID IMMEDIATELY.

B. Make the phosphoric acid solution.

- (1) Calculate how much solution is necessary.

NOTE: In this step, you have a minimum of two times as much solution than is needed for the anodize process. This is because it is necessary to have sufficient solution on the area to be anodized:

- During the time needed to get the specified voltage, and
 - To make sure that the solution flows for a minimum of 20 minutes.
- (a) Make sure that a minimum of 1.0 gallon (4.0 liters) of phosphoric acid solution for each 100 square inches (645 square cm) of treatment area is prepared and connected.
 - (b) As an alternative, you can circulate the acid and use it two times on the bond surface. Start with a minimum of 1/2 gallon (2.0 liters) of solution for each 100 square inches (645 square cm) of treatment area.

WARNING: ALWAYS ADD ACID TO WATER WHEN YOU MIX THEM. IF YOU ADD WATER TO ACID, THE ACID WILL BECOME VERY HOT AND WILL NOT BE STABLE. THIS CAN CAUSE INJURY TO PERSONS.

- (2) To make the phosphoric acid solution, add $14 \pm 1/3$ fluid ounces (410 ± 10 ml) of 75-80% phosphoric acid to each 135 ± 2 fluid ounces (4.0 liters ± 60 ml) of distilled water.

C. Clean and abrade the repair surfaces.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (1) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.
- (2) Abrade the surfaces with Scotch Brite, Type A, very fine pads or a high grade alumina sand paper (180-grit or finer). The metal surface will look clean when you finish this step of the process.

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- (3) Remove the unwanted abrasive particles from the surface. Use clean, dry air or nitrogen.
- (4) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.
- (5) Isolate the mechanical fasteners and all the areas that are not damaged. Use aluminum foil tape or a combination of aluminum foil tape and polyethylene film (or the equivalent).
- (6) Put on a mask to seal all areas where the damage goes through a skin. To make the mask: put aluminum foil tape, solid FEP or other satisfactory material on top of the honeycomb.

NOTE: If you do a one-stage repair, you can temporarily fill the hole before you put on the mask. Example: you can put the honeycomb repair core in the hole (without the core splice adhesive) or you can put in a solid plug.

- (7) Flush with clean water. You can also wipe with a clean, wet, lint-free cloth until no residue shows on the cloth.

D. Do a visual inspection for a water-break-free surface.

- (1) Flush the surface with clean (mineral-free or de-ionized) water. Do this for 30 seconds or until the surface has a continuous water film on all of the repair area.

NOTE: The preferred water temperature is between 50° and 100°F (10° and 38°C).

- (2) After the flush procedure is completed, the water film on the bond surface must stay continuous for a minimum of 30 seconds.

NOTE: The water surface tension at the edges of an aluminum skin can cause the water film to pull away from the edge a small distance. This condition is permitted unless it is caused by surface contamination or incorrect abrading.

- (3) If the film does not stay continuous for a minimum of 30 seconds, do Paragraph 12.C./REPAIR GENERAL and Paragraph 12.D./REPAIR GENERAL again.

E. Put a layer of plastic film (Mylar, acetate, polyester or an equivalent material) on the bench tops and other work areas. This will help to prevent the contamination of the repair parts.

F. Assemble the PACS immediately after you clean the repair surface. Refer to Figure 204/REPAIR GENERAL for the steps that follow:

CAUTION: DO NOT USE A STAINLESS STEEL SCREEN IF IT SHOWS CORROSION OR OTHER DETERIORATION. IF YOU DO, IT IS POSSIBLE THAT THERE WILL NOT BE THE NECESSARY AMOUNT OF CURRENT FLOW THROUGH THE SCREEN.

- (1) Cut a piece of the stainless steel screen to the shape and dimensions of the surface area to be anodized. Use 300 series alloy CRES with a wire gauge that is a minimum of American Wire Gauge (AWG) #20 (0.03 inch (0.8 mm) diameter) and a maximum of #14 (0.06 inch (1.5 mm) diameter).

NOTE: AWG #18 (0.04 inch (1.0 mm) diameter) is the usual type of stainless steel screen used.

- (2) Make a record of the dimensions of the area to be anodized and do a calculation of the area. This data will be used later to make a calculation of the volume of acid divided by the area that was anodized.

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- (3) Attach conductive negative (–) cathode wire(s) to the stainless steel screen. Make sure that there is a minimum of one wire for each 30 square inches (200 square cm) of the repair area. Use a sufficient length of wire to prevent tension in the wire between the power supply and the PACS assembly. Put the same space between each of the wires.

NOTE: The negative (–) cathode wire must have a good electrical conductivity with the stainless steel screen. Make sure that the wires and clamps are sufficiently large to transmit the necessary electrical current.

- (4) Cut three or four ply layers of non-woven mat breather material. Each layer must be a minimum of 1.0 inch (25 mm) larger than the stainless steel screen (to make sure that the screen will not touch the surface of the part).
- (5) Put two layers of the breather material on the area to be anodized. Align each layer with each other. Make sure that the breather material extends 0.5 inch (13 mm) from each edge of the area to be anodized.

NOTE: On repair areas that are vertical or not easy to get to, use tape to attach each breather cloth layer.

CAUTION: MAKE SURE THAT THE STAINLESS STEEL SCREEN AND CATHODE WIRE DOES NOT TOUCH THE ALUMINUM REPAIR SURFACE. THE RESULT CAN BE DAMAGE TO THE PARTS.

- (6) Put the screen on the breather material. Make sure that the edges of the screen are 0.5 inch (13 mm) from the edges of the breather material.
- (7) Put one or two layers of breather material on the screen. (Two layers above the screen are recommended for areas larger than 64 square inches (410 square cm). Have the edges align with the edges of the breather material below.
- (8) Put acid inlet tube(s) between the breather cloth layers at one edge. Do not put the inlet tube on the stainless steel screen. If you use two or more inlet tubes, put the tubes sufficiently far apart to make the surface fully wet.

NOTE: Use two or more acid solution inlet tubes for repair sizes that are larger than 64 square inches (410 square cm). This is necessary to keep the bond surface fully wet during the anodize procedure.

- (9) Put the vacuum outlet tube(s) between the breather cloths at the opposite edge. Do not put the outlet tube on the stainless steel screen.
- (10) Apply vacuum sealing compound on the aluminum part 1.0 inch (25 mm) or less from the edges of the breather cloth.
- (11) Cut a piece of vacuum bag film that is approximately 5.0 inches (130 mm) larger than the breather cloths. Put it fully around the repair area.
- (12) Remove all the wrinkles in the vacuum bag.
- (13) Seal the cathode wire(s) and the inlet tube(s).
- (14) Connect the outlet tube between the vacuum probe and the catch basin.
- (15) Attach the three-way valve to the inlet tube(s).
- (a) Turn the valve to the closed position (no flow of water or acid solution).
 - (b) Connect one valve line to a container with the phosphoric acid solution that you made in Paragraph 12.B./REPAIR GENERAL.
 - (c) Connect a second valve line to the water supply.



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- (16) If the surface to be anodized is vertical or face down, then Boeing recommends that you use two vacuum bags (an inner bag and an outer bag). The outer vacuum bag will contain the acid if there is leakage from the inner vacuum bag. If the surface is face up (as shown in Figure 204/REPAIR GENERAL) then the outer vacuum bag is not necessary.

(a) If the outer vacuum bag is necessary, go to Paragraph 12.F.(17)/REPAIR GENERAL.

(b) If the outer vacuum bag will not be used, then do the steps that follow:

- 1) Start a vacuum in the vacuum bag and seal all the leaks.

NOTE: The vacuum is through the drain line from the catch basin to the outlet tube.

- 2) Go to Paragraph 12.F.(18)/REPAIR GENERAL.

- (17) When you use two vacuum bags, do the steps that follow:

(a) Put a minimum of four continuous plies of fiberglass breather cloth around the inner vacuum bag.

(b) Put a vacuum base above the fiberglass breather cloth.

(c) Cut a second piece of vacuum bag film for the outer vacuum bag. Make sure that it is larger than the inner bag and fiberglass breather cloth.

(d) Put the outer vacuum bag above the fiberglass breather cloth and the inner bag layup. Seal it to the metal surface. Make sure that the outer bag is sealed. Remove all the wrinkles.

NOTE: Make sure that the cathode wire, inlet tube(s), and outlet tube(s) go below the outer bag. Seal it at the edge of the bag.

(e) Make a hole in the outer vacuum bag at the vacuum base location for the vacuum port.

(f) Connect the vacuum port and vacuum gage port to the vacuum base.

(g) Start a vacuum in the inner bag and seal all the leaks.

NOTE: The vacuum is through the drain line from the catch basin to the outlet tube.

(h) Start a vacuum in the outer bag and seal all the leaks.

NOTE: The vacuum in the outer bag will hold the inner bag and the parts in their positions.

- (18) Connect the wires to a DC power supply.

NOTE: Use a battery or a DC power supply as the power source for the anodizing procedure. The power source must have a capacity of 10 volts, minimum. The power source must also have a capacity of 8 amps/square foot (86 amps/square meter), minimum.

(a) Connect the negative (-) cathode wire that is attached to the stainless steel screen, to the negative lead on the power source.

(b) Connect the positive (+) anode wire to the aluminum part surface to be anodized, and to the positive (+) lead on the power source.

- G. Do the PACS anodize procedure.

- (1) Before you let the acid solution flow:

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- (a) Make a record of the initial quantity (in fluid ounces or liters, as applicable) of the acid in the container.

NOTE: This record will be necessary for the calculation in Paragraph 12.G.(9)(a)/REPAIR GENERAL.

- (b) If you recycle the acid solution, you must have a procedure to measure or calculate the total quantity of solution that flowed on the bond surface.
- (2) Make sure that the temperature of the acid and aluminum part stays between 70° and 85°F (21° and 29°C) during the anodizing procedure.
- (3) Open the three-way valve to let the phosphoric acid solution flow from its container to the inner vacuum bag.
- (a) Let a sufficient quantity of acid to flow in until the non-woven mat breather material becomes soaked. Make sure that you keep a sufficient and continuous acid solution flow rate.
- (b) Use a minimum of 0.03 fluid ounce (1.0 ml) a minute for each square inch (1.5 ml a minute for each 10 square cm) to be anodized. This quantity is necessary to keep the surface fully wet.
- (4) Do the steps that follow (as soon as possible) in the sequence that follows:
- (a) Set the voltage and current positions to zero on the electrical power supply.
- (b) Start the electrical power supply.
- (c) Increase the current adjustment to the full open position.
- (d) Slowly increase the voltage (approximately 5 volts for each minute) until it is between 9.5 to 10 volts (DC).
- (e) Do a check of the amperage after it gets to the correct voltage.

NOTE: A fast increase in the current (more than 20% of the stable value) could be a sign that the surface is burning. Add more acid solution. If this is an unsatisfactory solution, an electrical short could be the cause. Stop the procedure and look for the problem.

- 1) In one minute or less, the current will become stable.
- 2) The current density at 9.5 to 10 volts (DC) must be in a range that is between 0.014 and 0.048 amperes/square inches (0.0022 and 0.0074 amperes/square cm).

- (f) Apply the 9.5 to 10 volts (DC) for 18 to 22 minutes.

CAUTION: DO NOT LET THE ASSEMBLY BECOME DRY. THE RESULT CAN BE A BURNED SURFACE OR A SURFACE TREATMENT THAT IS UNSATISFACTORY. ADD MORE ACID AS NECESSARY TO KEEP THE SURFACE FULLY WET.

- (5) Make sure that there is a steady flow of acid over all of the surface of the part during the anodizing procedure. Signs that the acid flow rate is not sufficient or signs of local dry areas are:
- An increase in current after it has stabilized, or
 - A significant increase in temperature, or
 - A lightening of the color of the breather cloth.

NOTE: The breather cloth will change to a darker color when it becomes soaked with the phosphoric acid.

- (6) Stop the electrical power after the specified anodizing time.

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- (7) Quickly, make a record of the quantity of phosphoric acid that stays in the container.

NOTE: This record will be necessary for the calculation in Paragraph 12.G.(9)(a)/REPAIR GENERAL.

- (8) Immediately, turn the three-way valve to let the rinse water flow from the container to the inner bag.
- (a) Flush with a quantity of water equal to 0.03 fluid ounces (1.0 ml) a minute for each square inch (1.5 ml a minute for each 10 square cm) that was anodized.
 - (b) The rinse water must flush freely against all of the anodized surface.
- (9) Flush the bag with rinse water for a minimum of 5 minutes. Do the steps that follow, while the rinse water flushes the anodized surface:
- (a) Calculate the quantity of phosphoric acid that was used.
 - (b) Subtract the quantity of phosphoric acid (the record you made in Paragraph 12.G.(9)(a)/REPAIR GENERAL) from the initial quantity (the record you made in Paragraph 12.G.(1)/REPAIR GENERAL).
 - (c) Divide the volume of phosphoric acid that was used, by the area that was anodized (Use the data from the record you made in Paragraph 12.F.(2)/REPAIR GENERAL).
 - (d) If the calculated quantity of phosphoric acid used is less than 1/3 fluid ounce (10 ml) for each square inch (15 ml for each 10 square cm) of area that was anodized, then do Paragraph 12.G.(1)/REPAIR GENERAL through Paragraph 12.G.(7)/REPAIR GENERAL again.
 - (e) Stop the flow of rinse water if the calculated quantity of phosphoric acid used is sufficient.

H. Quickly, disassemble the PACS layup.

- (1) Stop the vacuum and disconnect all of the tubing.
- (2) Remove the outer vacuum bag and the fiberglass breather cloth. Be careful to not let contamination or other unwanted material get on the anodized surface.

NOTE: Do not touch the anodized surface with your bare skin or with gloves that have contamination on them. Do not let the adhesive tape touch the anodized surface.

- (3) Remove the inner vacuum bag, the breather cloths, and the stainless steel screen layup.
- (4) Discard the tape, the inner bag, the breather cloth, and the stainless steel screen in an approved container. Make sure to discard these materials by a procedure that is permitted by local health, safety, and environmental authorities.

- I. Flush the anodized surface with clean (mineral-free or de-ionized) water for 5 minutes. This will remove all possible phosphoric acid solution.

NOTE: Do not wipe or rub the repair surfaces.

- J. Let the anodized surface fully dry at room temperature. As an alternative, you can dry the parts with forced, clean, dry, filtered air that is a maximum of 160°F (71°C) until the surface is fully dry.

NOTE: You must apply the adhesive primer in less than 24 hours after the surface is anodized. Prevent the contamination of the anodized surface by moisture, dust, oil fumes, engine exhaust, or other unwanted material. Do not touch the dried anodized surfaces. Do not apply tape to the anodized surfaces.



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- K. Examine the anodized surface. You can use a Phosphoric Acid Anodize Detector (dichroscope) or do the polarized filter color inspection test that follows:

NOTE: You can purchase a Phosphoric Acid Anodize Detector (part number WCI-AD55) from West Coast Industries, Inc., 14900 Whitman Ave N, Seattle, WA 98133.

- (1) Polarized filter color inspection test.

- (a) Use a fluorescent light source on the anodized area.
- (b) Put a polarizing filter between yourself and the treated surface and look at the reflected light (from the surface) at an angle of 5 degrees or less. It can be helpful to put the light source at a glancing angle. Refer to Figure 206/REPAIR GENERAL.
- (c) While you look at the surface through the polarizing filter, turn the filter 90 degrees. A correctly anodized surface gives a constant change in color (on all areas of the anodized surface) when you look through the filter. The colors seen most frequently are purple, yellow, and green.

NOTE: It is not easy to see the colors on a rough or contoured surface. To find out if a surface is anodized correctly, change the view angle of the polarizing filter to see if the anodic coating is satisfactory.

- (2) The anodize procedure is not successful if you find one or more of the conditions that follow:

- (a) There are sudden changes in color as a result of stains, contamination, fingerprints, or other parts that touched the surface.
- (b) There are electrical burns or pits.
- (c) There are areas of the surface to be bonded that are not anodized.

- (3) The surface is fully anodized if you see a constant change in color (with the polarizing filter) on all the areas of the anodized surface.

- (4) If the color inspection test on a rough or contoured surface is not successful, you can do alternative tests to make sure you have a good anodized surface. Do one or more of the tests that follow:

- (a) Use an ohmmeter to do a resistance test of the anodized surface. Make sure that the ohmmeter probes are clean.
 - 1) Carefully, put the ohmmeter probes on the anodized surface. Make sure that you do not damage the anodized surface with the ohmmeter probes.
 - 2) Carefully touch the surface with the sides of the probes first, then lay them down. If the surface has a resistance of more than 20,000 ohms (20 kohms) the test is successful.
- (b) Do an infrared filter test to measure the weight of the anodize coating. Use an infrared filter device that is tuned to measure phosphoric acid anodize oxides. If the infrared filter test shows an anodized coating that is more than 20mg/square foot (215mg/square Meter), the test is successful.

NOTE: A source for the infrared filter is as follows: Personal Instruments, LLC 18 Commerce Road Newton, CT 06470 (203) 426-0152.

- (c) The surface is fully anodized if you see a constant change in color (with the polarizing filter) on 90 percent or more of the anodized surface and one or more of the alternative tests are satisfactory.
- (5) If the anodize procedure is not successful, you must do all of the steps in Paragraph 12./REPAIR GENERAL again. (You must remove the unsatisfactory anodic oxide by abrasion as given in Paragraph 12.C./REPAIR GENERAL).

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- L. If you put a mask on open honeycomb core during Paragraph 12.C.(6)/REPAIR GENERAL, then remove it now. Make sure that you do not touch or contaminate the surfaces that have been anodized. Do not let moisture get into the core cells.
 - (1) Do a visual check for moisture in the cells. If you see moisture, use blue litmus paper to make sure that there is no acid contamination.
 - (a) If the litmus paper changes to a red color, there is acid contamination in the core cells. Flush the core with water. Use more blue litmus paper and do a check for acid again.
 - (b) If the litmus paper stays blue, there is no acid in the core. Remove the moisture, then continue with the procedure.
 - (2) Make sure that the core is fully dry before you apply the adhesive primer.
- M. Keep the bond surface(s) clean if you cannot apply the adhesive primer immediately.
 - (1) Do not touch the surface(s) with your bare skin, waxed paper, or material that has a release agent or other contamination.
 - (2) If protection of the surface(s) is necessary, then put vacuum bag film or unwaxed paper (without ink or other contamination on it) on the bond surface(s).
- N. Apply the adhesive primer in less than 24 hours after the anodize procedure is completed. Refer to Paragraph 15./REPAIR GENERAL.

13. The Phosphoric Acid Non-Tank Anodizing (PANTA) Procedure

- A. The materials that you need are:
 - (1) Phosphoric Acid, 75-80% (by weight), as given in Federal Specification A-A-55820 or (optional) pre-mixed phosphoric acid gel
 - (2) (Optional) Floculated Silica (Cab-o-Sil, Grade M-5, or PTG)
 - (3) Copper Wire
 - (4) Corrosion Resistant Steel (300 Series CRES) Wire Mesh
 - (5) Gauze or Cheesecloth (Cotton, Clean and lint-free)
 - (6) DC Power Supply
 - (7) Solvent and Acid Resistant Tape
 - (8) 3M Scotch Brite Pads, Type A, Very Fine
 - (9) Aluminum Foil Tape
 - (10) Solid FEP
 - (11) Blue Litmus Paper
 - (12) Acetone or Methyl Propyl Ketone (MPK) Solvent
 - (13) Plastic Film (Mylar, acetate, polyester or equivalent plastic material)

WARNING: KEEP ACIDS AWAY FROM HEAT, FIRE, AND SPARKS. ACID FUMES ARE FLAMMABLE AND TOXIC. INJURY TO PERSONNEL CAN BE THE RESULT. DO NOT PERMIT ACIDS TO MIX WITH OTHER MATERIALS. MAKE SURE THAT THE AIR SUPPLY TO THE AREA IS NOT BLOCKED.

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(WARNING PRECEDES)

WARNING: USE RUBBER GLOVES, PROTECTIVE CLOTHING AND EYE PROTECTION. WHEN YOU WORK WITH PHOSPHORIC ACID. THE ACID CAN BURN YOUR EYES AND SKIN AND CAUSE INJURY. IF THE ACID TOUCHES THESE AREAS, FLUSH WITH A LARGE QUANTITY OF WATER AND GET MEDICAL AID IMMEDIATELY.

B. Make the phosphoric acid solution (or gel).

WARNING: ALWAYS ADD ACID TO WATER WHEN YOU MIX THEM. IF YOU ADD WATER TO ACID, THE ACID WILL BECOME VERY HOT AND WILL NOT BE STABLE. THIS CAN CAUSE INJURY TO PERSONS.

- (1) To make the phosphoric acid solution, add $14 \pm 1/3$ fluid ounces (410 ± 10 ml) of 75-80% phosphoric acid to each 135 ± 2 fluid ounces (4.0 liters ± 60 ml) of distilled water.
- (2) As an option, you can make the phosphoric acid solution thicker. Mix flocculated silica (Cab-O-Sil, Grade M-5 or PTG) with the phosphoric acid until the acid solution and silica become a gel.

NOTE: You can also get the phosphoric acid gel mixture from a vender (supplier).

C. Clean and abrade the repair surfaces.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (1) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.
- (2) Abrade the surfaces with Scotch Brite, Type A, very fine pads or a high grade alumina sand paper (180-grit or finer). The metal surface should look clean when you finish this step of the process.
- (3) Remove the unwanted abrasive particles from the surface. Use clean dry air or nitrogen.
- (4) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.
- (5) Isolate the mechanical fasteners and all the areas that are not damaged. Use aluminum foil tape or a combination of aluminum foil tape and polyethylene film (or the equivalent). This will prevent acid contamination.
- (6) Put on a mask to seal all areas where the damage goes through a skin. To make the mask, put aluminum foil tape, solid FEP or other satisfactory material on top of the honeycomb.

NOTE: If you do a one-stage repair, make sure that the hole is filled before you put on the mask. Example: you can put the honeycomb repair core in the hole (without the core splice adhesive) or you can put in a solid plug.

- (7) Flush with clean water and/or wipe with a clean, wet, lint-free cloth until no visible residue appears on the cloth.

D. Do a visual inspection for a water-break-free surface.

- (1) Flush the surface with clean (mineral-free or de-ionized) water. Do this for 30 seconds or until the surface has a continuous water film on all of the repair area.

NOTE: The preferred water temperature is between 50° and 100°F (10° and 38°C).

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- (2) After the flush procedure is completed, the water film on the bond surface must stay continuous for a minimum of 30 seconds.

NOTE: The water surface tension at the edges of an aluminum skin can cause the water film to pull away from the edge a small distance. This condition is permitted unless it is caused by visible surface contamination or incorrect abrading.

- (3) If the film does not remain continuous for a minimum of 30 seconds, do Paragraph 13.C./REPAIR GENERAL and Paragraph 13.D./REPAIR GENERAL again.
- E. Put a layer of plastic film (Mylar, acetate, polyester or an equivalent material) on the bench tops and other work areas. This will help to prevent the contamination of the repair parts.
- F. Assemble the PANTA system immediately after you clean the repair surfaces. Refer to Figure 205/REPAIR GENERAL when you do the steps that follow:
- (1) Make a dam to prevent the acid solution (or gel) and rinse water from going into the adjacent structure. To make the dam, build up aluminum foil, acid resistant tape, solid FEP, or other acceptable material around the surface to be treated.

CAUTION: DO NOT USE A STAINLESS STEEL SCREEN IF IT SHOWS CORROSION OR OTHER DETERIORATION. IF YOU DO, IT IS POSSIBLE THAT THERE WILL NOT BE THE NECESSARY AMOUNT OF CURRENT FLOW THROUGH THE SCREEN.

- (2) Cut a piece of the stainless steel screen to the shape and dimensions of the surface area to be treated. Use a 300 series alloy CRES with a wire gauge that is a minimum of American Wire Gauge (AWG) #20 (0.03 inch (0.8 mm) diameter) and a maximum of #14 (0.06 inch (1.5 mm) diameter).

NOTE: AWG #18 (0.04 inch (1.0 mm) diameter) is the usual type of stainless steel screen used.

- (3) Set up an acid drain and rinse water recovery basin to hold the waste acid and rinse water after the anodize procedure is completed.
- (4) Apply the acid and layup materials.

NOTE: You have 30 minutes maximum after you apply the phosphoric acid to start the anodize procedure.

- (a) Make sure the temperature of the aluminum part and the acid solution (or gel) during the anodizing procedure is between 70° and 85°F (21° and 29°C).
- (b) Keep the surface wet with acid solution (or gel) at all times. If the surface starts to dry, add more acid solution (or gel).

WARNING: KEEP ACIDS AWAY FROM HEAT, FIRE, AND SPARKS. ACID FUMES ARE FLAMMABLE AND TOXIC. INJURY TO PERSONNEL CAN BE THE RESULT. DO NOT PERMIT ACIDS TO MIX WITH OTHER MATERIALS. MAKE SURE THAT THE AIR SUPPLY TO THE AREA IS NOT BLOCKED.

WARNING: USE RUBBER GLOVES, PROTECTIVE CLOTHING AND EYE PROTECTION WHEN YOU WORK WITH PHOSPHORIC ACID. THE ACID CAN BURN YOUR EYES AND SKIN AND CAUSE INJURY. IF THE ACID TOUCHES THESE AREAS, FLUSH WITH A LARGE QUANTITY OF WATER AND GET MEDICAL AID IMMEDIATELY.

- (c) Apply a smooth layer of phosphoric acid solution (or gel) to the aluminum surfaces.

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- (d) Cut a layer of gauze (or the equivalent absorbent, porous material) that is larger than the area to be anodized.
 - 1) Put the gauze on the acid layer. Extend the gauze 0.5 inch (13 mm) minimum, from the edges of the area to be anodized. Do this until two or three layers of the gauze are assembled.
 - 2) Keep the thickness to a minimum to prevent gasses from being trapped (but make sure that there is enough so that the screen will not touch the surface to be anodized).
 - 3) Remove the wrinkles. If necessary you can use a paint brush or a plastic sweeper to make sure the acid fully soaks the gauze.

NOTE: You can pre-soak the gauze. The gauze can be pre-soaked by squeezing the acid gel solution through the gauze by hand. Use rubber gloves for protection.

CAUTION: MAKE SURE THAT THE STAINLESS STEEL SCREEN AND CATHODE WIRE DOES NOT TOUCH THE ALUMINUM REPAIR SURFACE. THE RESULT CAN BE DAMAGE TO THE PARTS.

- (e) Put the stainless steel screen on the layers of gauze and acid.

CAUTION: MAKE SURE THAT THE SURFACE OF THE REPAIR AREA IS OPEN TO THE AIR TO PERMIT THE RELEASE OF UNWANTED GASES. IF YOU DO NOT, THE REPAIR WILL BE UNSATISFACTORY.

- (f) Add a layer of phosphoric acid solution (or gel) to the stainless steel screen to make sure that the solution fully covers the screen.

(5) Make the electrical connections.

- (a) Attach a conductive negative (–) cathode wire to the stainless steel screen. Make sure that there is a minimum of one wire for each 30 square inches (200 square cm) of the repair area. The length of the wire must be sufficient so that there is no tension between the power supply and the PANTA assembly. The wires must be evenly spaced apart.

NOTE: The negative (–) cathode wire must have a good electrical conductivity with the stainless steel screen. Make sure that the wires and clamps are large enough to carry the necessary electrical current.

- (b) Connect the negative (–) cathode wire that is attached to the stainless steel screen to the negative lead on the power source. Connect the positive (+) anode wire to the aluminum part surface to be anodized, and to the positive (+) lead on the power source.

NOTE: Use a battery or a DC power supply as the power source for the anodizing procedure. The power source must have a capacity of 10 volts, minimum. The power source must also have a capacity of 8 amps/square foot (86 amp/square meter), minimum.

CAUTION: DO NOT LET THE ASSEMBLY BECOME DRY. THE RESULT CAN BE A BURNED SURFACE OR A SURFACE TREATMENT THAT IS UNSATISFACTORY. ADD MORE ACID AS NECESSARY TO KEEP THE SURFACE FULLY WET.

G. Do the PANTA procedure.

- (1) Do the steps that follow in the sequence that follows:

NOTE: You have less than 30 minutes to start the electricity after you apply the acid.

- (a) Set the voltage and current positions to zero on the electrical power supply.

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- (b) Start the electrical power supply.
- (c) Increase the current adjustment to the full open position.
- (d) Slowly increase the voltage (approximately 5 volts for each minute) until it is between 9.5 to 10 volts (DC).
- (e) Do a check of the amperage after it gets to the correct voltage.

NOTE: A fast increase in the current (more than 20% of the stable value) could be a sign that the surface is burning. Add more acid solution (or gel). If this is an unsatisfactory solution, an electrical short could be the cause. Stop the procedure and look for the problem.

- 1) In one minute or less, the current will become stable.
 - 2) The current density at 9.5 to 10 volts (DC) must be in a range that is between 0.014 and 0.048 amperes/square inches (0.0022 and 0.0074 amperes/square cm).
- (f) Apply the 9.5 to 10 volts (DC) for 10 to 12 minutes.

CAUTION: DO NOT LET THE ASSEMBLY BECOME DRY. THE RESULT CAN BE A BURNED SURFACE OR A SURFACE TREATMENT THAT IS UNSATISFACTORY. ADD MORE ACID AS NECESSARY TO KEEP THE SURFACE FULLY WET.

- (2) Stop the electrical power after the specified time.
- (3) Immediately, remove the screen and the gauze breather cloth. Discard these materials. Use a method to discard these materials that is permitted by your local safety, health, and environmental authorities.
- (4) Immediately, flush the phosphoric acid from the anodized surfaces with clean water. The time interval between power shut-off and the start of the flush must not be more than 2.5 minutes. Flush with clean (mineral free or de-ionized) water for a minimum of 5 minutes.

NOTE: Do not rub or wipe the repair surface.

- H. Let the anodized surface fully dry at room temperature. As an alternative, you can dry the parts with forced, clean, dry, filtered air that is a maximum of 160°F (71°C) until the surface is fully dry.

NOTE: You must apply the adhesive primer in less than 24 hours after the surface is anodized. Prevent the contamination of the anodized surface by moisture, dust, oil fumes, engine exhaust or other unwanted material. Do not touch the dried anodized surfaces. Do not apply tape to the anodized surfaces.

- I. Examine the anodized surface. You can use a Phosphoric Acid Anodize Detector (dichroscope) or do the polarized filter color inspection test that follows:

NOTE: You can purchase a Phosphoric Acid Anodize Detector (part number WCI-AD55) from West Coast Industries, Inc., 14900 Whitman Ave N, Seattle, WA 98133.

- (1) Polarized filter color inspection test.
 - (a) Use a fluorescent light source on the anodized area.
 - (b) Put a polarizing filter between yourself and the treated surface and look at the reflected light (from the surface) at an angle of 5 degrees or less. It can be helpful to put the light source at a glancing angle. Refer to Figure 206/REPAIR GENERAL.

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- (c) While you look at the surface through the polarizing filter, turn the filter 90 degrees. A correctly anodized surface gives a constant change in color (on all areas of the anodized surface) when you look through the filter. The colors seen most frequently are purple, yellow, and green.

NOTE: It is not easy to see the colors on a rough or contoured surface. To find out if a surface is anodized correctly, change the view angle of the polarizing filter to see if the anodic coating is satisfactory.

- (2) The anodize procedure is not successful if you find one or more of the conditions that follow:
 - (a) There are sudden changes in color as a result of stains, contamination, fingerprints, or other parts that touched the surface.
 - (b) There are electrical burns or pits.
 - (c) There are areas of the surface to be bonded that are not anodized.
- (3) The surface is fully anodized if you see a constant change in color (with the polarizing filter) on all the areas of the anodized surface.
- (4) If the color inspection test on a rough or contoured surface is not successful, you can do alternative tests to make sure you have a good anodized surface. Do one or more of the tests that follow:
 - (a) Use an ohmmeter to do a resistance test of the anodized surface. Make sure that the ohmmeter probes are clean.
 - 1) Carefully, put the ohmmeter probes on the anodized surface. Make sure that you do not damage the anodized surface with the ohmmeter probes.
 - 2) Carefully touch the surface with the sides of the probes first, then lay them down. If the surface has a resistance of more than 20,000 ohms (20 kohms) the test is successful.
 - (b) Do an infrared filter test to measure the weight of the anodize coating. Use an infrared filter device that is tuned to measure phosphoric acid anodize oxides. If the infrared filter test shows an anodized coating that is more than 20mg/square foot (215mg/square Meter), the test is successful.

NOTE: A source for the infrared filter is as follows: Personal Instruments, LLC 18 Commerce Road Newton, CT 06470 (203) 426-0152.

- (c) The surface is fully anodized if you see a constant change in color (with the polarizing filter) on 90 percent or more of the anodized surface and one or more of the alternative tests are satisfactory.
- (5) If the anodize procedure is not successful, you must do all of the steps in Paragraph 13./REPAIR GENERAL again. (You must remove the unsatisfactory anodic oxide by abrasion as given in Paragraph 13.C./REPAIR GENERAL).
- J. If you put a mask on open honeycomb core during Paragraph 13.C.(6)/REPAIR GENERAL, then remove it now. Make sure that you do not touch or contaminate the surfaces that have been anodized. Do not let moisture get into the core cells.
 - (1) Do a visual check for moisture in the cells. If you see moisture, use blue litmus paper to make sure that there is no acid contamination.
 - (a) If the litmus paper changes to a red color, there is acid contamination in the core cells. Flush the core with water. Use more blue litmus paper and do a check for acid again.
 - (b) If the litmus paper stays blue, there is no acid in the core. Remove the moisture, then continue with the procedure.

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- (2) Make sure that the core is fully dry before you apply the adhesive primer.
- K. Keep the bond surface(s) clean if you cannot apply the adhesive primer immediately.
 - (1) Do not touch the surface(s) with your bare skin, waxed paper, or material that has a release agent or other contamination.
 - (2) If protection of the surface(s) is necessary, then put vacuum bag film or unwaxed paper (without ink or other contamination on it) on the bond surface(s).
- L. Apply adhesive primer in less than 24 hours after the anodize procedure is completed. Refer to Paragraph 15./REPAIR GENERAL.

14. The Boegel EP II (AC-130) Surface Preparation

- A. Boegel EP-II is a water-based, metal adhesion promoter based on sol gel (a type of inorganic polymer) chemistry. The Boegel EP-II system is commercially available as AC-130 (Four part kit) and AC-130-2 (Two part kit).
- B. The materials that you need are:
 - (1) AC-130 Sol-Gel Kit (Source: Advanced Chemistry and Technology, 7341 Anaconda Avenue, Garden Grove, CA 92841, 800-732-4470)
 - (2) Cheesecloth, gauze or clean cotton rags, or BMS15-5, Class A wipers
 - (3) Acetone or Methyl Propyl Ketone (MPK) Solvent
 - (4) Scotch Brite, Type A, very fine pads or a high grade alumina sand paper (180-grit or finer) for cleaning.
 - (5) #Abrasive material for making the surface reactive to Boegel.

NOTE: Sandpaper must be #180 grit and must be one of the approved products specified below. Smaller grit numbers (larger grit dimensions) can cause damage to the metal surface. It is possible that larger grit numbers (smaller grit dimensions) will not remove all of the oxidation. Different grit, paper, or adhesive materials can cause an unsatisfactory chemical bond between the AC-130 and the bare metal.

- Merit Shur Stik ALO Resin Bond, #180-grit Abrasive Papers (Source: Merit Abrasives, Customer Service, 2770 W. Washington St., Stephenville, TX 76401-3798, Tel: 800 763-7999, Fax: 800 472-3094, website: www.meritabr.com). Refer to Table 204/REPAIR GENERAL for product identification.

Table 204: Merit Sandpaper Ordering Information

ALO Resin Bond 180 Grit Sanding Discs				
Disc Diameter	Quick-Change PowerLock Discs			ShurStik Adhesive Backed Discs
1/2 inch (13 mm)	N/A	N/A	N/A	08834171108
3/4 inch (19 mm)	08834161010	08834165109	08834164325	08834171122
1 inch (25 mm)	08834161023	08834165124	08834166252	08834171137
1 1/2 inches (38 mm)	08834161036	08834165139	08834166251	08834171152
2 inches (51 mm)	08834161050	08834165154	08834164916	08834171167
3 inches (76 mm)	08834161064	08834165169	08834166187	08834171182
4 inches (102 mm)	08834161078	08834165184	08834164843	08834171197
5 inches (127 mm)	N/A	N/A	N/A	08834172024
6 inches (152 mm)	N/A	N/A	N/A	08834172053

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- 3M Corporation, St. Paul, MN, USA. Tel: 1-888-364-3577, Website: <http://www.3m.com/aerospace>. Local distributors are available globally. Refer to Table 205/REPAIR GENERAL for product identification.

Table 205: 3M Sandpaper Ordering Information

3M™ Roloc™ Quick Change P180 Grit Sanding Discs	
Disc Diameter	777F (Regalite™ Grit) Ordering Information
1 inch (25 mm)	051144-94188-9 777F ROLOC 1 INCH TR P180 GRIT
1 1/2 inches (38 mm)	051144-94188-9 777F ROLOC 1.5 INCH TR P180 GRIT
2 inches (51 mm)	051144-83474-7 777F ROLOC 2 INCH TR P180 GRIT
3 inches (76 mm)	051144-94188-9 777F ROLOC 3 INCH TR P180 GRIT
Disc Diameter	361F (Aluminum Oxide Grit) Ordering Information
1 inch (25 mm)	051111-61023-7 361F ROLOC 1 INCH TR P180 GRIT
1 1/2 inches (38 mm)	051135-14039-0 361F ROLOC 1.5 INCH TR P180 GRIT
2 inches (51 mm)	051144-13873-9 361F ROLOC 2 INCH TR P180 GRIT
3 inches (76 mm)	051135-14039-0 361F ROLOC 3 INCH TR P180 GRIT
3M Stikit™ 180 Grit Sanding Discs	
Disc Diameter	300D (Aluminum Oxide Grit) Ordering Information
5 inches (127 mm)	051111-50454-3 300D STIKIT 5 INCH 180 GRIT
6 inches (152 mm)	051111-50463-5 300D STIKIT 6 INCH 180 GRIT
Disc Diameter	900DZ (Cubitron™ Ceramic Grit) Ordering Information
5 inches (127 mm)	051111-49642-8 900DZ STIKIT 5 INCH 180 GRIT
6 inches (152 mm)	051111-29351-5 900DZ STIKIT 6 INCH 180 GRIT

C. Prepare the repair area for the Boegel (AC-130) Prebond Treatment procedure.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (1) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.
 - (2) Abrade the surfaces with Scotch Brite, Type A, very fine pads or a high grade alumina sand paper (180-grit or finer). The metal surface will look clean when you finish this step of the process.
 - (3) Remove the unwanted abrasive particles from the surface. Use clean dry air or nitrogen.
 - (4) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.
- D. Mix the components of kit as given in the manufacturer's instructions. Use a kit size that is the best for the area to be treated. Example: approximately 50 ml of the Boegel (AC-130) solution is satisfactory to treat 200 square inches (1300 square cm) of bond zone. Scale it up if necessary.
- (1) 30 minutes after you mix the components, you can apply Boegel (AC130) to the surface to be treated.

NOTE: 30 minutes is the minimum time necessary for the components to react.

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- (2) Use the mixture after the abrade steps that follow, but not after 10 hours.

CAUTION: USE THE SANDPAPER THAT IS SPECIFIED IN THIS PROCEDURE. SOME TYPES OF SANDPAPER CAN CAUSE A WEAK BOND.

- E. Fully abrade the repair area again.

NOTE: This procedure is necessary to remove the metal oxide layer on the aluminum and make the surface reactive for the Boegel (AC-130).

- (1) Use a random orbital sander or die grinder.
 - (a) Make sure that the sander or grinder will not get oil contamination on the sandpaper or the bond surface.
 - (b) Only use a sander or grinder that has a vented or filtered exhaust for the dust particles.
- (2) Get approved sandpaper specified in Paragraph 14.B.(5)/REPAIR GENERAL. Use 2.0 inch (50 mm) diameter discs for the procedure that follows or refer to Figure 207/REPAIR GENERAL for alternative disc diameters and sanding procedures.
- (3) Refer to Figure 207/REPAIR GENERAL and do the steps that follow for a 40 square inch (260 square cm) surface area:
 - (a) With a 2.0 inch (50 mm) diameter disc, move the sander/grinder in one direction on the panel surface.
 - (b) Change the sandpaper after 30 seconds. Change the direction of movement by 90 degrees.
 - (c) Make sure that all of the repair area is fully abraded, including the edges.
 - (d) After all of the surface has been abraded, change the sandpaper and fully abrade the surface again. Move the sander in a diagonal direction (with a grinder) or random direction (with a sander) on all of the panel surface.
- (4) If you are doing a surface preparation on more than 40 square inches (260 square cm) you can do the diagonal or random pattern with one sheet of sandpaper. Example: If you treat a section that is 80 square inches (520 square cm) do the steps that follow:
 - (a) Abrade the surface in one direction for a minimum of 30 seconds.
 - (b) Change the sandpaper, and then abrade in a 90 degree direction for a minimum of 30 seconds. Then change the sandpaper again. Repeat this for a total treatment time of 2 minutes, minimum (with 4 sheets of sandpaper).
 - (c) Then, change the sandpaper and abrade all of the surface for 30 seconds more in a diagonal direction (with a grinder) or a random direction (with a sander).

NOTE: You can abrade a maximum of 200 square inches (1300 square cm) with the last sheet of sandpaper. Do not abrade the surface for more than 30 seconds with this last sheet of sandpaper. See Figure 207/REPAIR GENERAL for an example of how to prepare a surface of 200 square inches (1300 square cm).

- (5) Do a visual inspection. The surface should have a fully abraded appearance. If not, do the abrade steps again.
- (6) Remove the loose grit residue with clean, dry compressed nitrogen or air.

NOTE: Do not do a water-break-free test. Do not rinse off the loose grit. Do not touch the surface of the abraded area with your bare hands. Keep the surface clean and dry until you apply the Boegel (AC-130) Solution.



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- (7) Apply the Boegel (AC-130) solution in less than 30 minutes after you complete the abrade steps.

NOTE: After 30 minutes the surface will begin to oxidize. If you do not apply the Boegel (AC-130) in less than 30 minutes after you completed the abrade steps, you will need to do the abrade steps again to remove the oxide layer.

WARNING: DO NOT PERMIT THE BOEGEL (AC-130) SOLUTION TO TOUCH YOUR FACE OR EYES. USE APPROVED PROTECTION PROCEDURES. IF THE SOLUTION TOUCHES THESE AREAS, IRRITATION TO THE EYES AND SKIN CAN OCCUR.

F. Apply the Boegel (AC-130) solution.

- (1) Put on a mask to seal all areas where the damage goes through a skin. To make the mask, put aluminum foil tape, solid FEP or other satisfactory material on top of the honeycomb.

NOTE: If you do a one-stage repair, make sure that the hole is filled before you put on the mask. Example: you can put the honeycomb repair core in the hole (without the core splice adhesive) or you can put in a solid plug.

- (2) Isolate the mechanical fasteners and all the other areas that are not damaged. Use aluminum foil tape or a combination of aluminum foil tape and polyethylene film (or the equivalent). This will prevent contamination.
- (3) Make sure that the temperature of the Boegel and aluminum part stays between 50° and 100°F (10° and 38°C) during the procedure.
- (4) Apply the solution to the bond surface to be treated with a clean, natural (non-metallic) bristle brush or with a sprayer.
- (5) Apply a sufficient quantity of solution to cause the solution to drain from the bond surface. Keep the bond surface fully and continuously wet with the solution for 2 minutes, minimum.
- (6) When the 2 minutes is completed, the wetted surface must look like a water-break-free surface.

NOTE: The solution surface tension at the edges of an aluminum skin can cause the solution film to pull away from the edge a small distance. This condition is permitted unless it is caused by surface contamination or incorrect abrading.

- (a) The solution film on the bond surface must stay continuous for a minimum of 30 seconds.
- (b) If the solution film does not stay continuous for a minimum of 30 seconds, there is surface contamination. Do the cleaning, abrasion and application steps again.
- (7) If the break-free surface test is satisfactory, then drain off the remaining solution.
- (8) If you see drops of solution in crevices, pockets, or other contained areas, then they must be removed.
- (a) Lightly blow off the drops of solution with filtered dry air, or
- (b) Carefully remove the drops with clean cheesecloth or other absorbent material that is moist with Boegel (AC-130).

NOTE: Do not rub or wipe the surface. Do not touch the surface with your bare skin or with gloves that have contamination on them.

- G. Let the treated surfaces dry at room temperature for 60 minutes, minimum. You can use an oven, heat lamp, or forced air that is oil-free and is no hotter than 160°F (71°C) to dry the parts.

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- H. Examine all of the treated surface. The surface must look dry and not have dust, fingerprints or other contamination. Use filtered forced air to remove dust. If there is contamination that cannot be removed with forced air, then clean, abrade, and do the Boegel steps again.

NOTE: It is possible that you see stains on the prepared surface after the surface is dry. These stains are permitted.

- I. If you put a mask on open honeycomb core during Paragraph 14.F.(1)/REPAIR GENERAL, then remove it now. Make sure that you do not touch the surface to be bonded. Do not let moisture get into the core cells. Make sure that the core is fully dry before you apply the adhesive primer.
- J. Keep the bond surface(s) clean if you cannot apply the adhesive primer immediately.
- (1) Do not touch the surface(s) with your bare skin, waxed paper, or material that has a release agent or other contamination.
 - (2) If protection of the surface(s) is necessary, then put vacuum bag film or unwaxed paper (without ink or other contamination on it) on the bond surface(s).
- K. If the bond surface gets contamination on it before you apply the primer, then clean the bond surface and do the Boegel (AC-130) procedure again.
- L. Apply BMS5-89, Type II or BMS5-137 Type I, Class 3 adhesive primer not later than 24 hours after you apply the Boegel (AC-130) solution. Refer to Paragraph 15./REPAIR GENERAL.

15. Application of BMS5-89 or BMS5-137 Adhesive Primer to the Bond Surface

A. Applicability and Limitations

- (1) Use BMS5-89 adhesive primer on surfaces to be bonded with BMS5-101 film adhesive.
- (2) Use BMS5-137 adhesive primer on surfaces to be bonded with BMS5-137 film adhesive.
- (3) Use only BMS5-89 Type II or BMS5-137 Type I, Class 3 adhesive primer on surfaces that used Boegel (AC-130) for the surface preparation.

NOTE: BR6747-1 primer (BMS5-89 Type II or BMS5-137 Type I, Class 3) is a one-part heat cured primer. The solids content in this primer can settle out of the solution. It must be thoroughly and completely mixed before use and it must be constantly agitated (shake each 3- 5 seconds) when you do the spray application.

- (4) Do not mix different types or classes of adhesive primer in the same container or apply different types or classes on the same bond surface.
- (5) Make sure that all spray equipment and other application tools are completely clean before you use them to apply an adhesive primer.

- B. Remove the primer from storage. Do not open the container until it is between 65° and 90°F (18° and 32°C).

NOTE: Refer to Boeing Process Specification BAC5514-589 "Application of Corrosion Inhibiting Adhesive Primer" or BAC5514-5137 "Structural Bonding with BMS5-137 Adhesives" for the storage and shelf life specifications. Do not use the primer if it has lumps, gelatin or other signs of deterioration.

WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

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(WARNING PRECEDES)

WARNING: DO NOT USE SOLVENT BASED PRIMERS IN AREAS WITH EQUIPMENT THAT PRODUCE HEAT OR A SPARK. IF YOU DO, AN EXPLOSION CAN OCCUR AND CAUSE INJURY.

CAUTION: PREVENT CONTAMINATION OF THE PARTS AFTER YOU DO A SURFACE PREPARATION. WEAR CLEAN GLOVES, OR USE HOOKS TO MOVE THE PARTS. DO NOT APPLY THE PRIMER IF THE TEMPERATURE IS LESS THAN 50°F (10°C) OR MORE THAN 85 PERCENT OF THE RELATIVE HUMIDITY. IF YOU DO NOT OBEY, THE RESULT CAN BE AN UNSATISFACTORY BOND.

- C. Mix the adhesive primer. Use the manufacturer's instructions, or Boeing Process Specification BAC5514-589 "Application of Corrosion Inhibiting Adhesive Primer" for mixing BMS5-89 primer or BAC5514-5137 "Structural Bonding with BMS5-137 Adhesives for mixing BMS5-137 primer.
- D. Apply the adhesive primer.

NOTE: BMS5-89 and BMS5-137 must be baked after it is applied. Because you cannot measure the thickness until after you bake, you need sufficient training or experience to know what a good thickness looks like (You can also use a visual reference standard, or you can do an experiment on an aluminum part that will not be used for the repair). It is permitted for you to apply BMS5-89 or BMS5-137 primer on painted surfaces adjacent to the bare aluminum surface. It is not necessary to measure the thickness of the primer that is applied to the painted surfaces adjacent to the bare aluminum. It is not necessary to measure the thickness of the primer on the edges of the repair parts or the edges of the removed damage area. You have a maximum of 120 hours to start the baking procedure.

- (1) Apply the primer to a thickness that will cure to the specified thickness range after baking. Refer to Paragraph 15.H./REPAIR GENERAL.

NOTE: It can be necessary to apply the primer two or more times to get it to the specified thickness. Continuously shake the container (that has the primer) each 3 to 5 seconds until the procedure is completed.

- (2) Apply the primer to the edges of the repair parts and the edges at the removed damage area.

CAUTION: DO NOT USE FORCED AIR ON THE WET SURFACE. DEFECTS AND DAMAGE TO THE PRIMER CAN OCCUR. PROTECT THE PRIMER FROM DUST OR OTHER CONTAMINATION. IF YOU DO NOT, THE STRENGTH OF THE REPAIR CAN BE REDUCED.

- E. Let the primer dry. If more than one side will have primer, make sure that the first side is dry before you apply primer to the second side.
 - (1) BMS5-89, Type I solvent based primer can be dried for 30 minutes at room temperature. As an alternative, you can dry the primer with a heat lamp that is no hotter than 200°F (93°C) until the primer is hard (tack-free).

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- (2) BMS5-89, Type II or III and BMS5-137 Type I, Class 2 and 3 water based primer can be dried at room temperature, or with a heat lamp until all of the water that you see is gone (the primer does not look wet).

NOTE: You can heat stabilize wet BMS5-89 Type II or BMS5-137 Type I, Class 3 primer on the first surface before you apply primer to the other surface. Apply 200°F (93°C) heat for 15 minutes. (Do not use forced air on wet primer). Then apply primer to the surface on the second side.

- (3) After BMS5-89 Type III or BMS5-137 Type I, Class 4 primer has dried, wait 15 more minutes (minimum) before you start to bake.

CAUTION: MAKE SURE THAT YOU KEEP DUST AND OTHER CONTAMINATION FROM THE PRIMED SURFACE BEFORE AND AFTER THE PRIMER IS CURED. THE PRIMER MAY NOT FULLY CURE UNTIL AFTER THE ADHESIVE FILM IS APPLIED AND CURED. IF YOU REMOVE CONTAMINATION FROM A PRIMED SURFACE THAT IS NOT FULLY CURED, YOU CAN CAUSE DAMAGE TO THE PRIMER.

F. Bake the primer with an oven, heat lamp, or hot air. Refer to Table 206/REPAIR GENERAL:

NOTE: As an alternative, you can do a two stage cure. First, bake the primer at 175°F (80°C) for 2 hours minimum. Then do the layup. The cure will be complete when the adhesive is cured.

Table 206: Cure Instructions for Adhesive Primers

PRIMER	CURE TEMPERATURE RANGE	CURE TIME
BMS5-89 Type I or Type II	240° ± 20°F (116° ± 12°C)	30 to 120 minutes
BMS5-89 Type III	250° ± 20°F (121° ± 12°C)	30 to 120 minutes
BMS5-137 Type I, Class 2	285° ± 15°F (141° ± 8°C)	60 to 120 minutes
BMS5-137 Type I, Class 3	260° ± 10°F (127° ± 6°C)	60 to 120 minutes
BMS5-137 Type I, Class 4	315° ± 10°F (157° ± 6°C)	60 to 120 minutes

NOTE: If a part with a primed surface will be stored before you apply the film adhesive, or if there is a possibility for damage or contamination to the primer, then: (1) Bake the primer at the highest temperature and longest time that is shown in Table 206/REPAIR GENERAL and (2) put a clean, protective cover over the primed surface (for example: you can use unwaxed, unprinted paper or vacuum bag material).

G. Calibrate your primer thickness measurement tool.

NOTE: You can use an eddy current procedure, or a procedure that gives the equivalent satisfactory results. There are electronic coating thickness gauges available that use eddy current, ultrasound, and other technology that are not sold by The Boeing Company. You are permitted to use any applicable technology that can accurately and precisely measure paint thickness. Make sure that you follow the manufacturer's instructions.

- (1) Do a calibration test on a measurement tool every time that you do a repair procedure. Do a calibration test for each metal alloy and gage thickness. Do a calibration test every time you measure the thickness of a different primer type.
- (a) Measure the primer thickness on a primer thickness standard that has the same metal gage thickness and the same aluminum alloy as the airplane or repair part that has primer to be measured.

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- (b) Make sure that the primer thickness on the primer thickness standard is precisely known and is of the same primer type as the primer on the airplane or repair part.
- (2) If the measurement agrees with the known primer thickness on the primer thickness standard, then you are permitted to use the measuring tool on airplane and repair parts.
- H. Measure the primer thickness after the primer has cooled to ambient temperature.

NOTE: If you are not sure if the primer was baked sufficiently, you can do a solvent wipe test. Put a small amount of MEK solvent on the primed surface and let it stay for approximately 5 seconds. Rub the solvent off with a clean cloth. Continue to rub the surface for approximately 5 seconds. Some primer will come off on to the cloth. This is permitted if bare metal does not show. If bare metal shows after the surface is rubbed, then the primer must be removed from all of the surface to be bonded, and you must do the surface preparation and primer procedure again.

- (1) Refer to the baked thickness ranges that follow for the different primer options:
 - (a) BMS5-89, all Types: 0.00015 and 0.00040 inch (0.004 and 0.010 mm)
 - (b) BMS5-137 Type I, Class 2: 0.00020 and 0.00035 inch (0.005 and 0.009 mm)
 - (c) BMS5-137 Type I, Class 3: 0.00015 and 0.00035 inch (0.004 and 0.009 mm)
 - (d) BMS5-137 Type I, Class 4: 0.00015 and 0.00040 inch (0.004 and 0.010 mm)
- (2) If the primer is not at the specified thickness, then you must remove the primer.
 - (a) Do one of the applicable surface preparations in Paragraph 11./REPAIR GENERAL and put adhesive primer on the bond surface again.
 - (b) Bake the primer. Let the primer cool to ambient temperature and measure the thickness again.
- (3) If the thickness is satisfactory, apply the adhesive as given in Paragraph 18./REPAIR GENERAL or Paragraph 19./REPAIR GENERAL.

16. Hydrofluoric Acid (HF) - Alodine Procedure

NOTE: This surface preparation procedure has size limits. Refer to Figure 201/REPAIR GENERAL.

- A. The materials that you need are:
 - (1) Hydrofluoric Acid (HF)
 - (2) 3M Scotch-Brite, Type A, very fine pads or a high grade alumina sandpaper (180-grit or finer)
 - (3) Aluminum Foil Tape
 - (4) Solid FEP
 - (5) Cheesecloth, gauze or clean cotton rags, or BMS5-15 Class A wipers
 - (6) Blue litmus paper
 - (7) Alodine 1200
 - (8) Acetone or Methyl Propyl Ketone (MPK) Solvent
- B. Clean and abrade the repair surfaces.



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WARNING: DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE OR CAUSE DAMAGE TO THE ENVIRONMENT. REFER TO THE MATERIAL SAFETY DATA SHEETS (MSDS) AND THE LOCAL SAFETY PRECAUTIONS.

- (1) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.
- (2) Abrade the surfaces with Scotch Brite, Type A, very fine pads or a high grade alumina sand paper (180-grit or finer). The metal surface should look clean when you finish this step of the process.
- (3) Remove the unwanted abrasive particles from the surface. Use clean dry air or nitrogen.
- (4) Do a solvent wipe with MPK or acetone as given in SOPM 20-30-03.

CAUTION: DO NOT PERMIT THE ACID SOLUTION TO TOUCH OTHER SURFACES ADJACENT TO THE REPAIR BOND AREAS. IF IT DOES, THE RESULT CAN BE DAMAGE TO THE PAINT AND ADHESIVE SYSTEMS.

- (5) Isolate the mechanical fasteners and all the areas that are not damaged, with aluminum foil tape or a combination of aluminum foil tape and polyethylene film (or the equivalent). This will prevent acid contamination.
- (6) Put on a mask to seal all areas where the damage goes through a skin. To make the mask, put aluminum foil tape, solid FEP or other satisfactory material on top of the honeycomb.

NOTE: If you do a one-stage repair, make sure that the hole is filled before you put on the mask. Example: you can put the honeycomb repair core in the hole (without the core splice adhesive) or you can put in a solid plug.

- (7) Flush with clean water and/or wipe with a clean, lint-free cloth until no visible residue appears on the cloth.

C. Do a visual inspection for a water-break-free surface.

- (1) Flush the surface with clean (mineral-free or de-ionized) water. Do this for 30 seconds or until the surface has a continuous water film on all of the repair area.

NOTE: The preferred water temperature is between 50° and 100°F (10° and 38°C).

- (2) After the flush procedure is completed, the water film on the bond surface must stay continuous for a minimum of 30 seconds.

NOTE: The water surface tension at the edges of an aluminum skin can cause the water film to pull away from the edge a small distance. This condition is permitted unless it is caused by visible surface contamination or incorrect abrading.

- (3) If the film does not remain continuous for a minimum of 30 seconds, do Paragraph 16.B./REPAIR GENERAL and Paragraph 16.C./REPAIR GENERAL again.

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WARNING: DO NOT BREATHE THE FUMES WHEN YOU DO WORK WITH HYDROFLUORIC ACID SOLUTIONS. USE MECHANICAL AIRFLOW AND RESPIRATORY PROTECTION. DO NOT LET THE SOLUTIONS TOUCH YOUR EYES OR SKIN. WEAR GLOVES AND PROTECTIVE CLOTHING. IF YOU DO NOT OBEY, YOU CAN CAUSE SKIN IRRITATION OR INJURY. IF THE SOLUTION TOUCHES YOUR EYES, CLEAN WITH A LARGE QUANTITY OF WATER AND GET MEDICAL AID IMMEDIATELY.

- D. Prepare the Alodine 1200 solution as given in 51-20-01, GENERAL. Let it stay mixed for one hour before you use it.

NOTE: A dirty solution is not satisfactory for use. Prepare the solution in small quantities. Discard the solution if you do not use it before 24 hours or if the solution is dirty. If you use non-distilled water, then add nitric acid to control the pH of the solution. For the Alodine 1200 product, the pH must be between 1.5 and 2.0. Use pHydron papers to check the pH of the solution.

- E. Do the HF acid etch procedure.

- (1) Make sure that the temperature of the HF acid and the aluminum part stays between 50° and 100°F (10° and 38°C) during the etch procedure.
- (2) Make a clean cloth moist, but do not soak it, with a 2 percent solution of HF acid. Rub the bonding surface area with the moist cloth. Let the solution stay on the surface for 15 to 30 seconds.
- (3) Quickly rub mating surfaces of the bond area with the moist cloth.
- (4) Let the HF solution stay on the surface for approximately 15 to 30 seconds.
- (5) Quickly remove the solution with a cloth moist with clean water.

NOTE: Do not permit the cloth to touch the etched surface for more than 2 minutes. Do not permit the cloth to touch surfaces that were not etched with the HF solution and then to touch the etched surfaces. This will cause contamination of the etched surfaces.

- F. Apply the Alodine solution to the etched area as given in 51-20-01, GENERAL.

NOTE: Do not permit the etched surfaces to dry before you apply the chemical conversion coating.

- (1) Make sure that the temperature of the Alodine and the aluminum part stays between 50° and 100°F (10° and 38°C) during the procedure.
- (2) Apply the Alodine solution to the etched area in less than 60 seconds after the HF acid etch procedure is completed.
 - (a) Apply the Alodine solution with a fiber or nylon brush, or clean, dry cheesecloth.

NOTE: Make sure that you apply a sufficient quantity of chemical conversion coating to give a smooth layer.

- (b) Make sure that the etched area stays moist with Alodine solution for 3 to 4 minutes.



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CAUTION: USE CARE WHEN YOU RINSE THE COATED SURFACE. IF YOU DO NOT, THE RESULT CAN BE AN UNSATISFACTORY CHEMICAL CONVERSION COATING. THE NEW COATING IS FRAGILE AND CAN BE EASILY DAMAGED.

- (3) Rinse the area with a moist, but not soaked, cheesecloth. Make sure that the cheesecloth and water are clean.

NOTE: Lightly touch the surface for 1 to 2 minutes. Then, do it again with another clean moist cheesecloth to remove more of the solution from the surface. Do not wipe the surface.

- (4) Do a check of the repair area to see if acid remains on the surface.
- (a) Look at the repair surface and all of the crevices in the repair area.
 - (b) If you see moisture, use blue litmus paper to make sure that there is no acid on the surface or in the crevices.

NOTE: If the litmus paper remains blue then remove the moisture and continue with the procedure. If the litmus paper changes to a red color, then acid remains on the surface. You must do Paragraph 16.F.(3)/REPAIR GENERAL and Paragraph 16.F.(4)/REPAIR GENERAL again until the litmus paper remains blue.

CAUTION: USE CARE WHEN YOU DRY THE COATED SURFACE. DO NOT WIPE OR RUB THE SURFACE. THE NEW COATING IS FRAGILE AND CAN BE EASILY DAMAGED.

- (5) Carefully dry the surface with clean dry cheesecloth to remove the rinse water. If necessary, do this again to remove the water from the surface.

WARNING: DO NOT PERMIT THE CHEMICAL CONVERSION COATING TO DRY ON THE BRUSHES OR CHEESE CLOTH. MAKE SURE THAT YOU WASH ALL OF THE COATING FROM THE FROM THESE MATERIALS BEFORE IT IS DRY. WRING OUT THE MATERIALS AND PUT THEM INTO A FIRE-PROOF CONTAINER. IF YOU DO NOT, THE RESULT CAN BE A CHEMICAL FIRE CAUSED BY SPONTANEOUS COMBUSTION.

- (6) Do not put materials that have Alodine on them in the same container with materials that have solvent on them.
- (a) Wash all of the Alodine from the materials used for the application, before the materials are discarded.
 - (b) Discard the materials in an approved container. Use a procedure to discard these materials that is permitted by your local safety, health, and environmental authorities.
- (7) Permit the surfaces to fully air-dry. You are permitted to use filtered hot air up to a maximum of 130°F (54°C). A minimum 15 minutes is recommended.

NOTE: You must apply the final finish or start the adhesive procedures as soon as possible after the chemical conversion coating is dry. Wear clean gloves to keep contamination from the part.

- G. Do a visual check of the repair surface for a powdery coating. All Alodine coatings must be free of powder.

- (1) If you find a powdery coating on the surface, then you must do Paragraph 16.F.(3)/REPAIR GENERAL through Paragraph 16.F.(7)/REPAIR GENERAL and Paragraph 16.G./REPAIR GENERAL again until the surface is free of powder.

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- (2) If the surface is free of powder, then continue with the procedure.
- H. If you put a mask on open honeycomb core during Paragraph 16.B.(6)/REPAIR GENERAL, then remove it now. Make sure that you do not touch the surface to be anodized. Do not let moisture get into the core cells.
- (1) Do a visual check for moisture in the cells. If you see moisture, use blue litmus paper to make sure that there is no acid contamination.
- (a) If the litmus paper changes to a red color, there is acid contamination in the core cells. Flush the core with water. Use more blue litmus paper and do a check for acid again.
- (b) If the litmus paper stays blue, there is no acid in the core. Remove the moisture, then continue with the procedure.
- (2) Make sure that the core is fully dry before you apply the adhesive primer.
- I. Keep the bond surface(s) clean if you cannot apply the adhesive primer immediately.
- NOTE:** If the bond surface becomes contaminated before you apply the primer, then clean the bond surface and do the HF - Alodine procedure again.
- (1) Do not touch the surface(s) with your bare skin, waxed paper, or material that has a release agent or other contamination.
- (2) If protection of the surface(s) is necessary, then put vacuum bag film or unwaxed paper (without ink or other contamination on it) on the bond surface(s).
- J. Apply the BAC5710, Type 60 adhesive primer not later than 24 hours after you apply the Alodine. Refer to Paragraph 17./REPAIR GENERAL.

17. Application of BAC5710, Type 60 Adhesive Primer

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WARNING: DO NOT USE SOLVENT BASED PRIMERS IN AREAS WITH EQUIPMENT THAT PRODUCE HEAT OR A SPARK. IF YOU DO, AN EXPLOSION CAN OCCUR AND CAUSE INJURY.

- A. Mix the Courtaulds Aerospace 515X346 primer with 910X520 catalyst and the 020-702 thinner. Refer to Table 207/REPAIR GENERAL for the mixture ratio of the primer components.

Table 207: Necessary Mix Ratio for the BAC5710, Type 60 Primer Components

COMPONENTS	MIX RATIO BY VOLUME
515X346 Base	4 parts
910X520 Catalyst	1 part
020-702 Thinner	4 parts

- B. Prepare the mixture as given in the manufacturer's instructions.
- (1) Permit the mixture to stay at room temperature for 30 minutes before you apply it to the surface.
- (2) Apply the primer before 60 minutes after you apply the chemical conversion coating to the repair area.

NOTE: Do not apply the primer if its pot-life has expired (8 hours at 77°F (25°C)).

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CAUTION: PREVENT CONTAMINATION OF THE PARTS AFTER YOU DO A SURFACE PREPARATION. WEAR CLEAN GLOVES, OR USE HOOKS TO MOVE THE PARTS. DO NOT APPLY THE PRIMER IF THE TEMPERATURE IS LESS THAN 50°F (10°C) OR MORE THAN 85 PERCENT OF THE RELATIVE HUMIDITY. IF YOU DO NOT OBEY, THE RESULT CAN BE AN UNSATISFACTORY BOND.

- C. Apply a layer of primer to the surface to give a 0.0002 to 0.0008 inch (0.005 to 0.020 mm) dry film thickness.
- D. Measure the primer thickness with an eddy current procedure, or a procedure that uses a visual standard, or with a procedure that gives the equivalent satisfactory results.

NOTE: If the primer is more than the specified thickness, then you must remove the primer, do the HF - Alodine procedure, and apply the primer again. Do not continue unless you have the correct primer thickness. If a second layer of the primer is necessary, permit the first layer to air dry for 1 hour before you apply the second layer.

- E. Permit the primer to air dry at a temperature between 70°F and 90°F (21°C and 32°C) for 60 to 90 minutes before you apply the adhesive.
 - (1) Keep the primed mating surfaces free from contamination and sunlight.
 - (2) Do not store the primed mating surfaces for more than 7 days before you make the bond.
 - (3) Do not wipe the primed mating surfaces with solvent before you make the bond.

18. Application of BMS5-101 or BMS5-137 Film Adhesive

A. Applicability and Limitations

- (1) 250°F (121°C) Repair - Use BMS5-101 Type II Film Adhesive. This repair option can be used on panels that were initially manufactured at 250°F (121°C).
- (2) 310°F (154°C) Repair - Use BMS5-137 Type II (EA 9657 only). This repair option can be used on panels that were initially manufactured at 350°F (177°C).
- (3) 350°F (177°C) Repair - Use BMS5-137 Type II Film Adhesive. This repair option can be used on panels that were initially manufactured at 350°F (177°C).

NOTE: Use a pressurized autoclave when you do the 350°F (177°C) cure.

- B. Make a clear plastic template that shows the size and shape of the largest external doubler and the damage cutout. Use the template to make ink marks on the primed surface where the largest external doubler must be put.

NOTE: Use a water-resistant, alcohol based ink pen that will not contaminate or damage the primer or the adhesive. You can use a Sharpie™ SAN30000, SAN35000, or SAN37000 Series fine point pen (or an equivalent pen). Sharpie™ pens are a trademark of the Sanford Corporation.

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- C. Make sure that you do these application steps in a clean area. Use a tabletop or other non-airplane component work surface when you cut adhesive film.
 - (1) Clean all the work surfaces, templates, and tools with solvent. Remove all contamination. Refer to SOPM 20-30-03.

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- (2) If necessary, you can put clean vacuum bag film on the work surface to keep contamination off the adhesive.
- D. BMS5-121 Positioning Fabric applicability and limitations.
- (1) BMS5-101 Type II film adhesive:
- (a) BMS5-121 positioning fabric will be necessary when you use BMS5-101 Type II film adhesive and the vacuum bag procedure on an external doubler that has more than 64 square inches (400 square cm) of surface area. (You can also use positioning fabric with doublers that have less than 64 square inches (400 square cm) of surface area).
- NOTE:** Positioning fabric does not improve nor harm a repair that is cured in an autoclave.
- (b) If two sides of a honeycomb panel are repaired with external doublers, it is not necessary to use positioning fabric on more than one side of the honeycomb core. If you do a flush repair, put the positioning fabric on the side of the honeycomb core that has the external doubler.
- NOTE:** Positioning fabric will be necessary on each side of the panel if two or more external doublers are necessary for each side of the panel. Refer to Paragraph 18.E.(2)/REPAIR GENERAL.
- (2) BMS5-137 Type II film adhesive:
- (a) Do not use BMS5-121 positioning fabric over open core when you use BMS5-137 Type II film adhesive.
- NOTE:** BMS5-137 film adhesive does not flow sufficiently to make good core fillets.
- (b) BMS5-121 positioning fabric will be necessary when you use BMS5-137 Type II film adhesive and the vacuum bag procedure on an external doubler that has more than 64 square inches (400 square cm) of surface area and no open core. (You can also use positioning fabric with doublers that have less than 64 square inches (400 square cm) of surface area).
- NOTE:** Positioning fabric does not improve nor harm a repair that is cured in an autoclave.
- (c) BMS5-121 positioning fabric will be necessary when you use BMS5-137 Type II film adhesive when you use a vacuum bag procedure on an external overlap of more than 3.0 inches (75 mm) from open honeycomb core and the total doubler area is 64 square inches (400 square cm) (or more) of surface area.
- E. Do the step that follows if BMS5-121 positioning fabric is necessary. Refer to Figure 213/REPAIR GENERAL and the steps that follow:
- (1) Put a layer of BMS5-121 positioning fabric between the surface to be repaired and the repair doubler. Cut the fabric so that the edge of the fabric is 0.5 inch (13 mm) minimum, from all edges of the repair doubler.
- (2) Put positioning fabric between each doubler when more than one doubler is necessary for the repair. Cut the fabric so that the edge of the fabric is 0.5 inch (13 mm) minimum, from all edges of each repair doubler.
- F. Cut the film adhesive. Refer to Figure 213/REPAIR GENERAL for the steps that follow:



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- (1) Use only certified film adhesives from the Boeing Material Specification Qualified Products List (QPL).

NOTE: A manufacturer can make an adhesive film material that can be qualified to BMS5-129 and/or to BMS5-101 and be listed in each Qualified Products List (QPL). Do not use a BMS5-129 material for a metal bond repair unless the material has been tested and certified to the BMS5-101 specification also.

- (2) Keep the bag that contains the roll of film adhesive at room temperature until there is no condensation on the bag.

NOTE: Do not touch the adhesive with your bare skin. Wear gloves to protect the adhesive from contamination.

- (3) Put the film adhesive on a clean work surface. Make sure that the film adhesive side that is against the work surface has a separator sheet.

- (a) If you use BMS5-101 Type II, OST with BMS5-121 positioning fabric, make sure that the mat side is up, tacky side down, against the work surface. If you use OST without the positioning fabric, make sure that the tacky side is up, mat side down, against the work surface.

NOTE: OST film adhesive has a mat carrier cloth on one of the outer surfaces, thus producing one side that is more tacky than the other side. Non-OST mat or knit film adhesive has a carrier cloth in the middle of the adhesive, thus both sides are equally tacky. Both OST and Non-OST can be used with BMS5-121 positioning fabric.

- (b) If you are using Grade 5 film adhesive, then put two plies on the work surface. Make sure that you remove the separator sheet (or sheets) between the plies.

- (c) If you are using Grade 10 or 15 film adhesive, then put one ply on the work surface.

NOTE: Do not use Grade 15 film adhesive to bond parts that have a gage thickness of 0.020 inch or less.

- (4) Put the repair part with the surface to be bonded against the adhesive. If there is a separator sheet on top of the adhesive, make sure that it is removed.
- (5) Cut the film adhesive all around the repair part with a sharp knife. Let the film adhesive extend 0.01 to 0.1 inch (0.3 to 2.5 mm) from the edge of the repair part.
- (6) If you are using Grade 5 or 10 film adhesive, and the repair has an open core, then cut a piece of adhesive to the same dimensions as the open core. (Do not do this step if you are using a Grade 15 film adhesive).

- G. Put the BMS5-121 positioning fabric (when specified) on to the area to be repaired. Make sure that the edges of the fabric go past the marks that were made in Paragraph 18.B./REPAIR GENERAL a minimum of 0.5 inches (13 mm).

NOTE: If you can not see the marks through the fabric, then use the template again to make marks that will show the position of the largest external doubler.

- H. Put each of the repair parts (one at a time and in the correct sequence) on to the surface to be repaired. Refer to Figure 213/REPAIR GENERAL and the applicable repair procedure in Table 202/REPAIR GENERAL.

- (1) Remove the separator sheet from each repair part before it is installed.
 - (2) Apply equal and light finger pressure to each repair part as it is installed.
 - (3) Apply small pieces of high-temperature polyester tape (or equivalent) to the edges of the repair part(s) to hold the part(s) on to the part to be repaired.

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I. Do the instructions that follow to assemble the vacuum bag. Refer to Figure 215/REPAIR GENERAL.

- (1) Put a breather strip all around and against the edges of the largest external repair doubler.

NOTE: Put the breather strips on the BMS5-121 positioning fabric (when the fabric is specified).

- (2) Put a minimum of four thermocouples at the edges of the repair doubler(s) as given in Figure 214/REPAIR GENERAL.

NOTE: Use thermocouples and a measurement system that can measure temperature to a minimum accuracy of $\pm 5^{\circ}\text{F}$ ($\pm 3^{\circ}\text{C}$).

- (3) Connect the thermocouples to the applicable temperature recorder devices.
- (4) Get a heat blanket that is a minimum 2 inches (50 mm) larger all around than the largest repair doubler.
- (5) Use the heat blanket dimensions to find the correct dimensions of the layup and bagging materials.
- (a) Cut two layers of dry peel ply that are 2 inches (50 mm) larger all around than the dimensions of the heat blanket. Put one of the dry peel plies on the repair part(s). Make sure that the edges of the peel ply extend an equal distance from the edges of the largest repair doubler.
- (b) Cut a layer of solid or perforated FEP parting film to the same dimensions as the heat blanket. Put the parting film on to the dry peel ply. Make sure that the edges of the parting film are an equal distance from the edges of the peel ply.
- (c) Put the second dry peel ply on to the first peel ply and the parting film. Make sure that the edges of the second peel ply are against the edges of the first peel ply.
- (6) Protect the component to be repaired from too much heat.
- (a) If there are attached fittings on the part to be repaired, then put insulation material between the attached fittings and the heat blanket.
- (b) If the heat blanket extends more than 3.0 inches (75 mm) from the edge of the damage cutout, you can do this recommended procedure:
- NOTE:** If a heat blanket gets too hot, it can cause damage to the repair and to the adhesive in the undamaged skin. To help prevent damage (if the heat blanket gets too hot), do not let the heat blanket touch more skin than is necessary. Insulation between the heat blanket and the skin is recommended.
- 1) Put one edge of each insulation material on the skin, 2.0 to 3.0 inches (50 to 75 mm) from the edge of the damage cutout.
- 2) Put the opposite edge of each insulation material where the edges of the heat blanket will be.
- (7) Put the heat blanket on to the top peel ply. Make sure that edges of the heat blanket are an equal distance from the edges of the peel ply (and the insulation, if applicable).
- (8) Put four to six layers of glass fabric (or two layers of 0.04 inch (1.0 mm) breather fabric, or one layer of 0.1 inch (2.5 mm) breather fabric) above the heat blanket as a breather. Make sure that the breather is 2 inches (50 mm) larger all around than the heat blanket.
- (9) Put a vacuum base above the fiberglass breather cloth for each vacuum port and vacuum gage port.
- (10) Put on the vacuum bag sealant.



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- (a) You can put the vacuum bag sealant all around the area to be repaired, or
- (b) If you use an envelope bag procedure, then seal the open part of the bag with the sealant.
- (11) Make a hole in the outer vacuum bag at the vacuum base location for each vacuum port and vacuum gage port.
- (12) Put the vacuum bag film on the repair area.
- (13) Connect the vacuum port and vacuum gage ports to their vacuum bases.

NOTE: A procedure to remove the vacuum source will be necessary, that will not decrease the vacuum in the bag. If necessary, put a valve on the vacuum line between the vacuum bag and the vacuum source.

- (14) If necessary, put insulation material on the outer surface of the vacuum bag.

19. Application of BMS5-92 or BMS5-141 Paste Adhesive

NOTE: Only small repair sizes can use these adhesives. Refer to Figure 201/REPAIR GENERAL for permitted repair sizes.

- A. Make a clear plastic template that shows the size and shape of the largest external doubler and the damage cutout. Use the template to make ink marks on the primed surface where the largest external doubler must be put.

NOTE: Use a water-resistant, alcohol based ink pen that will not contaminate or damage the primer or the adhesive. You can use a SharpieTM SAN30000, SAN35000, or SAN37000 Series fine point pen (or an equivalent pen). SharpieTM pens are a trademark of the Sanford Corporation.

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CAUTION: MAKE SURE THAT YOU DO THIS PROCEDURE IN A CLEAN AREA. DO NOT LET CONTAMINATION OF THE REPAIR PARTS OCCUR. IF YOU DO NOT OBEY, YOU CAN CAUSE AN UNSATISFACTORY REPAIR.

- B. Clean the work area, templates, and tools with solvent before you start to apply the adhesive. Refer to SOPM 20-30-03 for the applicable solvents and procedures.

CAUTION: DO NOT MIX MORE THAN 450 GRAMS OF BMS 5-141 AT ONE TIME. IF YOU DO, AN EXOTHERMIC REACTION (A BUILD-UP OF HEAT) CAN OCCUR. THE RESULT CAN BE DAMAGE TO THE ADHESIVE.

- C. Use one of the adhesives that follow:

- (1) BMS5-92
 - (a) Type V, Class 1 or Class 2 (preferred).
 - (b) Type I, Class 4 (alternative).
- (2) BMS5-141

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- D. Refer to the manufacturer's instructions to mix paste adhesives. Tap the container or use a satisfactory procedure to remove air bubbles from the mixture.

NOTE: As an aid to make sure that you get the necessary thickness on the bond surface, you can add up to 1 percent by weight of 0.005 inch (0.13 mm) diameter glass beads. Mix the glass beads with the Part B hardener before you add the Part A base.

- E. Apply a thin, smooth layer of paste adhesive to all of the mating surfaces.

NOTE: Do not touch the adhesive with your bare skin. Wear gloves to protect the adhesive from contamination.

- (1) Make sure that the mating surfaces have adhesive primer on them before you apply the paste adhesive.
- (2) After you mix the adhesive, apply the mixture to the repair parts as soon you can, but not after the pot-life has expired. Make sure that the mating surfaces have sufficient adhesive so that it will squeeze out from the edges of the repair part(s) when you mate them.
- (3) After you apply the adhesive, you have a maximum of 5 minutes to mate the repair parts(s). (After 5 minutes, the adhesive will get a thin, cured skin layer on it, that will make it difficult to get a good bond).

- F. Install the repair parts.

- (1) Put the repair parts into their correct positions.

NOTE: Use a satisfactory procedure to remove air bubbles from that can be below each repair part. For example, you can put one edge of the repair part on the component. Then slowly put the repair part on the adhesive.

- (2) Apply a equal and continuous pressure of 1 psi (7 kPa) minimum, to the surface of the repair parts. Let the adhesive squeeze out all around the edges.

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- G. Clean all of the unwanted adhesive from the repair parts with solvent before you continue with the cure. Refer to SOPM 20-30-03 for the applicable solvents and procedures. Remove all of the contamination.

NOTE: Do not permit the solvent to get in the bond line.

20. Cure the bond

- A. If you use an autoclave or oven:

NOTE: Go to step Paragraph 20.B./REPAIR GENERAL if you will do a heat blanket cure. Do not cure paste adhesives in a pressurized autoclave. Use an oven or go to step Paragraph 20.C./REPAIR GENERAL if you are curing a paste adhesive.

- (1) Remove all aluminum attached fittings and hinges from the panel to be repaired. If the panel (to be repaired) is attached to other structure that does not need a bonded repair, then disassemble the parts. Put only the panel (to be repaired) inside of an oven or autoclave.



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- (2) Make sure that you use an applicable tool to hold all of the parts in their positions during the repair procedure.

NOTE: In most (but not all) conditions, the tool must be the same contour as the part to be cured.

- (3) If an oven is used, then use a circulating oven that has equipment that can supply a vacuum and control the temperature. If you are curing a paste adhesive, use a tool or weight to put 1 psi (7 kPa) minimum pressure on the part. Use the vacuum bag procedure as specified in Paragraph 20.B./REPAIR GENERAL (but without the heat blanket). Then go to step Paragraph 21./REPAIR GENERAL.
- (4) If an autoclave is used, then increase the pressure and temperature in the autoclave as specified in Boeing Process Specification BAC5514 "Common Bonding Requirements for Structural Adhesives" (or equivalent procedure).
- (5) Cure the bond as given in Table 208/REPAIR GENERAL.
- (6) After the cure is completed, decrease the pressure and temperature in the autoclave as specified in Boeing Process Specification BAC5514 "Common Bonding Requirements for Structural Adhesives" (or equivalent procedure).
- (7) Examine the repair as specified in Paragraph 21./REPAIR GENERAL.

B. Vacuum bag and heat blanket procedure for film adhesives.

- (1) Remove some of the air out of the honeycomb core before you start the cure.
 - (a) Use an initial vacuum of 3 to 5 inches (7.6 to 12.7 cm) of mercury (Hg) for 15 minutes.
 - (b) Apply a vacuum to a minimum of 22 inches (56 cm) of mercury (Hg) for 1 minute.
- (2) Do an inspection of the vacuum bag. Look for leaks in the vacuum bag.

NOTE: A vacuum bag that has a leak can cause porosity in the adhesive and a weak bond.

- (a) Remove the vacuum source.

NOTE: Do not disconnect the vacuum line(s). This can cause a loss of vacuum in the bag.

- (b) Monitor the vacuum gage. After 5 minutes, the total difference in the vacuum must be less than 5 inches of (12.7 cm) of mercury (Hg).

WARNING: USE ONLY EXPLOSION-PROOF EQUIPMENT WHEN YOU DO THESE TYPES OF REPAIRS. IF YOU DO NOT, PERSONAL INJURY AND DAMAGE TO ADJACENT EQUIPMENT CAN BE THE RESULT. WHEN YOU WORK WITH FLAMABLE MATERIALS, HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION.

- (3) Cure the bond as given in Table 208/REPAIR GENERAL.
 - (a) You can use hot air, heat lamps, or a radiant heater with the heat blankets, if necessary.
 - (b) Start to measure the cure time after the thermocouples show the bond to be at the specified cure temperature.

REPAIR GENERAL

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Table 208: Adhesive Cure Data

ADHESIVE SPECIFICATION	POT LIFE	CURE TEMPERATURE	CURE TIME (MINIMUM)	RATE OF TEMPERATURE INCREASE PER MINUTE
BMS5-92, Type I or V Adhesive Resin	Refer to Figure 211/REPAIR GENERAL	Refer to Figure 211/REPAIR GENERAL	Refer to Figure 211/REPAIR GENERAL	Not Applicable
BMS5-101 Adhesive Film	Not Applicable	225°F to 260°F (107°C to 127°C)	90 minutes	3 ± 2°F (2 ± 1 °C)
BMS5-137 Type II, Class 1 (EA 9657)	Not Applicable	300°F to 320°F (149°C to 160°C)	5 Hours	Between 2 and 3°F (1 and 2°C)
BMS5-137 Type II, Class 1 (All Products)	Not Applicable	340°F to 360°F (171°C to 182°C)	90 Minutes	Between 2 and 10°F (1 and 5°C)
BMS5-141 Adhesive Paste	60 Minutes	Refer to Figure 212/REPAIR GENERAL	Refer to Figure 212/REPAIR GENERAL	Not Applicable

(4) Apply and keep a vacuum at a minimum of 20 inches (50 cm) of mercury (Hg) during the cure cycle.

(5) If it is necessary to add more pressure, put shot-bags, clamps or other mechanical pressure on to the repair area.

NOTE: If the repair is on a honeycomb panel, this pressure can prevent a disbond, (during the cure cycle) between the undamaged skin and core.

(a) The pressure must be applied equally to all the areas. The total pressure on a honeycomb panel must not be more than 25 psi (170 kPa).

(b) Use cast ceramic, plaster, or plastic tools when you apply pressure to the outer skin on a contoured or rounded panel.

(6) When the cure time is completed, decrease the temperature at a rate of 5°F (3°C) a minute.

(7) Let the repaired part decrease in temperature to 150°F (66°C) or less before you release the pressure.

NOTE: If a temperature indication goes below the specified cure temperature, then extend the cure time before you decrease the temperature. Continue at the specified cure temperature for a minimum time equal to the time that the indication was below the specified cure temperature.

(8) Examine the repair as specified in Paragraph 21./REPAIR GENERAL.

C. Paste adhesives.

(1) Continue to apply 1 psi (7 kPa) minimum pressure.

(2) You can decrease the cure times for paste adhesives if you increase the cure temperature of the repair. Refer to Figure 211/REPAIR GENERAL and Figure 212/REPAIR GENERAL for the time-temperature cure charts. You can use an oven, hot air, heat lamps, or a radiant heater to increase the cure temperature.

21. Do an examination of the bonded repair

A. Use a synthetic fiber material (Scotchbrite™ pads, for example) to remove all fabric, plastic film, and thermocouple materials that are bonded to the outside of the repair. Make sure that you do not scratch the aluminum or remove clad material.

B. Do a visual inspection of the repair doubler(s).



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STRUCTURAL REPAIR MANUAL

- (1) Look for a continuous bead of cured adhesive around the edges of each repair doubler. Look for disbonds, gaps, or a failure of the bond line. No disbonds, gaps or failures at the bond line (that you can see) are permitted. If some of the bead is missing or not fully cured, the repair is unsatisfactory.

NOTE: A bead that is not fully cured will be soft and tacky.

- (2) Look to see if a repair doubler moved during the cure. Movement of 0.06 inches (1.5 mm) or less is permitted.

C. A post repair Non-Destructive Inspection (NDI) of the repair area is recommended.

- (1) If a heat blanket was used, then do an NDI of the area that was below the heat blanket. If you use NDI procedures, refer to NDT Part 1, 51-01-01 and NDT Part 1, 51-04-00. Other NDI procedures, if they are satisfactory, are also permitted.

NOTE: You can use a tap test procedure as an alternative inspection procedure for a skin thickness that is a 0.040 inch (1.0 mm) or less. Use the tap test as given in NDT Part 1, 51-05-01.

- (2) Continue to use NDI to examine the area 8 inches (20 cm) from where the edges of the heat blanket were.
- (3) If you find an NDI indication that shows a possible disbond, you can do additional tests and analysis to verify that it is a disbond. If tests and analysis verify that the repair has a disbond, then the repair is unsatisfactory.

D. Remove all repair parts that have an unsatisfactory bond or cut out and repair the area that is disbonded. Do all of the necessary repair steps to make the repair satisfactory.

22. Clean, seal and finish

- A. If the repair is satisfactory, then clean the surfaces that are to be sealed and finished. Refer to AMM 51-21-00/701.
- B. Seal all of the gaps and edges of the doubler(s) as given in 51-20-05, GENERAL.
- C. Apply a protective finish to the bare surfaces as given in AMM 51-21-10/701.

REPAIR GENERAL

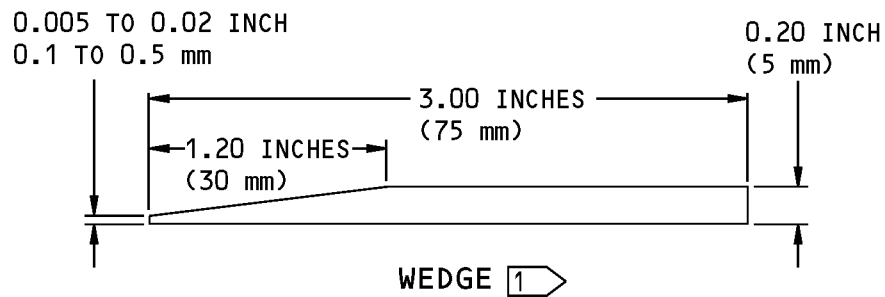
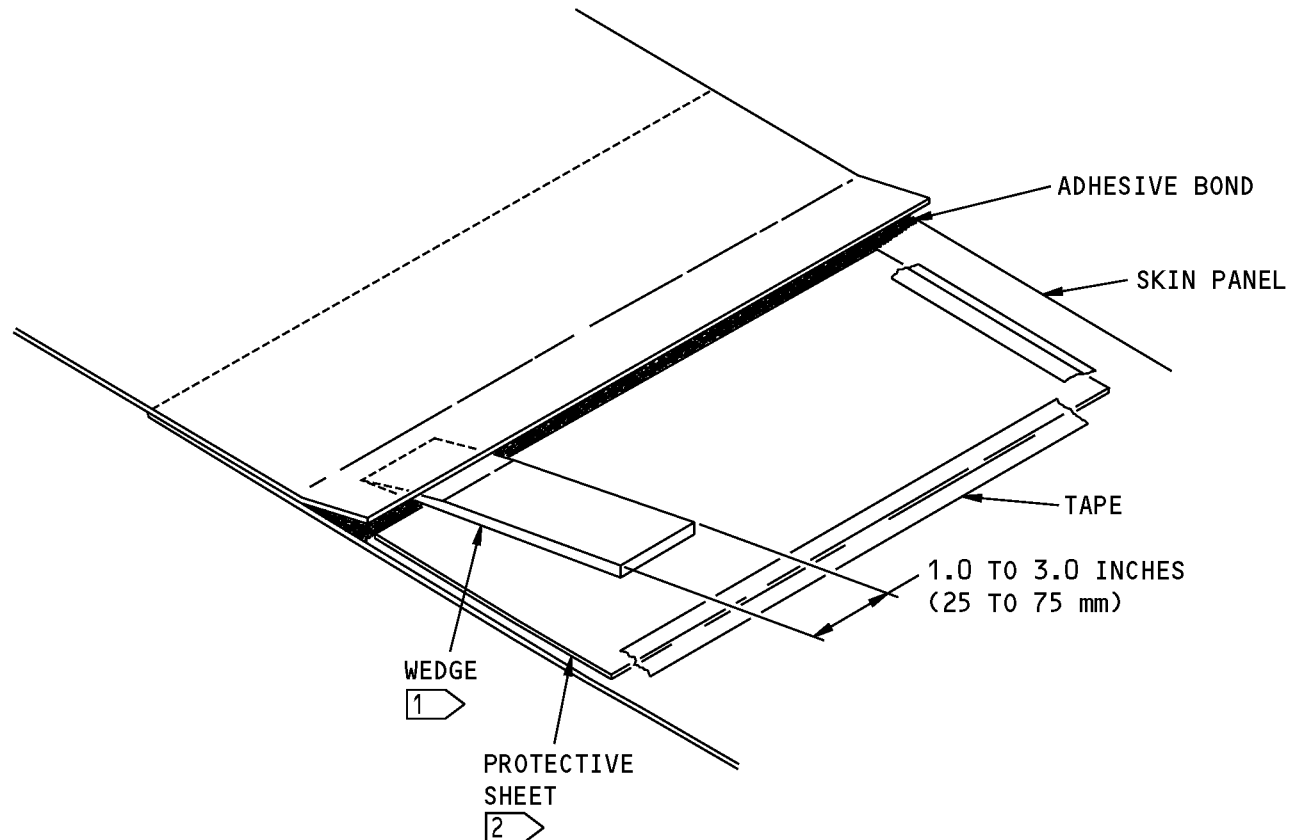
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SEPARATION OF THE BONDED PARTS WITH WEDGES

A

NOTES

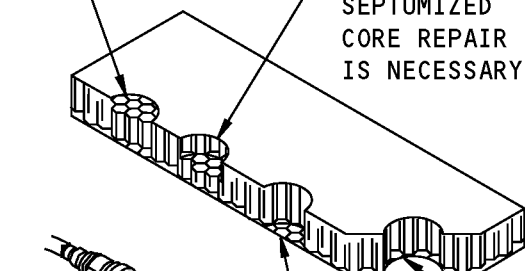
- 1** WOOD OR PLASTIC ARE EXAMPLE MATERIALS
- 2** METAL OR PLASTIC ARE EXAMPLE MATERIALS

Damage Removal Procedures
Figure 203 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**

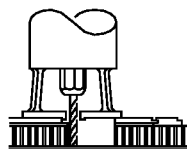
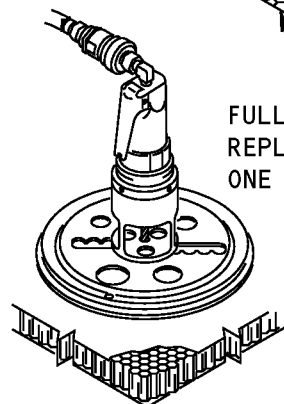
CORE UNDAMAGED.
REPAIR TO
FACESHEET ONLY

PARTIAL CORE
REPLACEMENT.
SEPTUMIZED
CORE REPAIR
IS NECESSARY



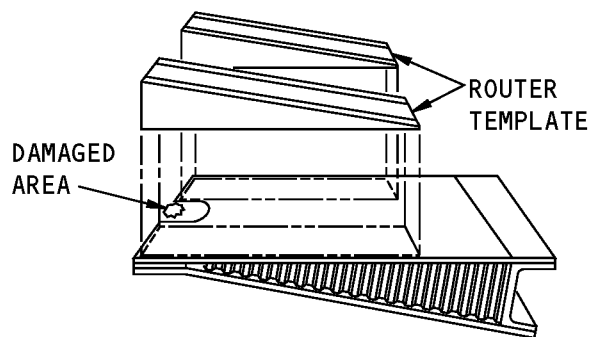
FULL CORE
REPLACEMENT,
ONE SIDED REPAIR

FULL CORE
REPLACEMENT, TWO
SIDED REPAIR



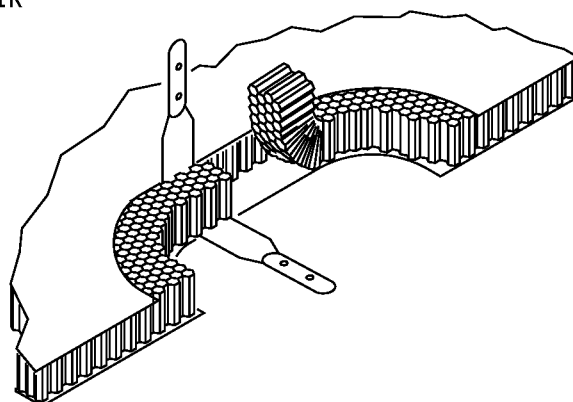
HONEYCOMB CORE REMOVAL

(B)



**REMOVING HONEYCOMB CORE
FROM A TAPERED CONTROL SURFACE**

(C)



REMOVAL OF CORE WITH CORE KNIFE

(D)

INSTRUCTIONS

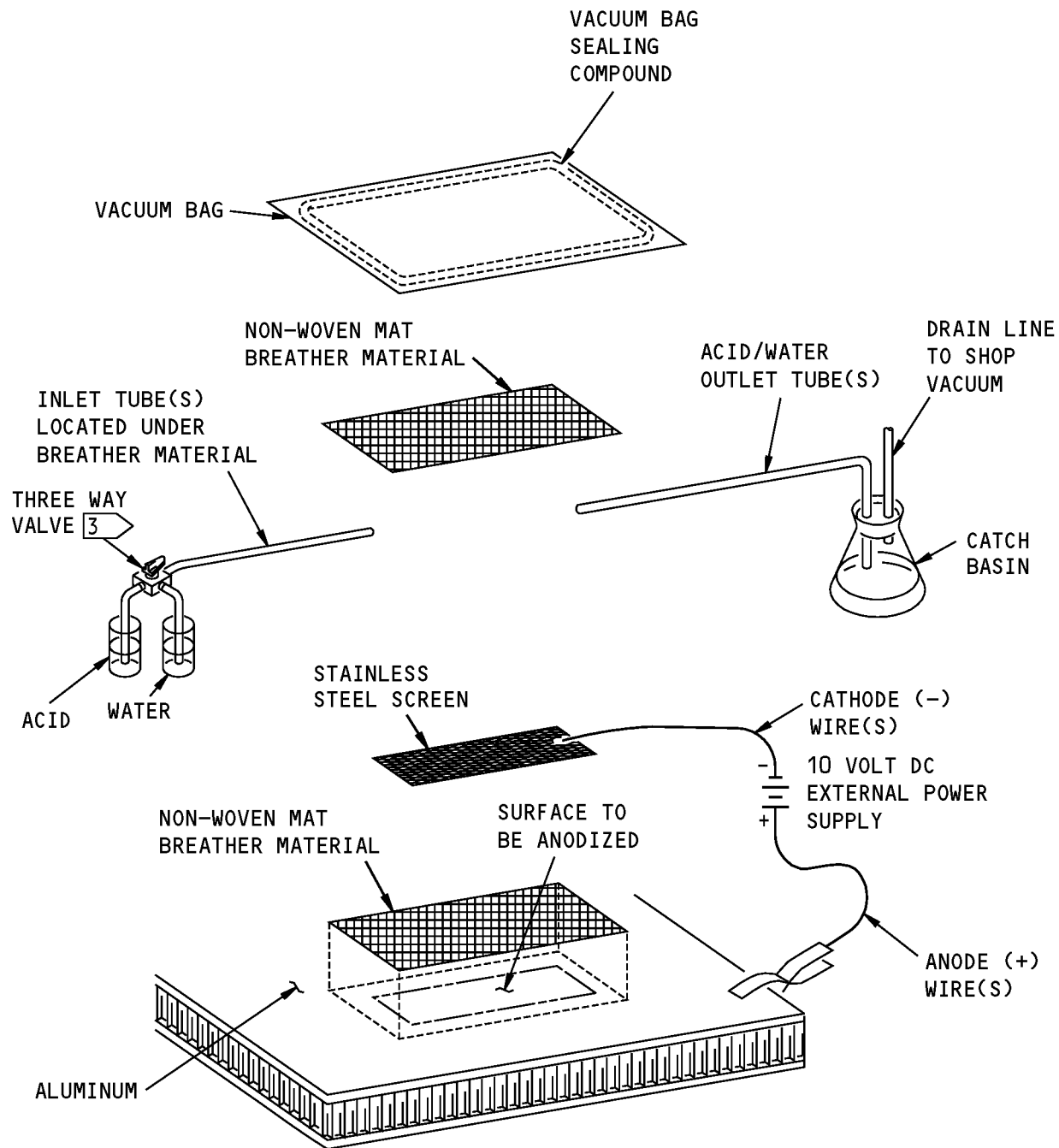
1. Remove the face sheet and/or core with a power router, using a router template to protect the undamaged part of the face sheet. Refer to SRM 51-10-02 for instructions on the use of a router and template.

NOTE: The router can be adjusted to remove: One of the face sheets only, a face sheet and part of the core, a face sheet and all of the core, or both the face sheets and core. See Detail B.

2. If you are routing a tapered part, you can use wedge shaped router templates. This will permit the router to cut the core material parallel with the lower surface. See Detail C.
3. It is permitted to remove honeycomb core with a core knife. See Detail D.

**Damage Removal Procedures
Figure 203 (Sheet 2 of 2)**

**757-200
STRUCTURAL REPAIR MANUAL**

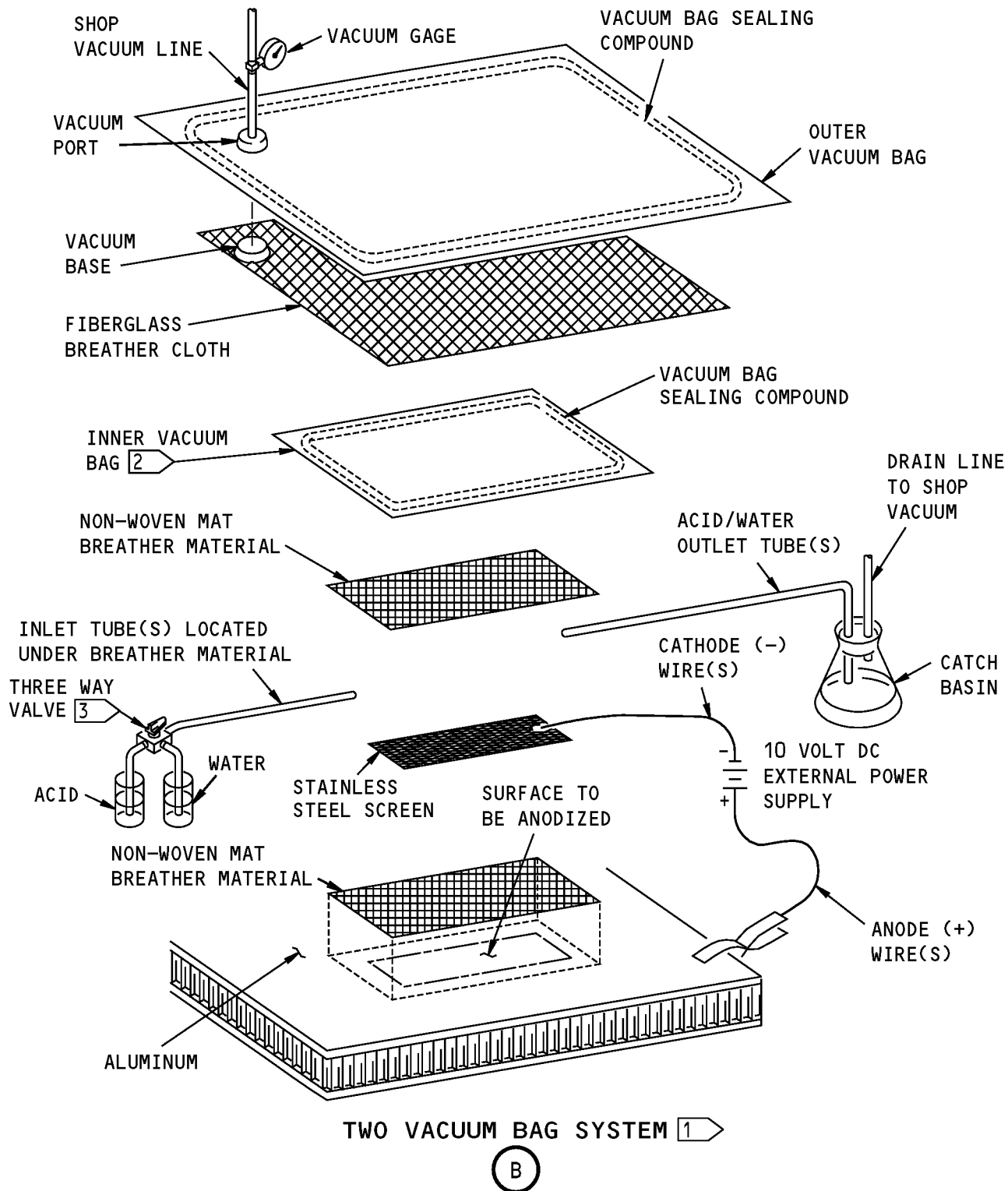


ONE VACUUM BAG SYSTEM 1

A

**Phosphoric Acid Containment System (PACS)
Figure 204 (Sheet 1 of 3)**

STRUCTURAL REPAIR MANUAL



Phosphoric Acid Containment System (PACS)
Figure 204 (Sheet 2 of 3)



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STRUCTURAL REPAIR MANUAL

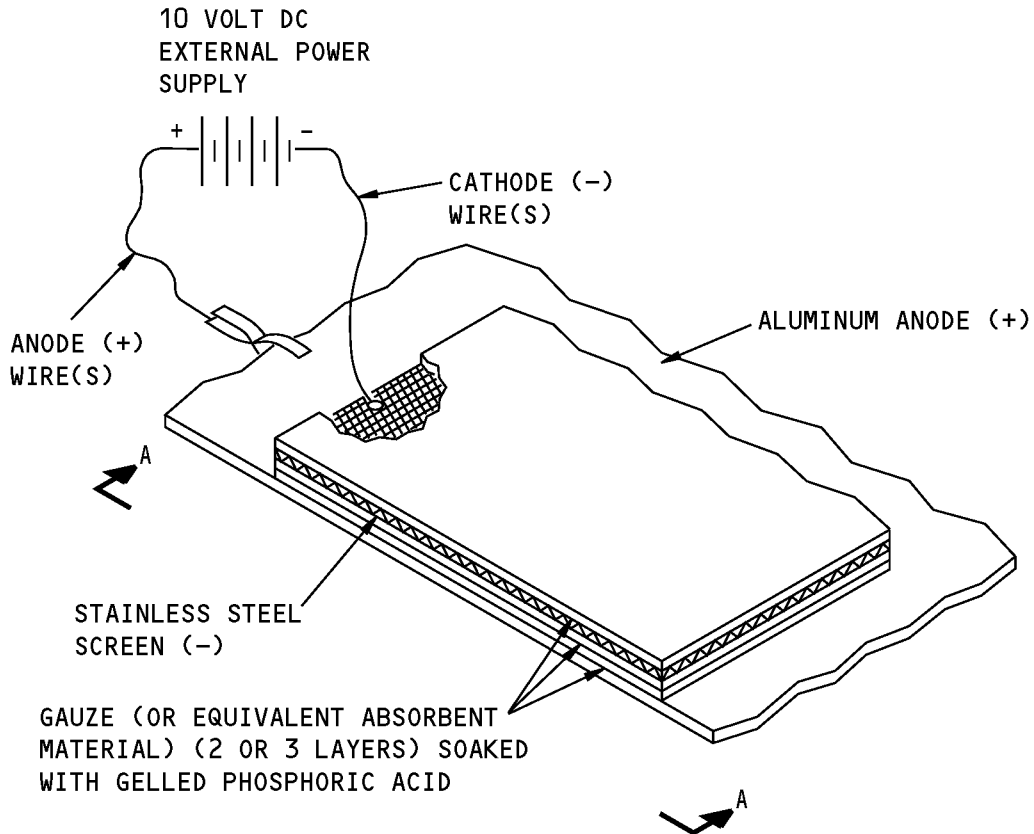
NOTES

- 1 WHEN THE SURFACE TO BE ANODIZED IS FACE UP (AS SHOWN IN THIS FIGURE), THE SECOND, OUTER VACUUM BAG IS OPTIONAL. IF THE SURFACE TO BE ANODIZED IS FACE DOWN OR IF THE SURFACE IS VERTICAL, THEN BOEING RECOMMENDED THAT YOU USE AN OUTER VACUUM BAG. THE OUTER VACUUM BAG WILL CONTAIN THE ACID IF THERE IS LEAKAGE FROM THE INNER VACUUM BAG. SEE DETAIL A FOR THE ONE VACUUM BAG SYSTEM, SEE DETAIL B FOR THE TWO VACUUM BAG SYSTEM.
- 2 AFTER YOU ARE FINISHED WITH THE PACS PROCEDURE, DO A CHECK FOR ACID LEAKAGE BEFORE YOU REMOVE THE INNER VACUUM BAG. IF THERE WAS ACID LEAKAGE, RINSE AND REMOVE ALL OF THE ACID AND OTHER CONTAMINATION FROM THE ALUMINUM FIRST. THEN REMOVE THE INNER VACUUM BAG.
- 3 THE THREE-WAY VALVE OPERATION MUST PERMIT THE CONDITIONS THAT FOLLOW:

 - NO FLOW (OFF)
 - FLOW OF ACID ONLY
 - FLOW OF RINSE WATER ONLY

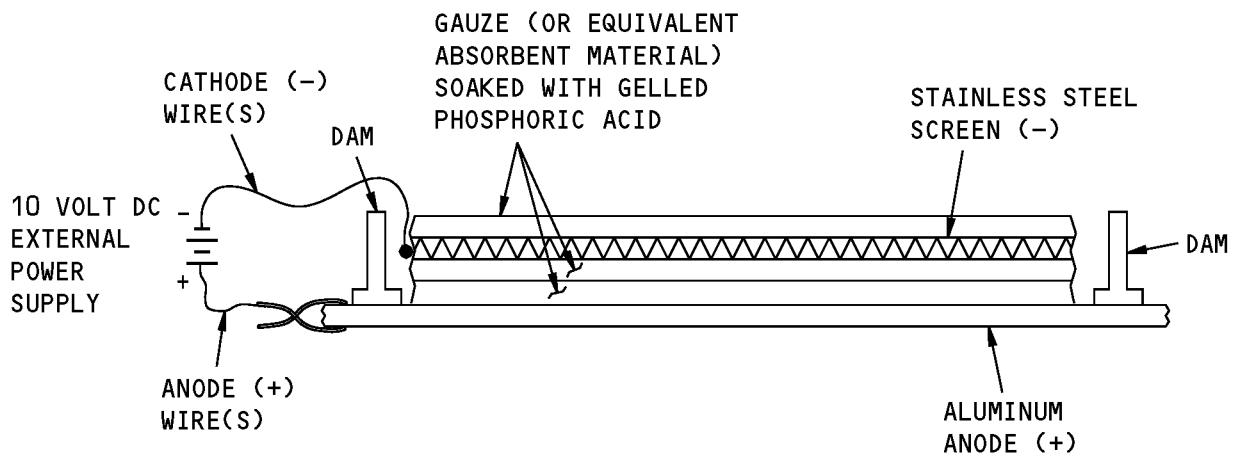
Phosphoric Acid Containment System (PACS)
Figure 204 (Sheet 3 of 3)

STRUCTURAL REPAIR MANUAL



TYPICAL PANTA LAYUP (DAM NOT SHOWN)

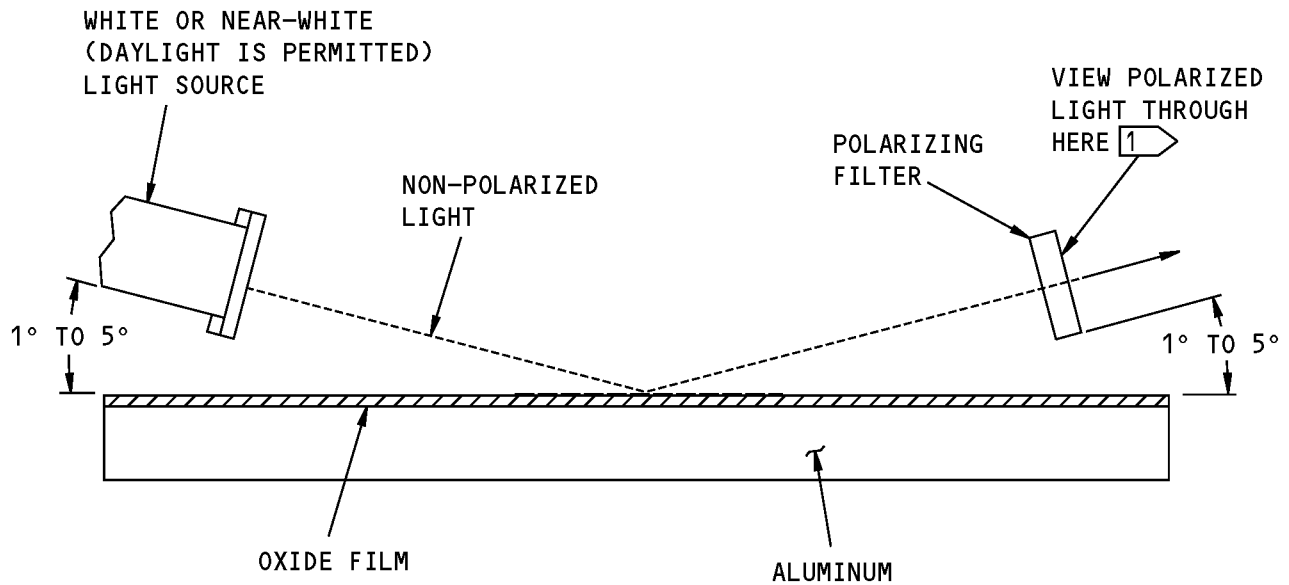
A



A-A

**Phosphoric Acid Non-Tank Anodize (PANTA) Layup
Figure 205**

757-200
STRUCTURAL REPAIR MANUAL

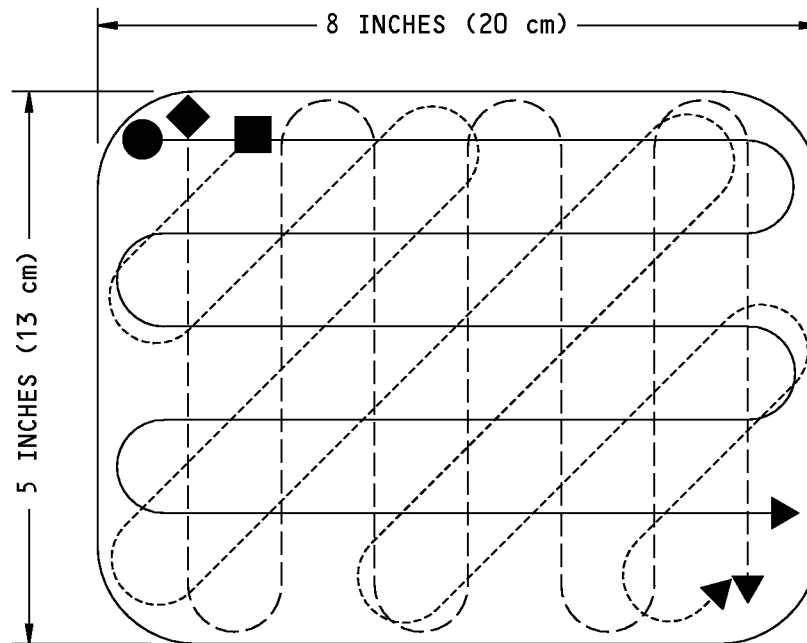


NOTES

- 1 VIEW THE LIGHT AS YOU ROTATE (TURN) THE FILTER 90° TO INSPECT FOR A COLOR CHANGE

Polarized Light Test - Verification of Anodic Oxide Film
Figure 206

**757-200
STRUCTURAL REPAIR MANUAL**



**AREA SANDING PATTERN (SMALL SECTION)– THREE DISC EXAMPLE
(2.0 INCHES (50 mm) DIAMETER DISCS) 1**

A

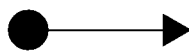
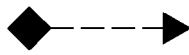
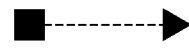
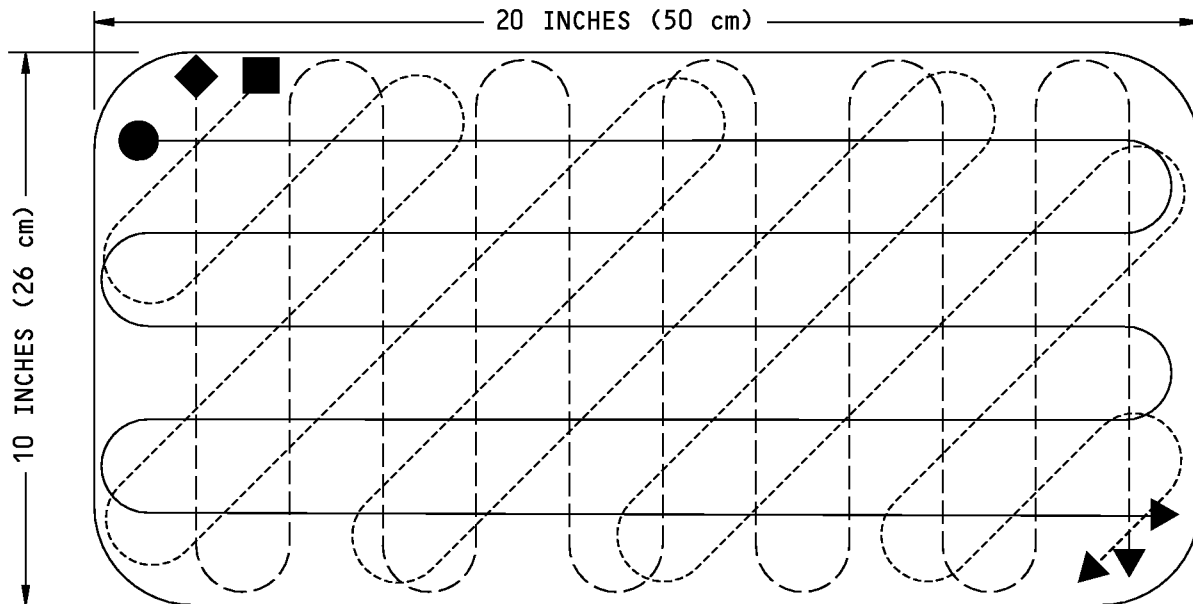
SANDING PROCEDURES FOR BOEGEL	
TIME SANDPAPER USED	30 SECONDS FIRST DIRECTION 
	30 SECONDS/ \perp DIRECTION 
	30 SECONDS (MAX) 
	DIAGONAL DIRECTION (GRINDER) OR RANDOM DIRECTION (SANDER)

TABLE A

**Sanding Procedure Used for Boegel
Figure 207 (Sheet 1 of 5)**

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STRUCTURAL REPAIR MANUAL



AREA SANDING PATTERN (LARGE SECTION)- 11 DISC EXAMPLE
(2.0 INCHES (50 mm) DIAMETER DISCS) 1

B

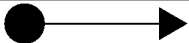
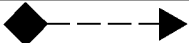
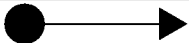
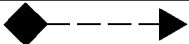
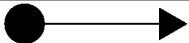
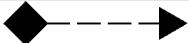
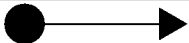
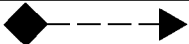
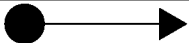
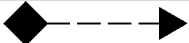
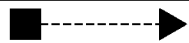
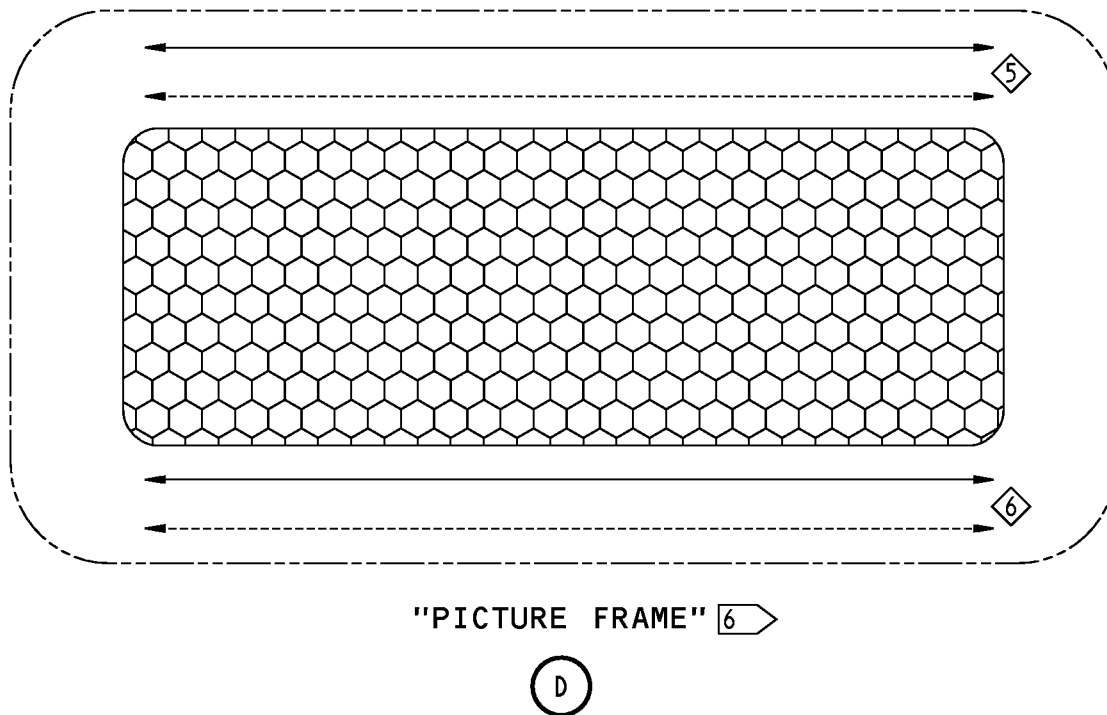
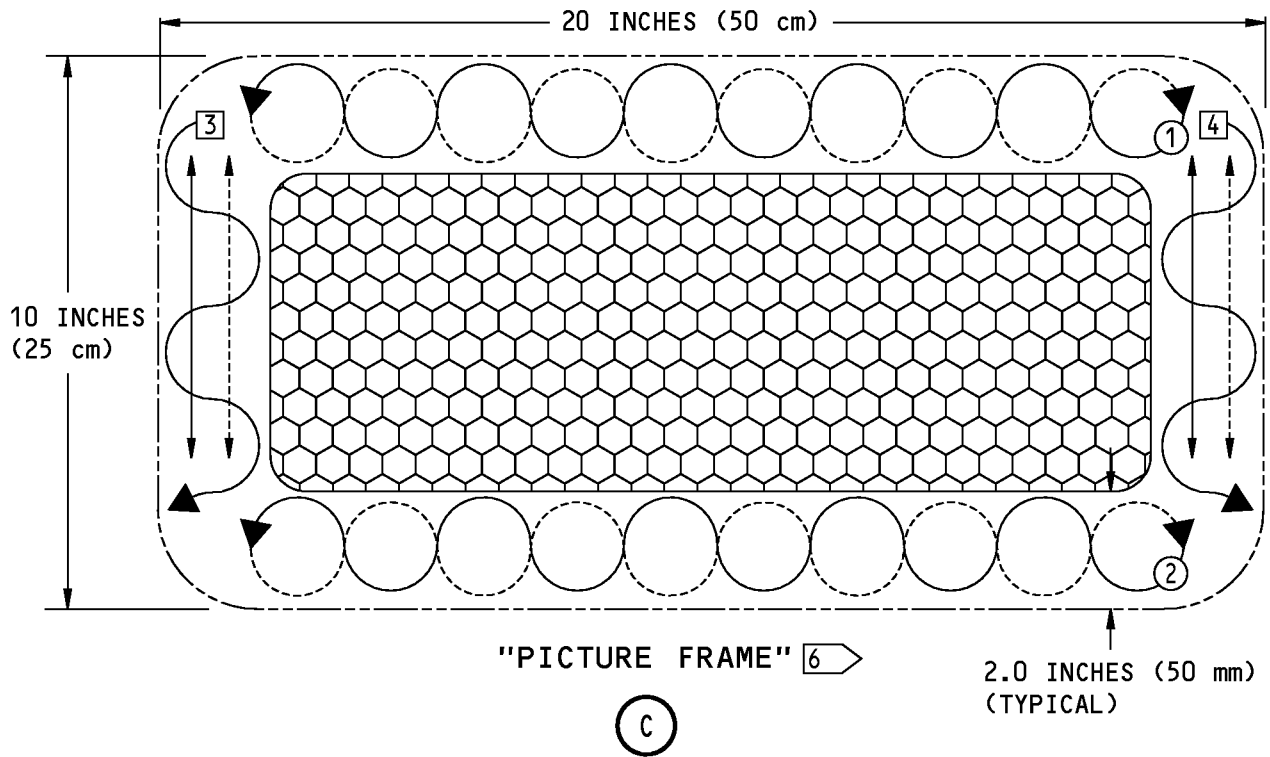
SANDING PROCEDURES FOR BOEGEL (DETAILS A AND B)				
SANDPAPER SEQUENCE	DIRECTION	TIME	TOOL	
1ST PIECE 	0 DEGREES	30 SECONDS	GRINDER OR SANDER	
2ND PIECE 	90 DEGREES	30 SECONDS	GRINDER OR SANDER	
3RD PIECE 	0 DEGREES	30 SECONDS	GRINDER OR SANDER	
4TH PIECE 	90 DEGREES	30 SECONDS	GRINDER OR SANDER	
5TH PIECE 	0 DEGREES	30 SECONDS	GRINDER OR SANDER	
6TH PIECE 	90 DEGREES	30 SECONDS	GRINDER OR SANDER	
7TH PIECE 	0 DEGREES	30 SECONDS	GRINDER OR SANDER	
8TH PIECE 	90 DEGREES	30 SECONDS	GRINDER OR SANDER	
9TH PIECE 	0 DEGREES	30 SECONDS	GRINDER OR SANDER	
10TH PIECE 	90 DEGREES	30 SECONDS	GRINDER OR SANDER	
LAST PIECE 	45 DEGREES	30 SECONDS	GRINDER	
(WITH GRINDER OR SANDER)	RANDOM	30 SECONDS	SANDER	

TABLE B

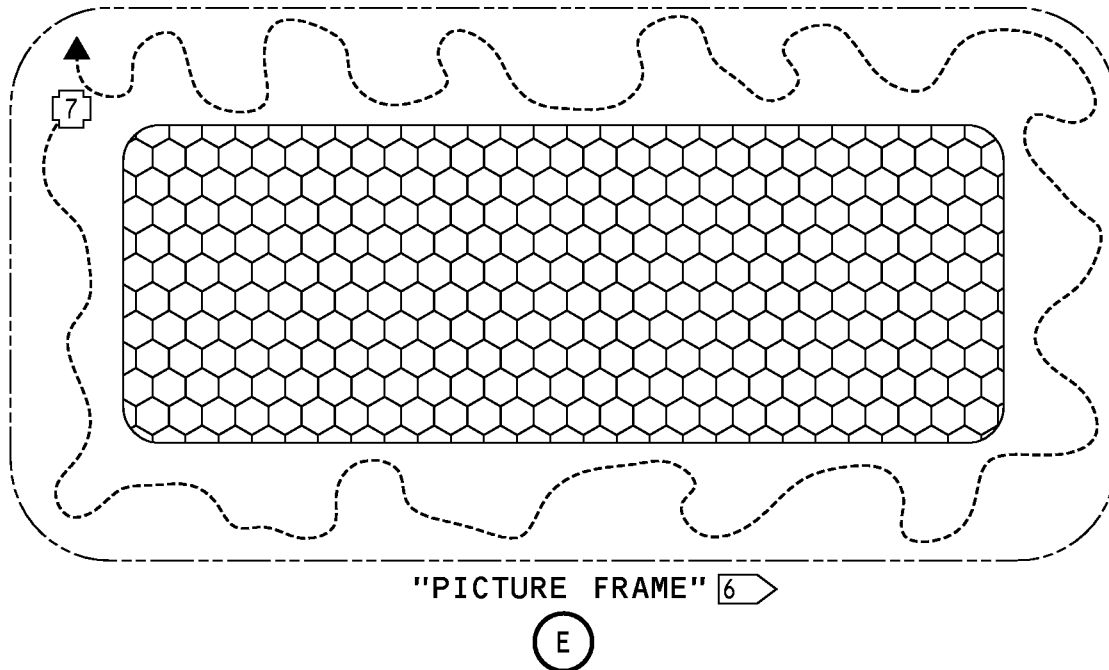
Sanding Procedure Used for Boegel
Figure 207 (Sheet 2 of 5)

**757-200
STRUCTURAL REPAIR MANUAL**



**Sanding Procedure Used for Boegel
Figure 207 (Sheet 3 of 5)**

757-200
STRUCTURAL REPAIR MANUAL







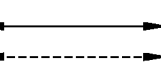
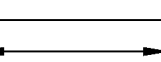
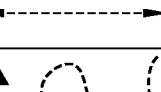
SANDING PATTERNS FOR A "PICTURE FRAME" (DETAILS C, D, AND E) USING A DIE GRINDER WITH A 2 INCH (50 mm) DISK		
SANDPAPER SEQUENCE	PATTERN	TIME
1ST PIECE ① 	SINE WAVES	30 SECONDS
2ND PIECE ② 	SINE WAVES	30 SECONDS
3RD PIECE ③ 	SINE WAVES AND THEN STRAIGHT LINES	30 SECONDS
4TH PIECE ④ 	SINE WAVES AND THEN STRAIGHT LINES	30 SECONDS
5TH PIECE ⑤ 	STRAIGHT LINES	30 SECONDS
6TH PIECE ⑥ 	STRAIGHT LINES	30 SECONDS
7TH PIECE ⑦ 	RANDOM	30 SECONDS

TABLE C

**Sanding Procedure Used for Boegel
Figure 207 (Sheet 4 of 5)**

757-200
STRUCTURAL REPAIR MANUAL




















180 GRIT SANDING DISCS 			
DISC DIAMETER	SHEETS NECESSARY TO SAND AREAS 10 SQUARE INCHES (64 SQUARE cm) OR LESS	SHEETS NECESSARY TO SAND AREAS 11 TO 21 SQUARE INCHES (70 TO 135 SQUARE cm)	SHEETS NECESSARY TO SAND AREAS 22 TO 42 SQUARE INCHES (140 TO 270 SQUARE cm)
3/4 INCH (19 mm)	2 	NOT PERMITTED	NOT PERMITTED
1.0 INCH (25 mm)	2 	NOT PERMITTED	NOT PERMITTED
1 1/2 INCHES (38 mm)	NOT PERMITTED	2 	NOT PERMITTED
2.0 INCHES (50 mm)	NOT PERMITTED	2 	3 
3.0 INCHES (75 mm)	NOT PERMITTED	2 	2 
4.0 INCHES (100 mm)	NOT PERMITTED	2 	2 
5.0 INCHES (125 mm)	NOT PERMITTED	NOT PERMITTED	2 
6.0 INCHES (150 mm)	NOT PERMITTED	NOT PERMITTED	 

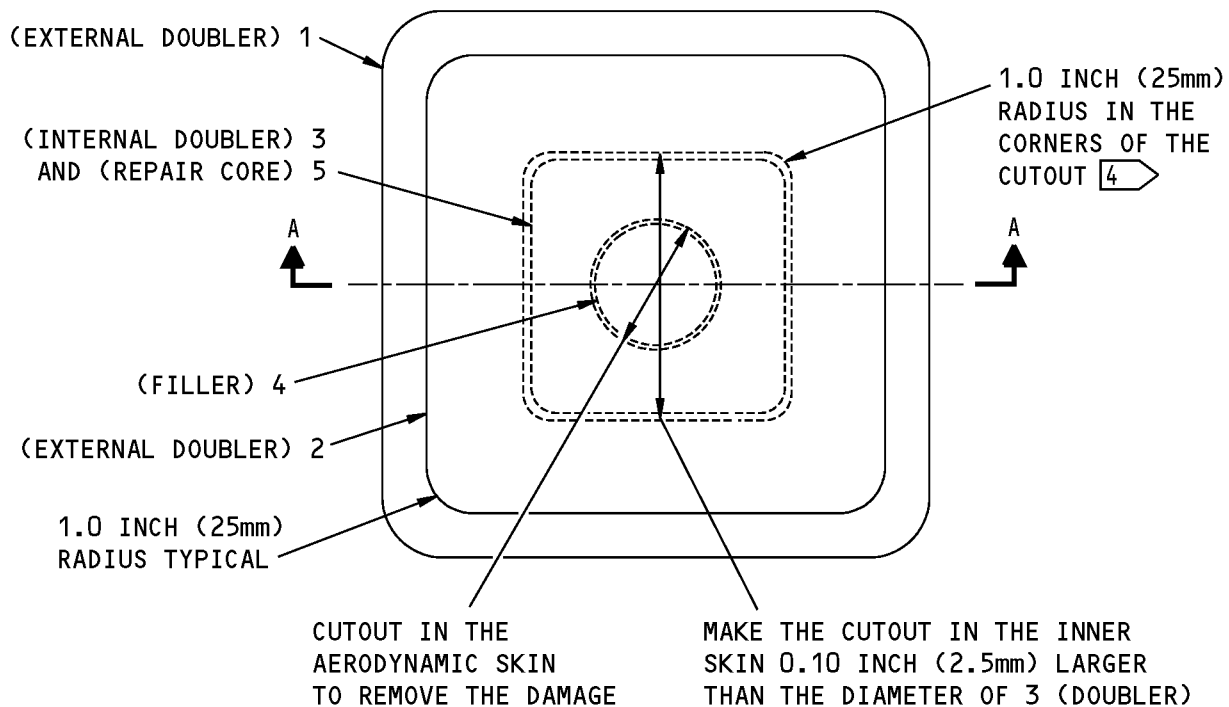
TABLE D

NOTES

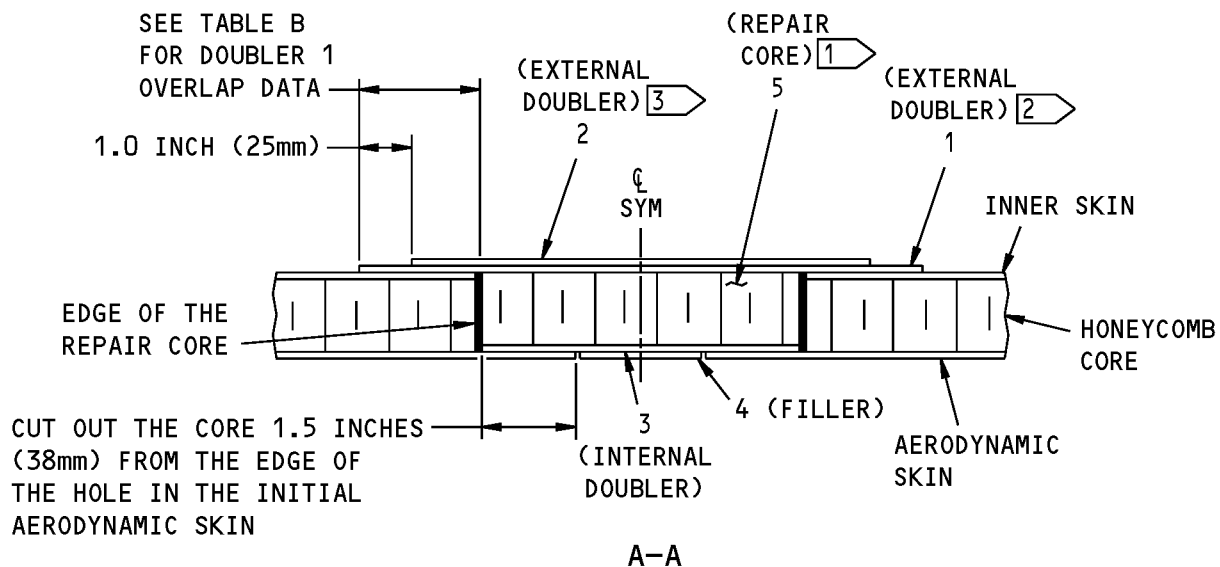
-  REFER TO TABLE D FOR ALTERNATIVE DISC DIAMETERS.
-  REFER TO DETAIL B WHEN MORE THAN THREE SHEETS ARE NECESSARY. ALWAYS USE THE LAST SHEET IN A DIAGONAL DIRECTION (GRINDER) OR RANDOM DIRECTION (SANDER).
-  FIRST SHEET:
DO 20 SECONDS IN THE \leftrightarrow DIRECTION AND 10 SECONDS IN THE \perp DIRECTION.
SECOND SHEET:
DO 10 SECONDS IN THE \perp DIRECTION AND 20 SECONDS IN A DIAGONAL DIRECTION (GRINDER) OR RANDOM DIRECTION (SANDER).
-  REFER TO DETAIL A.
-  NOT PERMITTED FOR AREAS LESS THAN 40 SQUARE INCHES (260 cm)
USE TWO SHEETS TO SAND AREAS THAT ARE 40 TO 50 SQUARE INCHES (260 TO 320 SQUARE cm).
-  A "PICTURE FRAME" DESCRIBES THE AREA ALONG THE EDGES OF A CUTOUT. REFER TO TABLE C.

Sanding Procedure Used for Boegel
Figure 207 (Sheet 5 of 5)

757-200
STRUCTURAL REPAIR MANUAL

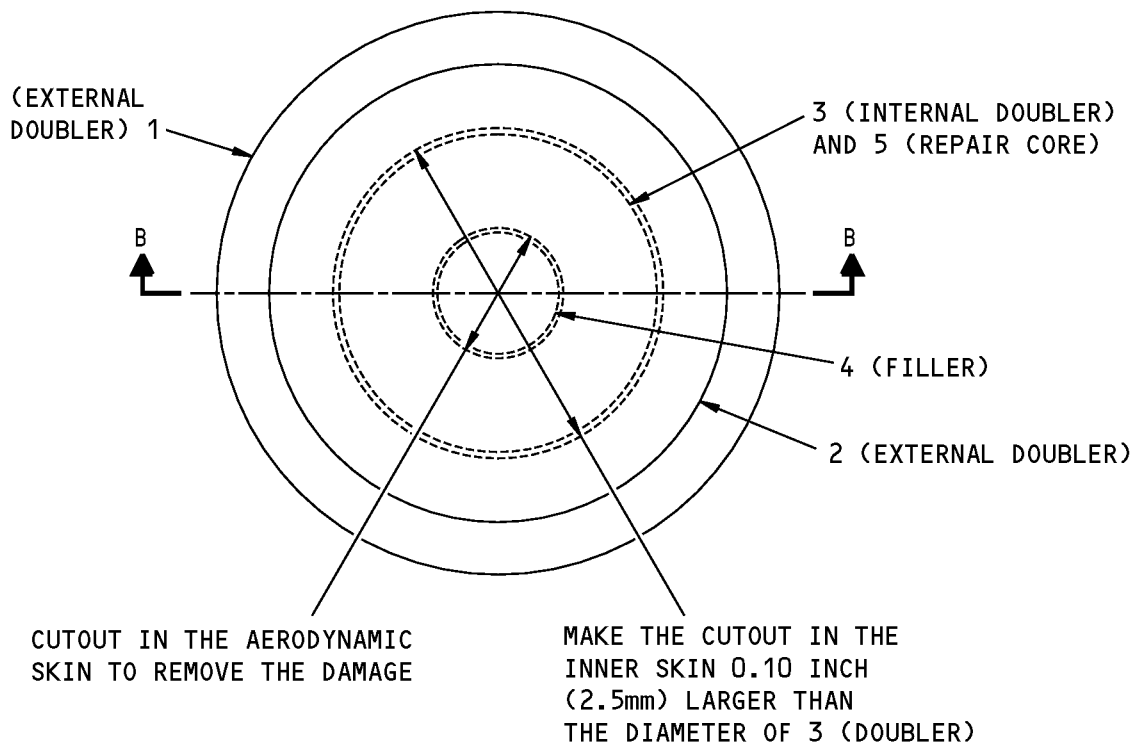


A

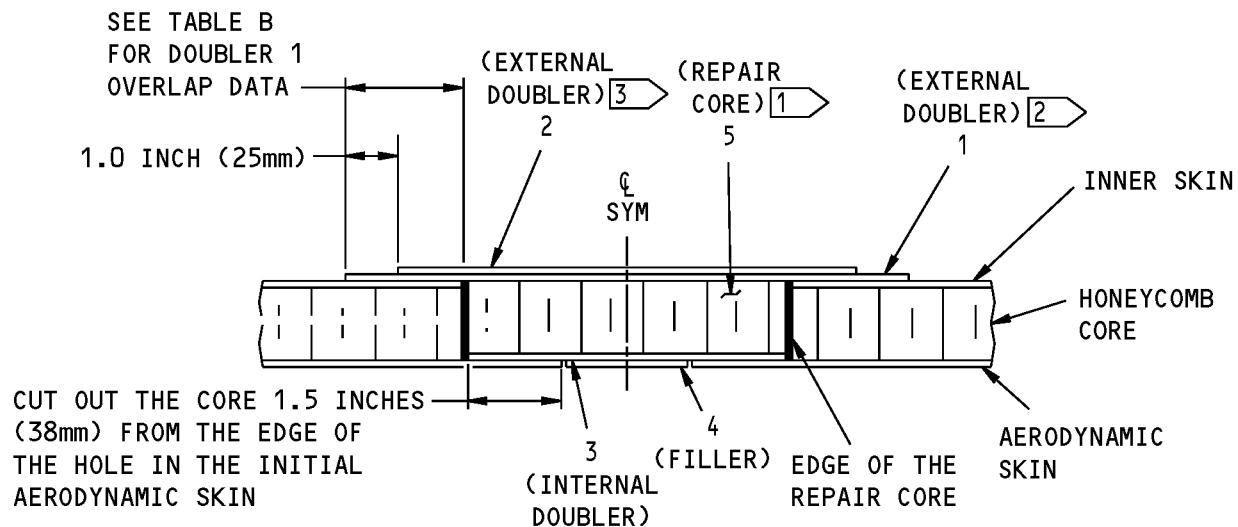


Repair Doubler Specifications for Flush Repairs
Figure 208 (Sheet 1 of 4)

757-200 STRUCTURAL REPAIR MANUAL



B



B-B

Repair Doubler Specifications for Flush Repairs
Figure 208 (Sheet 2 of 4)

757-200
STRUCTURAL REPAIR MANUAL





















REPAIR PART THICKNESS (INCHES) FOR BONDED REPAIRS				
INITIAL SKIN GAGE RANGE	PART 1 EXTERNAL DOUBLER	PART 2 EXTERNAL DOUBLER	PART 3 INTERNAL DOUBLER	PART 4 FILLER
0.012 TO 0.020	SAME AS THE INITIAL SKIN	NOT NECESSARY		
0.021 TO 0.025	0.025 			
0.026 TO 0.032	0.032 			
0.033 TO 0.041	0.016 	0.025 	SAME AS THE AERODYNAMIC SKIN 	SAME AS THE AERODYNAMIC SKIN 
0.042 TO 0.045	0.020 	0.025 		
0.046 TO 0.050	0.025 	0.025 		
0.051 TO 0.057	0.025 	0.032 		
0.058 TO 0.064	0.032 	0.032 		
0.065 TO 0.072	0.032 	0.040 		
0.073 TO 0.080	0.040 	0.040 		

TABLE A

INITIAL SKIN THICKNESS	THE MINIMUM OVERLAP DIMENSION OF DOUBLER 1
0.00 TO 0.032	1.5 INCHES (38 mm)
> 0.032	2.5 INCHES (63 mm)

TABLE B

REPAIR PART THICKNESS (INCHES) FOR HIGH CURVATURE REPAIRS		
INITIAL SKIN	PART 1 EXTERNAL DOUBLER	PART 2 EXTERNAL DOUBLER
0.021 TO 0.028	0.012	0.016
0.029 TO 0.032	0.012	0.020

TABLE C

Repair Doubler Specifications for Flush Repairs
Figure 208 (Sheet 3 of 4)

757-200
STRUCTURAL REPAIR MANUAL

NOTES

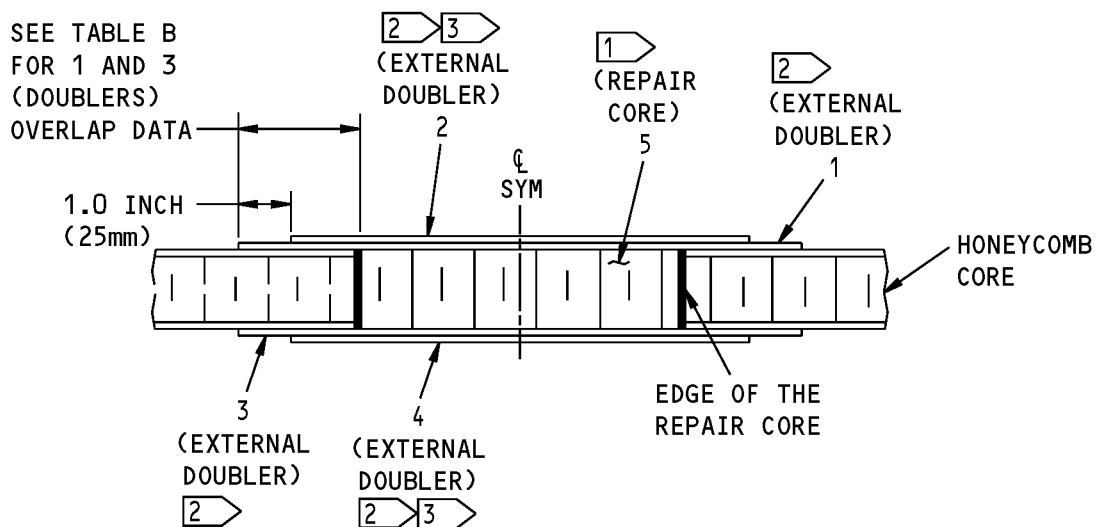
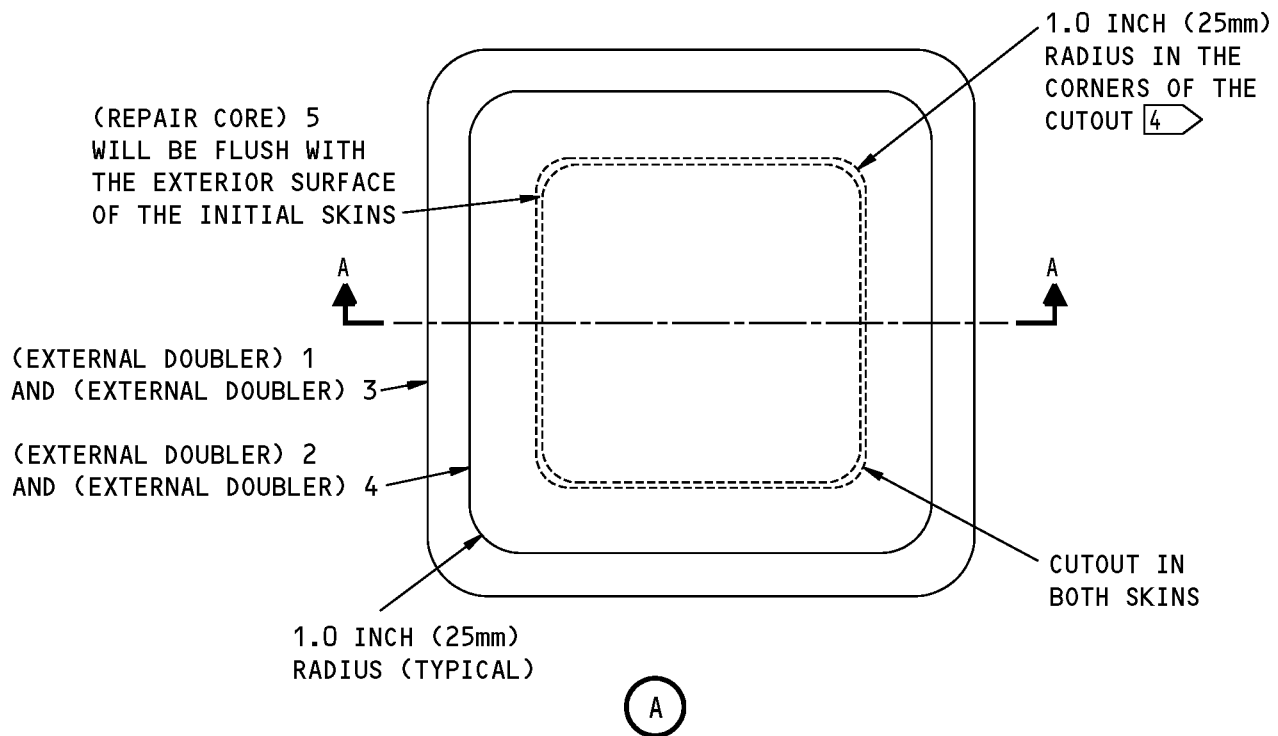
- USE THIS FIGURE TO DETERMINE THE DOUBLER DIMENSIONS ONLY.
- THE MATERIAL FOR THE REPAIR PARTS MUST BE EQUIVALENT TO THE SAME BOEING MATERIAL SPECIFICATION (BMS) AND HEAT TREAT AS THE SKIN TO BE REPAIRED.
- BONDING SURFACES OF 2000 SERIES ALUMINUM DOUBLERS CAN BE CLAD OR NON-CLAD (BARE). BONDING SURFACES OF 7000 SERIES ALUMINUM DOUBLERS MUST BE NON-CLAD (BARE).

- 1 MAKE THE PART 5 REPAIR CORE LEVEL WITH THE OUTER SURFACE OF THE SKIN TO BE REPAIRED. (UNLESS SPECIFIED DIFFERENTLY IN A SPECIFIC REPAIR).
- 2 FOR THE INITIAL SKIN THICKNESSES THAT ARE 0.021 TO 0.032 GAGE, THE PART 2 (EXTERNAL DOUBLER) IS NOT NECESSARY IF THE SKIN IS FLAT, OR IF THE PART 1 DOUBLER CAN TOUCH ALL OF THE BOND SURFACE WITH ONLY LIGHT FINGER PRESSURE.

IF THE SKIN SURFACE HAS A HIGH CURVATURE, YOU CAN DO ONE OF THE STEPS THAT FOLLOW:
 - MAKE THE PART 1 DOUBLER TO THE SAME CURVATURE AS THE SKIN SURFACE, SO THAT LIGHT FINGER PRESSURE MAKES THE DOUBLER TOUCH ALL OF THE SKIN SURFACE, OR
 - MAKE THE PART 1 DOUBLER FROM 0.012 GAGE, AND MAKE THE PART 2 DOUBLER FROM THE THICKNESS SPECIFIED IN TABLE C.
- 3 WHEN YOU USE THE PART 2 (EXTERNAL DOUBLER), MAKE THE PART 2 (EXTERNAL DOUBLER) 1.0 INCH (25 mm) SMALLER ALL AROUND THAN THE PART 1 (EXTERNAL DOUBLER).
- 4 IF YOU ARE REPAIRING A CRACK, GOUGE, OR SMALL HOLE, YOU CAN USE A MINIMUM RADIUS THAT IS 0.25 INCH (6 mm).
- 5 IF A SKIN TO BE REPAIRED HAS A HIGH CURVATURE AND A GAGE OF 0.033 OR THICKER, THEN MAKE THE REPAIR DOUBLERS TO THE SAME CURVATURE AS THE SKIN SURFACE. MAKE SURE THAT LIGHT FINGER PRESSURE CAN MAKE THE DOUBLERS TOUCH ALL OF THE SKIN SURFACE.

Repair Doubler Specifications for Flush Repairs
Figure 208 (Sheet 4 of 4)

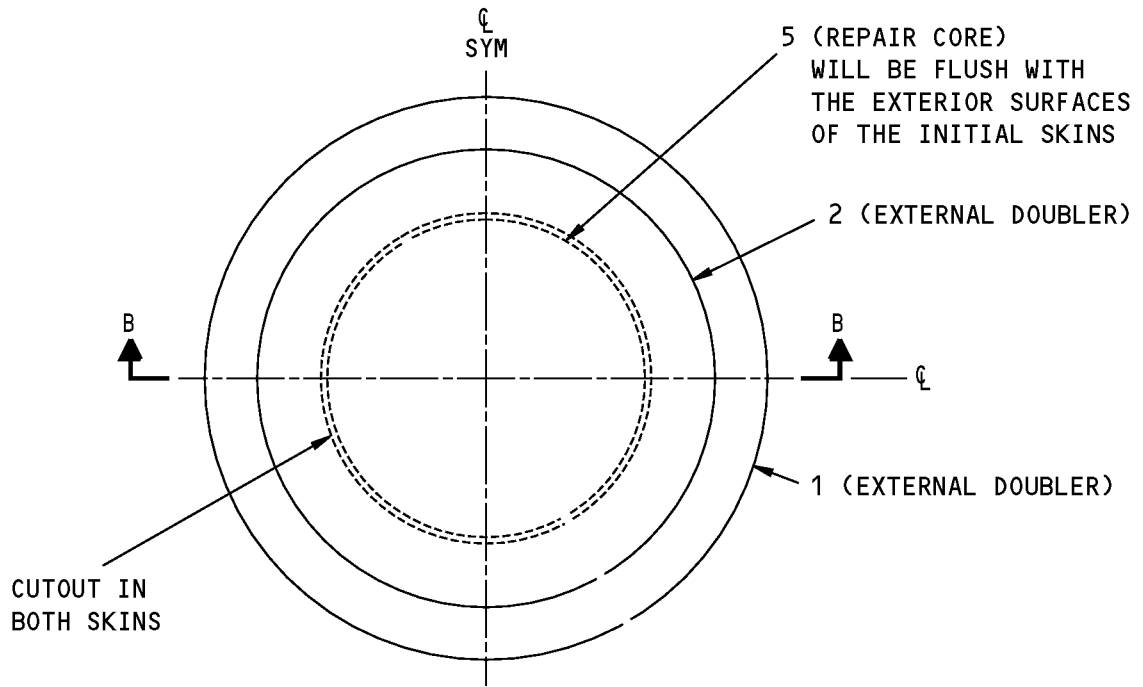
757-200
STRUCTURAL REPAIR MANUAL



TWO-SIDED REPAIR SHOWN
SEE DETAIL B FOR ONE SIDED REPAIR
A-A

Repair Doubler Specifications for External Patch Repairs
Figure 209 (Sheet 1 of 4)

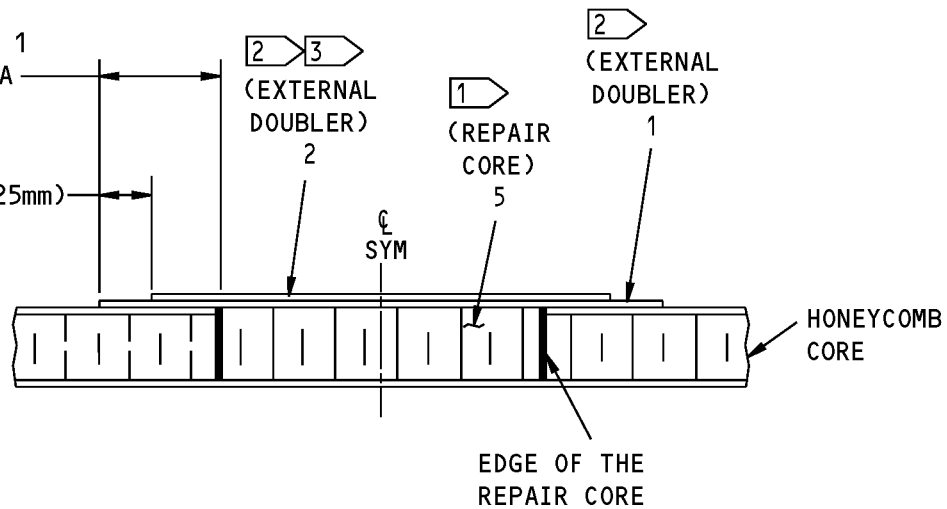
757-200
STRUCTURAL REPAIR MANUAL



(B)

SEE TABLE B
FOR DOUBLER 1
OVERLAP DATA

1.0 INCH (25mm)
(TYPICAL)



ONE-SIDED REPAIR SHOWN
SEE DETAIL A FOR TWO-SIDED REPAIR
B-B

Repair Doubler Specifications for External Patch Repairs
Figure 209 (Sheet 2 of 4)



757-200
STRUCTURAL REPAIR MANUAL

REPAIR PART THICKNESS (INCHES) FOR BONDED REPAIRS		
INITIAL SKIN GAGE RANGE	PART 1 AND 3 DOUBLER	PART 2 AND 4 DOUBLER
0.012 TO 0.020	SAME AS THE INITIAL SKIN	NOT NECESSARY
0.021 TO 0.025	0.025	
0.026 TO 0.032	0.032	
0.033 TO 0.041	0.016	0.025
0.042 TO 0.045	0.020	0.025
0.046 TO 0.050	0.025	0.025
0.051 TO 0.057	0.025	0.032
0.058 TO 0.064	0.032	0.032
0.065 TO 0.072	0.032	0.040
0.073 TO 0.080	0.040	0.040

TABLE A

INITIAL SKIN THICKNESS	THE MINIMUM OVERLAP DIMENSION OF DOUBLERS 1 AND 3
0.00 TO 0.032	1.5 INCHES (38mm)
> 0.032	2.5 INCHES (63mm)

TABLE B

REPAIR PART THICKNESS (INCHES) FOR HIGH CURVATURE REPAIRS		
INITIAL SKIN	PART 1 AND 3 DOUBLER	PART 2 AND 4 DOUBLER
0.021 TO 0.028	0.012	0.016
0.029 TO 0.032	0.012	0.020

TABLE C

Repair Doubler Specifications for External Patch Repairs
Figure 209 (Sheet 3 of 4)

757-200
STRUCTURAL REPAIR MANUAL

NOTES

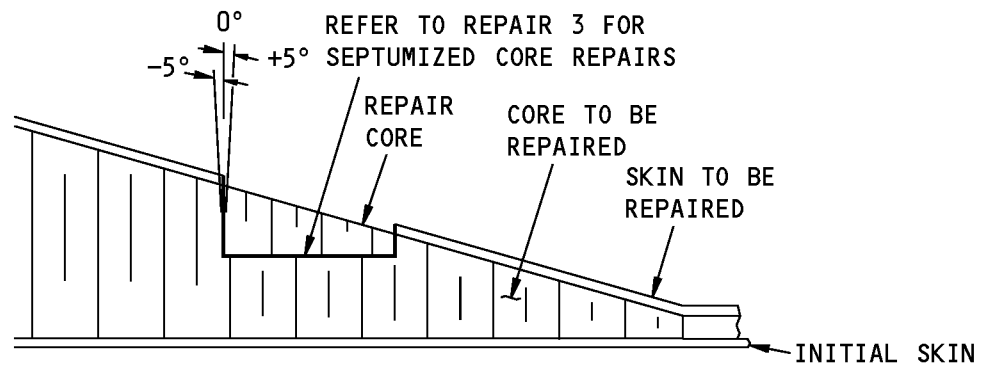
- USE THIS FIGURE TO DETERMINE THE DOUBLER DIMENSIONS ONLY.
- THE MATERIAL FOR THE REPAIR PARTS MUST BE EQUIVALENT TO THE SAME BOEING MATERIAL SPECIFICATION (BMS) AND HEAT TREAT AS THE SKIN TO BE REPAIRED.
- BONDING SURFACES OF 2000 SERIES ALUMINUM DOUBLERS CAN BE CLAD OR NON-CLAD (BARE). BONDING SURFACES OF 7000 SERIES ALUMINUM DOUBLERS MUST BE NON-CLAD (BARE).

- 1 MAKE THE PART 5 REPAIR CORE TO BE LEVEL WITH THE OUTER SURFACE OF THE SKIN TO BE REPAIRED (UNLESS SPECIFIED DIFFERENTLY IN A SPECIFIC REPAIR).
- 2 FOR THE INITIAL SKIN THICKNESSES THAT ARE BETWEEN 0.021 AND 0.032 GAGE, THE PARTS 2 AND 4 DOUBLERS ARE NOT NECESSARY IF THE INITIAL SKIN IS FLAT OR IF THE PARTS 1 AND 3 DOUBLERS CAN TOUCH ALL OF THE BOND SURFACE WITH ONLY LIGHT FINGER PRESSURE.

IF THE SKIN SURFACE HAS A HIGH CURVATURE, YOU CAN DO ONE OF THE STEPS THAT FOLLOW:
 - MAKE THE PARTS 1 AND 3 DOUBLERS TO THE SAME CURVATURE AS THE SKIN SURFACE, SO THAT LIGHT FINGER PRESSURE MAKES THE DOUBLERS TOUCH ALL OF THE SKIN SURFACE, OR
 - MAKE THE PARTS 1 AND 3 DOUBLERS FROM 0.012 GAGE, AND MAKE THE PARTS 2 AND 4 DOUBLERS FROM THE THICKNESS SPECIFIED IN TABLE C.
- 3 WHEN YOU USE THE PART 2 AND 4 DOUBLERS, MAKE THE PARTS 2 AND 4 DOUBLERS 1.0 INCH (25 mm) SMALLER ALL AROUND THAN THE PARTS 1 AND 3 DOUBLERS.
- 4 IF YOU ARE REPAIRING A CRACK, GOUGE, OR SMALL HOLE, YOU CAN USE A MINIMUM RADIUS THAT IS 0.25 INCH (6 mm).
- 5 CHAMFER ALL EDGES OF THE DOUBLER AS SHOWN IN FIGURE 213 FOR DOUBLERS 0.032 GAGE AND THICKER (AERODYNAMIC SURFACES ONLY. CHAMFER OF DOUBLERS ON NON-AERODYNAMIC SURFACES IS PERMITTED BUT IS NOT NECESSARY).
- 6 IF A SKIN TO BE REPAIRED HAS A HIGH CURVATURE AND A GAGE OF 0.033 OR THICKER, THEN MAKE THE REPAIR DOUBLERS TO THE SAME CURVATURE AS THE SKIN SURFACE. MAKE SURE THAT LIGHT FINGER PRESSURE CAN MAKE THE DOUBLERS TOUCH ALL OF THE SKIN SURFACE.

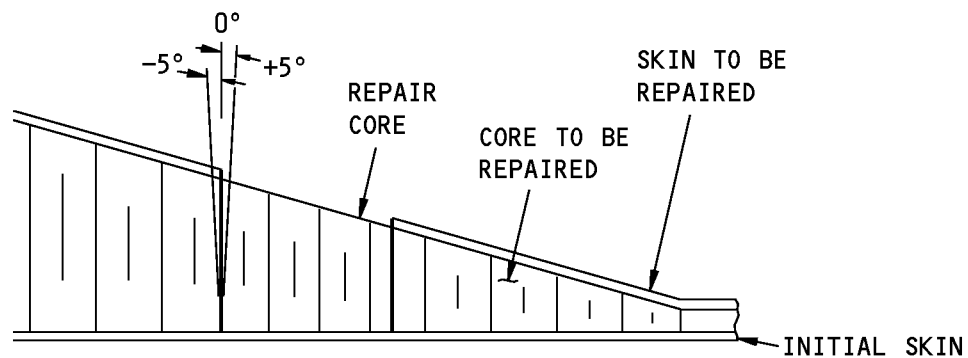
Repair Doubler Specifications for External Patch Repairs
Figure 209 (Sheet 4 of 4)

STRUCTURAL REPAIR MANUAL



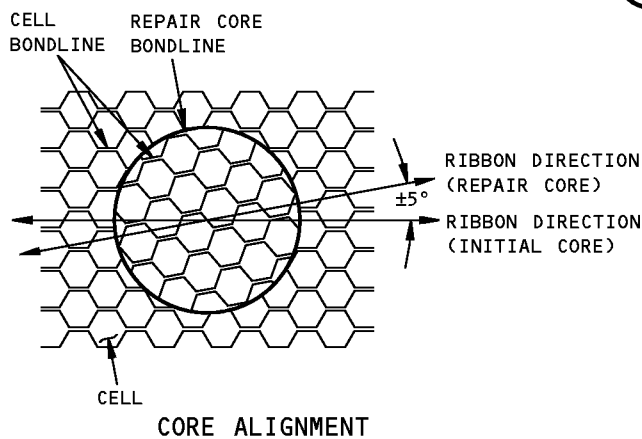
**PARTIAL DEPTH CORE REPLACEMENT
(TYPICAL) 1**

(A)

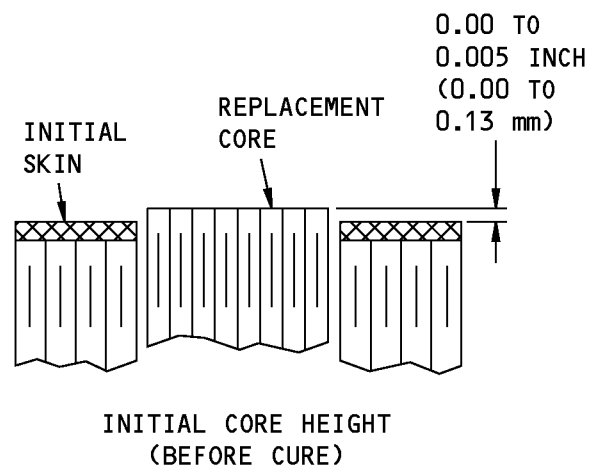


**FULL DEPTH CORE REPLACEMENT
(TYPICAL) 1**

(B)



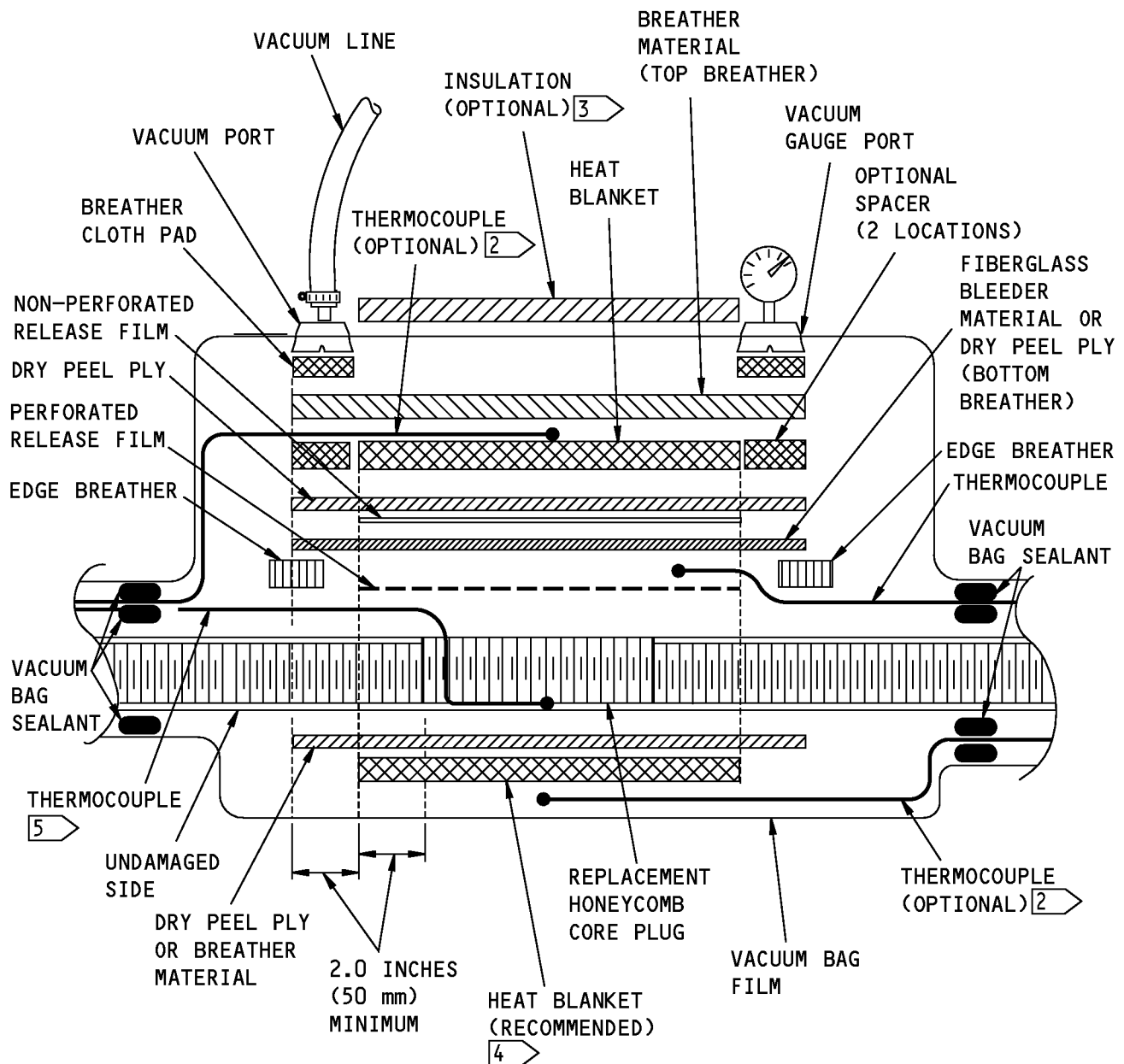
(C)



(D)

**Installation of the Repair Core
Figure 210 (Sheet 1 of 3)**

757-200
STRUCTURAL REPAIR MANUAL



VACUUM BAG PROCEDURE FOR REPLACEMENT CORE
WHEN THE TWO STAGE CURE PROCEDURE IS USED

E

Installation of the Repair Core
Figure 210 (Sheet 2 of 3)



757-200
STRUCTURAL REPAIR MANUAL

NOTES

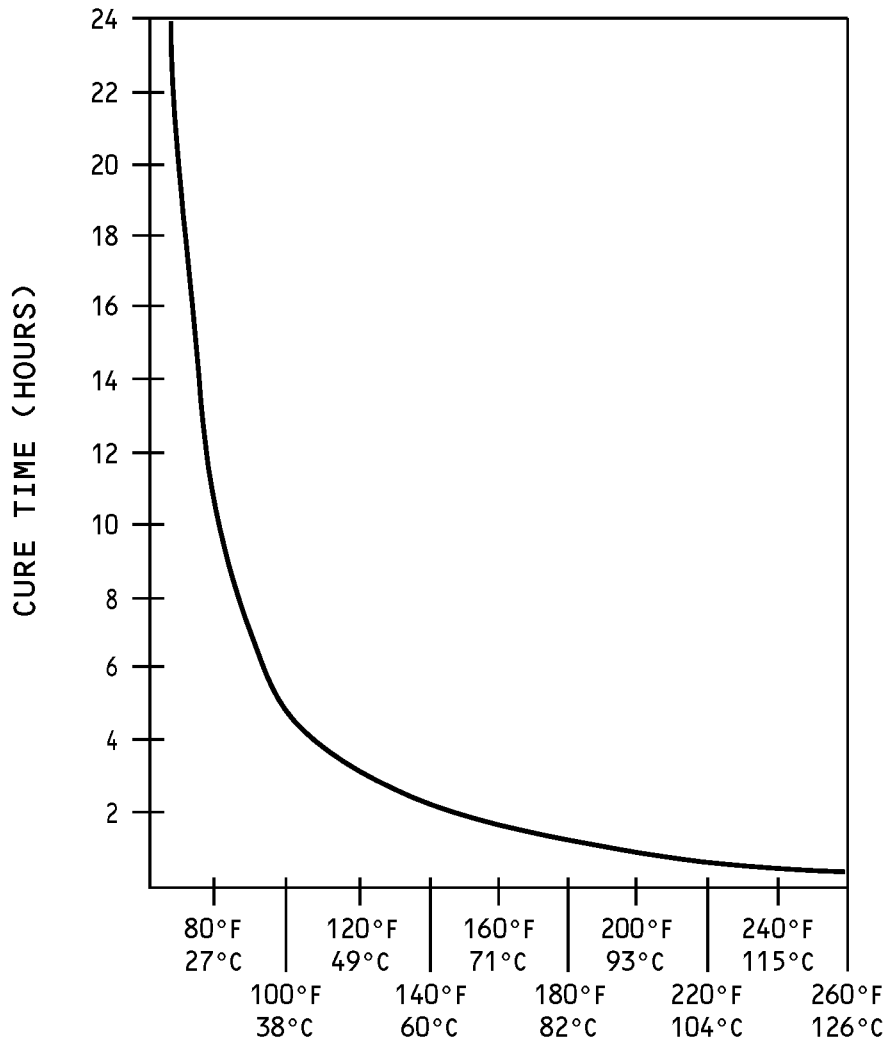
- 1 > MAXIMUM ERROR OF THE CELL WALLS AFTER INSTALLATION OF THE REPAIR CORE.
- 2 > YOU CAN USE THESE THERMOCOUPLES TO MAKE SURE THAT IF THE HEAT BLANKET GETS TOO HOT, YOU CAN TURN OFF THE POWER SUPPLY BEFORE YOU DAMAGE THE SKIN PANEL.
- 3 > 4-8 PLIES OF BREATHER MATERIAL IS AN EXAMPLE. YOU CAN USE OTHER INSULATION MATERIALS ALSO. THIS WILL KEEP THE HEAT IN THE REPAIR AREA.
- 4 > IF YOU USE A HEAT BLANKET ON THE UNDAMAGED SIDE, MAKE SURE THAT THE HEAT BLANKET CAN BE HELD AGAINST THE PART. A VACUUM BAG CAN BE USED TO HOLD THE HEAT BLANKET, OR YOU CAN PUT THE PART ON A TOOL SURFACE (WITH INSULATION BETWEEN THE HEAT BLANKET AND THE TOOL SURFACE.
- 5 > THERMOCOUPLE CONFIGURATION WHEN HEAT IS NOT APPLIED TO THE UNDAMAGED SIDE. IT IS PERMITTED TO LET THE THERMOCOUPLE STAY IN POSITION AFTER THE COMPLETION OF THE CURE CYCLE. CUT OFF THE WIRE AT THE TOP OF THE CORE.

Installation of the Repair Core
Figure 210 (Sheet 3 of 3)

STRUCTURAL REPAIR MANUAL

CLASS	POT LIFE AT LESS THAN 80°F (27°C)	PARTS BY WEIGHT PART A (BASE)		PARTS BY WEIGHT PART B (HARDENER)
		TYPE I	TYPE V	TYPE I AND V
1	20 MINUTES MAXIMUM	140	49	100
2	60 MINUTES MAXIMUM	140	49	100
3	90 MINUTES MAXIMUM	140	---	100
4	120 MINUTES MAXIMUM	140	---	100

**BMS 5-92 TWO-PART PASTE ADHESIVE MIXTURE DATA
TABLE A**

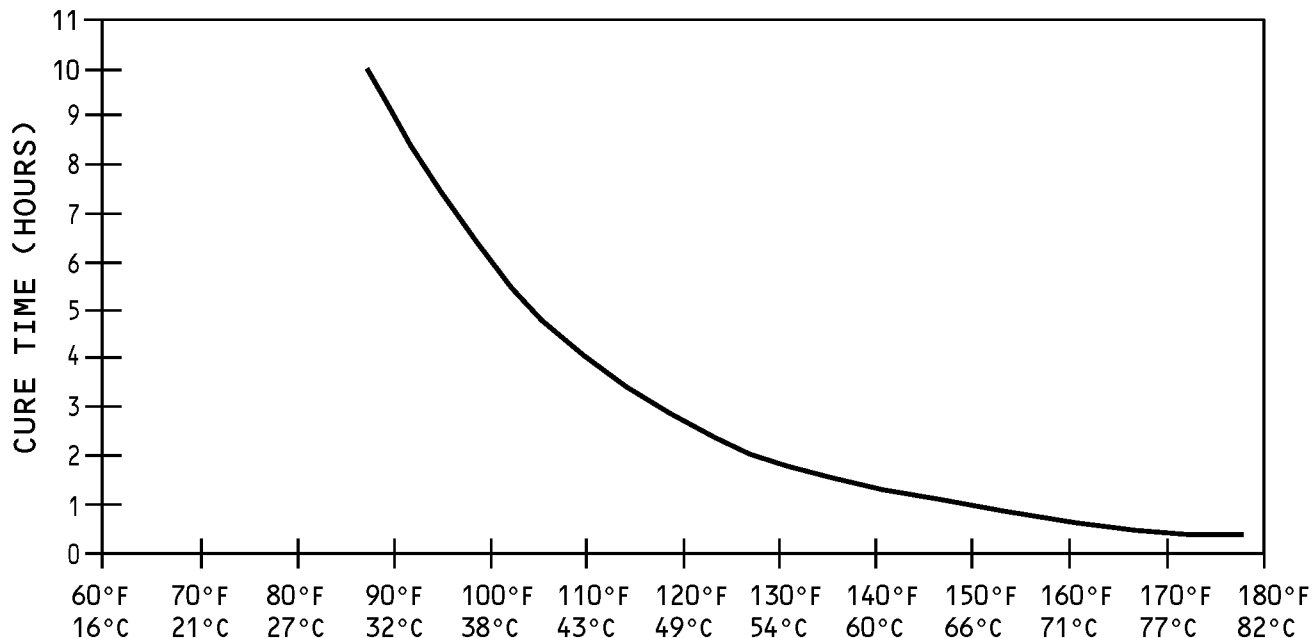


BMS 5-92, TYPE I CURE TEMPERATURE

(A)

**Cure Time for BMS5-92, Two-part Paste Adhesive
Figure 211 (Sheet 1 of 2)**

757-200
STRUCTURAL REPAIR MANUAL



BMS 5-92, TYPE V, CLASS 2 CURE TEMPERATURE

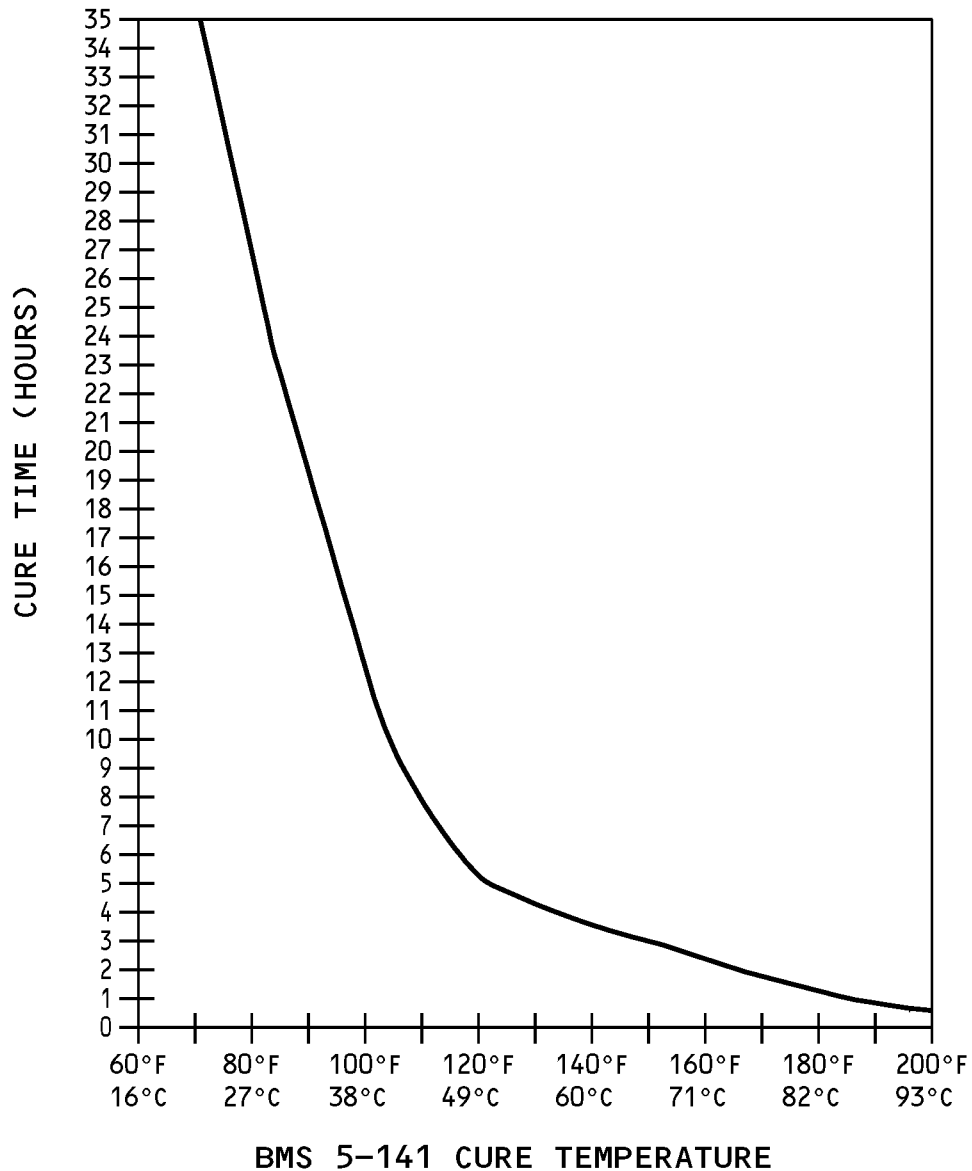
(B)

NOTES

- IF A TYPE IS NOT SPECIFIED IT IS PREFERRED THAT YOU USE TYPE V.
- CURE UNDER PRESSURE AS FOLLOWS:
 - (1) BMS5-92, TYPE V, CLASS 1 ADHESIVE:
3 HOURS MINIMUM AT 70 TO 100°F (21 TO 38°C), OR
2 HOURS MINIMUM AT 120 TO 130°F (49 TO 54°C).
 - (2) BMS5-92, TYPE V, CLASS 2 ADHESIVE:
7 HOURS MINIMUM AT 70 TO 100°F (21 TO 38°C) OR SEE CHART B.

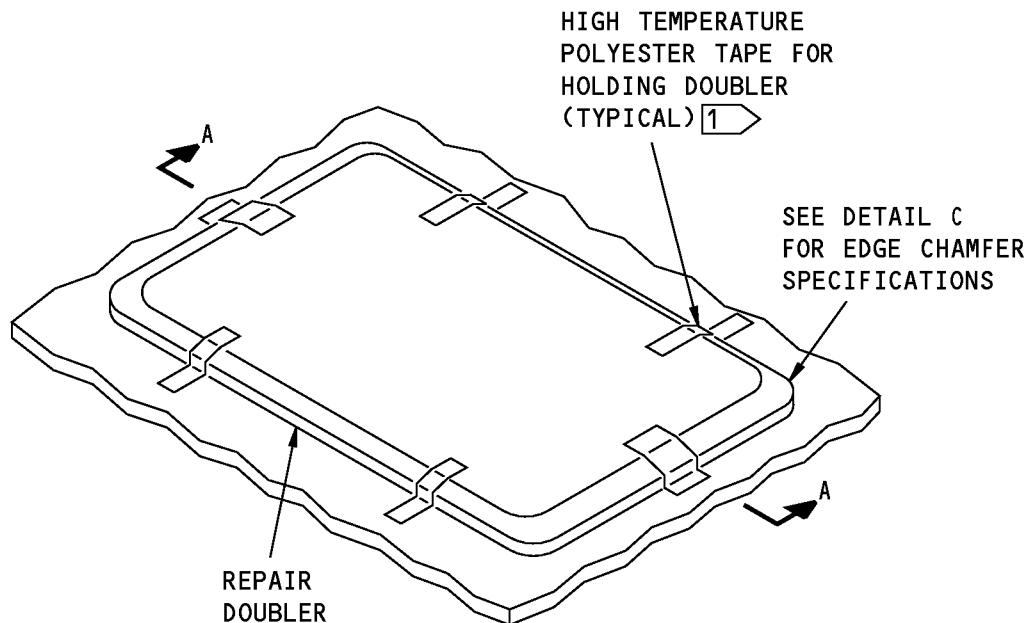
Cure Time for BMS5-92, Two-part Paste Adhesive
Figure 211 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL



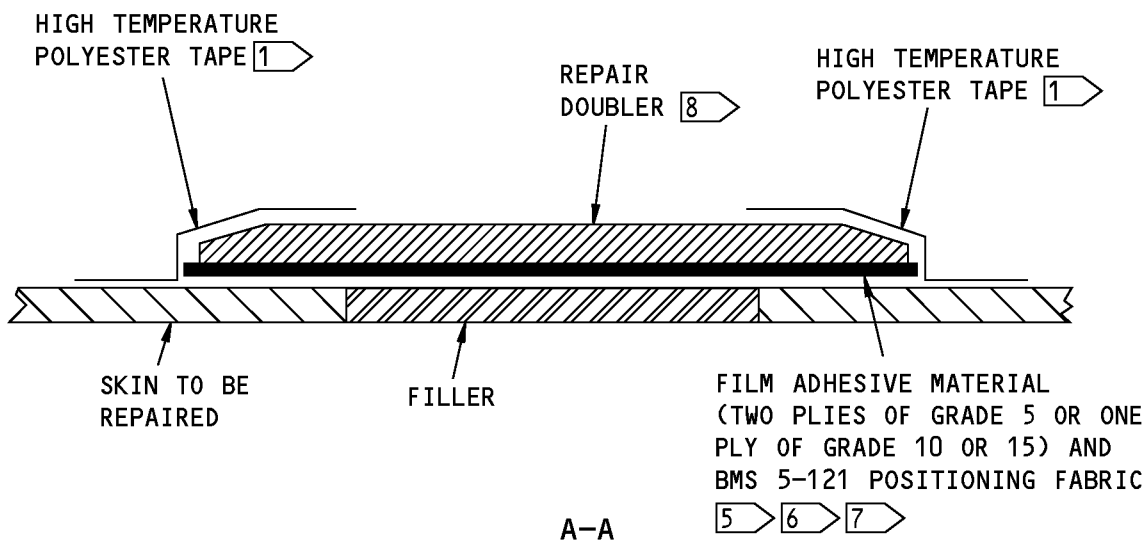
Cure Time for BMS5-141 Paste Adhesive
Figure 212

**757-200
STRUCTURAL REPAIR MANUAL**



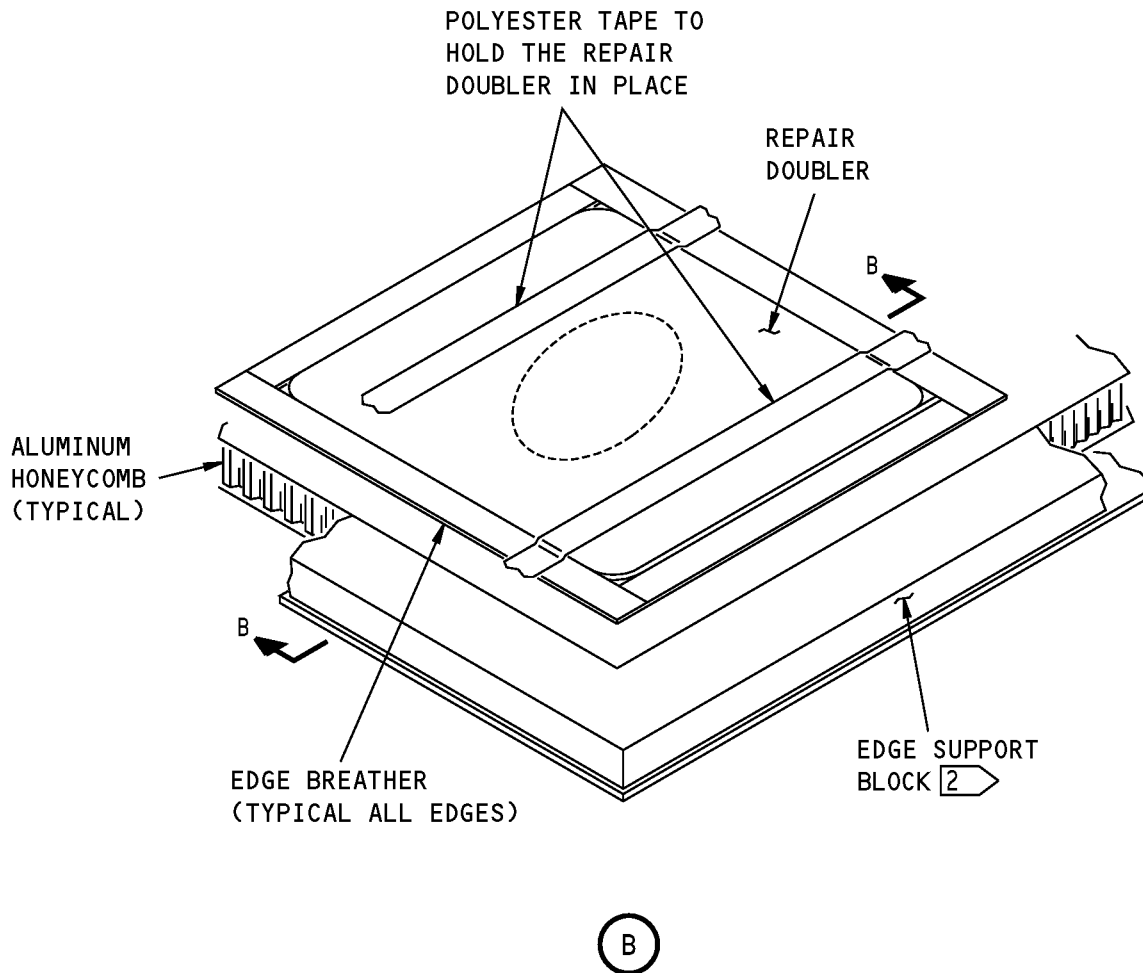
**METAL TO METAL
(NO HONEYCOMB)**

A



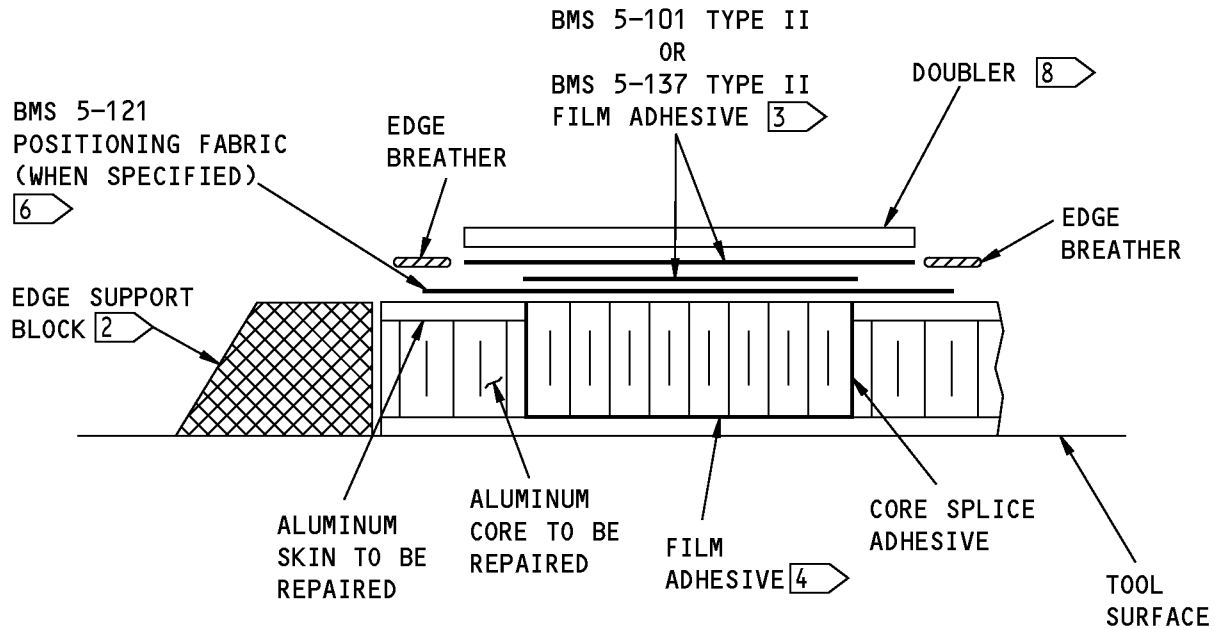
**Installation of the Repair Doubler
Figure 213 (Sheet 1 of 6)**

**757-200
STRUCTURAL REPAIR MANUAL**

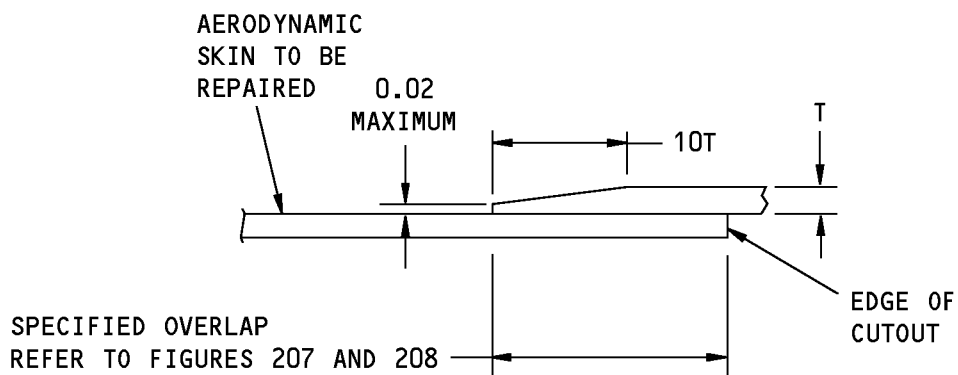


**Installation of the Repair Doubler
Figure 213 (Sheet 2 of 6)**

757-200 STRUCTURAL REPAIR MANUAL



B-B

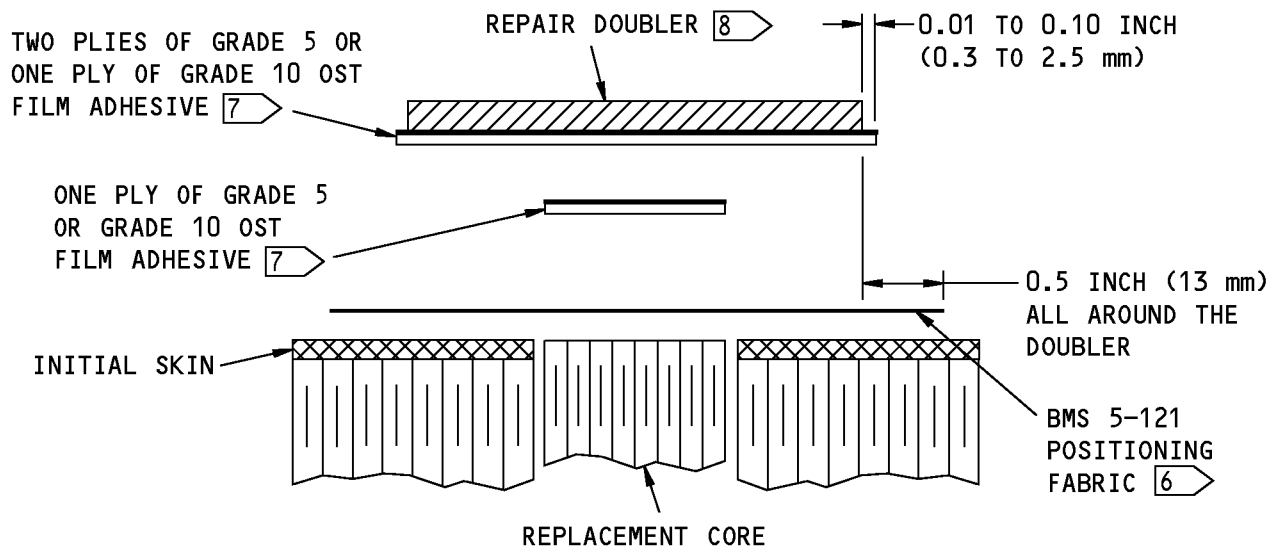


TYPICAL CHAMFERED EXTERNAL PATCH
(GAGE THICKNESS 0.032 AND MORE)

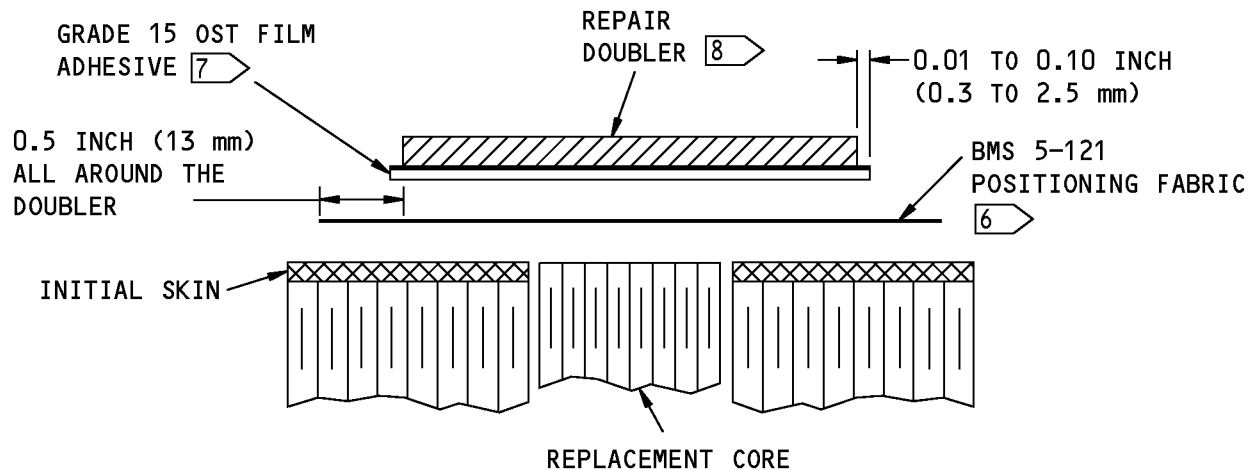
(C)

Installation of the Repair Doubler
Figure 213 (Sheet 3 of 6)

757-200
STRUCTURAL REPAIR MANUAL



**INSTALLATION OF EXTERNAL DOUBLER AND GRADE 5
OR GRADE 10 OST FILM ADHESIVE**



**INSTALLATION OF EXTERNAL DOUBLER AND
GRADE 15 OST FILM ADHESIVE** (5)

**INSTRUCTIONS TO APPLY ONE-SIDE-TACKY (OST)
FILM ADHESIVE** (7)

D

Installation of the Repair Doubler
Figure 213 (Sheet 4 of 6)

STRUCTURAL REPAIR MANUAL

TWO PLIES OF GRADE 5 OR
ONE PLY OF GRADE 10
NON-OST FILM ADHESIVE
(MAT OR KNIT CARRIER)

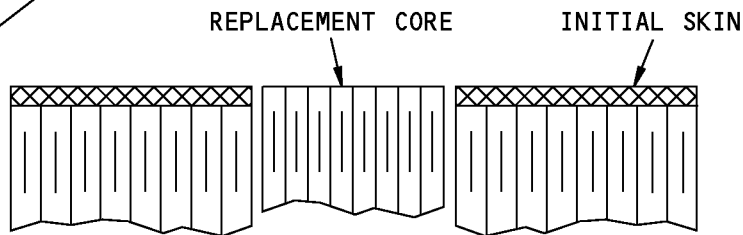
REPAIR DOUBLER [8]

0.01 TO 0.10 INCH
(0.3 TO 2.5 mm)

0.5 INCH (13 MM)
ALL AROUND THE
DOUBLER

BMS 5-121
POSITIONING
FABRIC [6]

ONE PLY OF GRADE 5 OR
GRADE 10 NON-OST FILM
ADHESIVE (MAT OR KNIT
CARRIER)



INSTALLATION OF EXTERNAL DOUBLER AND GRADE 5 OR GRADE 10 NON-OST FILM ADHESIVE

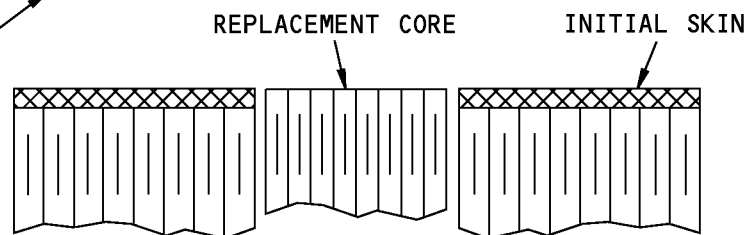
GRADE 15 NON-OST
FILM ADHESIVE
(MAT OR KNIT CARRIER)

REPAIR
DOUBLER [8]

0.01 TO 0.10 INCH
(0.3 TO 2.5 mm)

0.5 INCH (13 MM)
ALL AROUND THE
DOUBLER

BMS 5-121
POSITIONING
FABRIC [6]



INSTALLATION OF EXTERNAL DOUBLER GRADE 15 NON-OST FILM ADHESIVE [5]

INSTRUCTIONS TO APPLY NON-OST FILM ADHESIVE

E

Installation of the Repair Doubler
Figure 213 (Sheet 5 of 6)

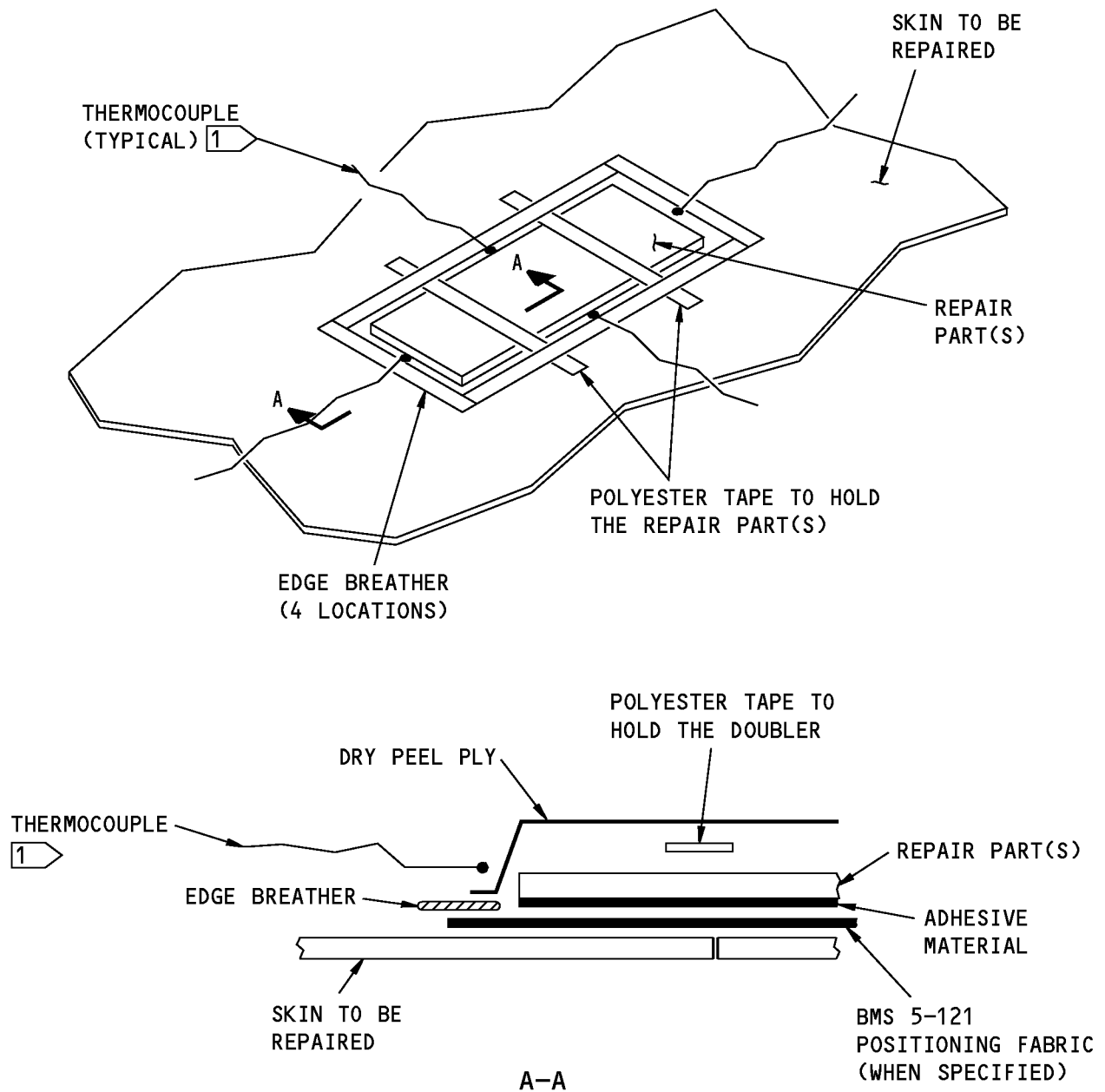
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NOTES

- THIS IS APPLICABLE FOR THE FILM ADHESIVE BOND PROCEDURE.
 - MAKE SURE THAT ALL SEPARATOR SHEETS ARE REMOVED BEFORE YOU ASSEMBLE THE REPAIR PARTS.
- 1 ➤ APPLY TAPE TO HOLD THE REPAIR DOUBLER IN POSITION DURING THE CURE. DO NOT SEAL THE EDGES OF THE PANEL. IF YOU SEAL THE EDGES OF THE PANEL WITH TAPE, IT CAN PREVENT THE FLOW OF THE ADHESIVE MATERIAL AND THE REMOVAL OF AIR DURING THE FINAL STAGE OF THE CURE. APPLY LESS THAN 25 PERCENT OF THE EDGE LENGTH OF THE REPAIR DOUBLER WITH TAPE.
 - 2 ➤ ONLY NECESSARY FOR SQUARE EDGED HONEYCOMB PANELS.
 - 3 ➤ USE THREE PLYS OF GRADE 5, TWO PLYS OF GRADE 10 OR ONE PLY OF GRADE 15 BETWEEN THE REPAIR DOUBLER AND THE CORE. IF GRADE 5 OR GRADE 10 IS USED, MAKE THE BOTTOM PLY THE SAME DIMENSIONS AS THE CORE. MAKE THE TOP PLY (PLIES) THE SAME SIZE AS THE THE DOUBLER. SEE DETAIL D AND DETAIL E.
 - 4 ➤ USE THREE PLYS OF GRADE 5, TWO PLYS OF GRADE 10 OR ONE PLY OF GRADE 15 CUT TO THE SAME DIMENSIONS AS THE HOLE.
 - 5 ➤ DO NOT USE GRADE 15 FILM ADHESIVE IF THE DOUBLER TO BE BONDED IS ≤ 0.020 GAGE
 - 6 ➤ REFER TO PARAGRAPH 18 FOR POSITIONING FABRIC APPLICABILITY AND LIMITATIONS.
 - 7 ➤ IF BMS 5-101 TYPE II OST IS INSTALLED WITH BMS 5-121 POSITIONING FABRIC, THEN PUT THE TACKY SIDE DOWN AGAINST THE POSITIONING FABRIC. IF OST IS INSTALLED WITHOUT POSITIONING FABRIC (WHEN THERE IS 64 SQUARE INCHES (400 SQUARE cm) OR LESS OF OPEN CORE) THEN PUT THE MAT SIDE DOWN AGAINST THE OPEN CORE.
 - 8 ➤ IF MORE THAN ONE DOUBLER IS NECESSARY, THEN PUT FILM ADHESIVE MATERIAL (TWO PLYS OF GRADE 5 OR ONE PLY OF GRADE 10 OR 15) AND BMS 5-121 POSITIONING FABRIC BETWEEN EACH DOUBLER. 6 ➤ 7 ➤

Installation of the Repair Doubler
Figure 213 (Sheet 6 of 6)

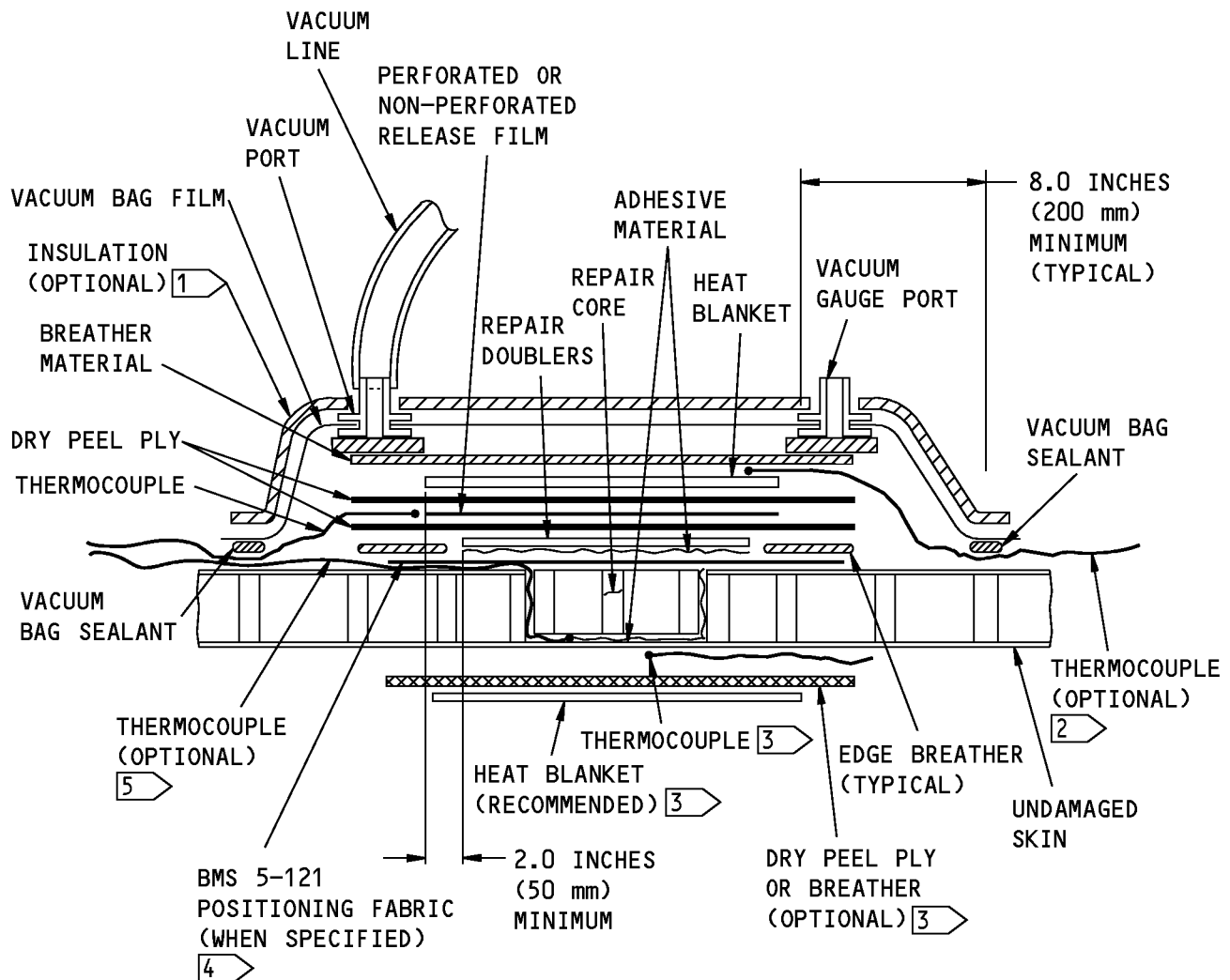
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- 1** REPAIRS MUST HAVE A MINIMUM OF FOUR THERMOCOUPLES AT THE EDGES OF THE LARGEST REPAIR PART. SPACE THE THERMOCOUPLES EQUAL DISTANCES AROUND THE REPAIR PART(S).

**Thermocouple Locations
Figure 214**

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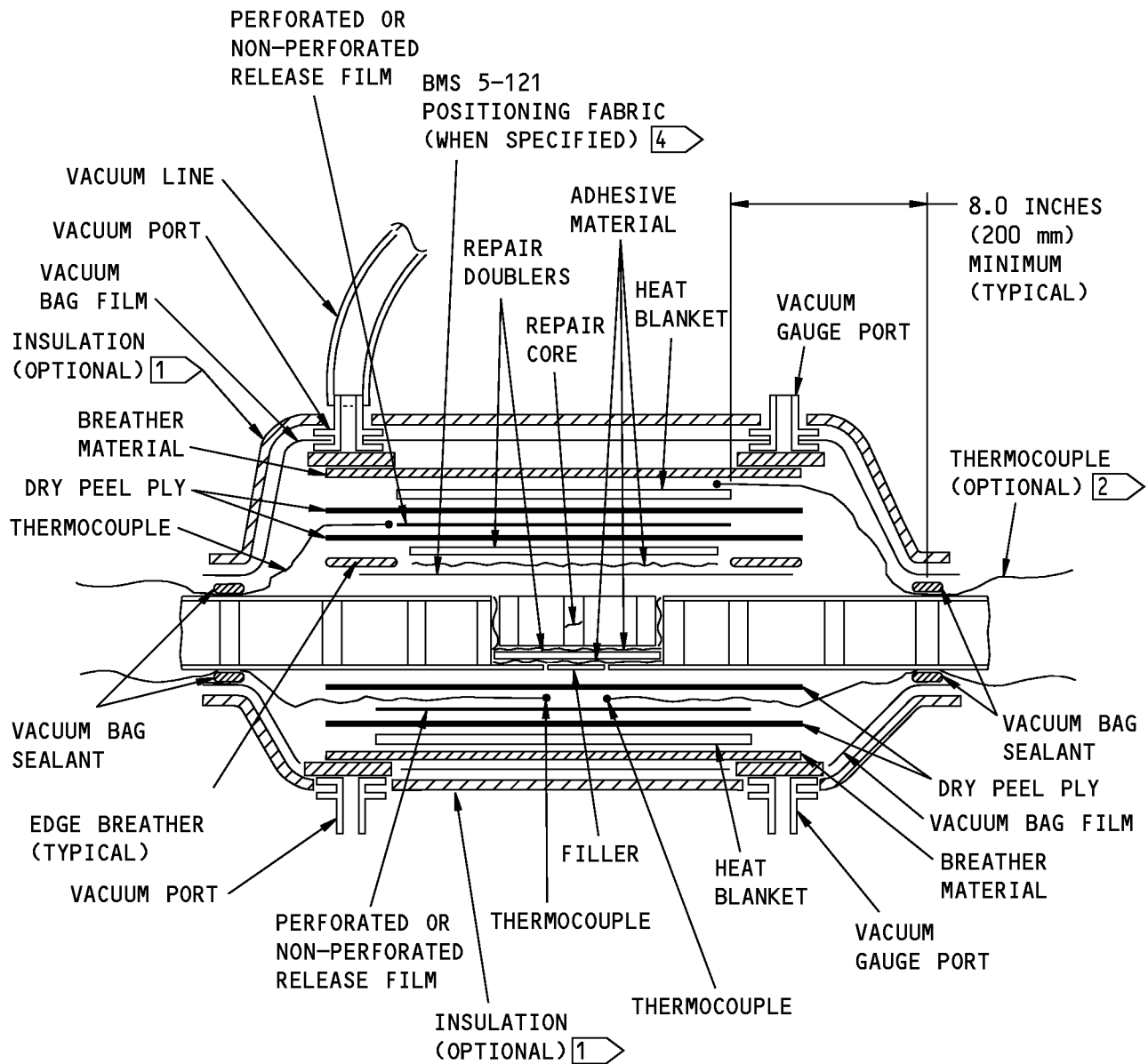


REPAIR OF DAMAGE TO ONE SIDE

A

Layup of Vacuum Bagging Materials
Figure 215 (Sheet 1 of 5)

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STRUCTURAL REPAIR MANUAL

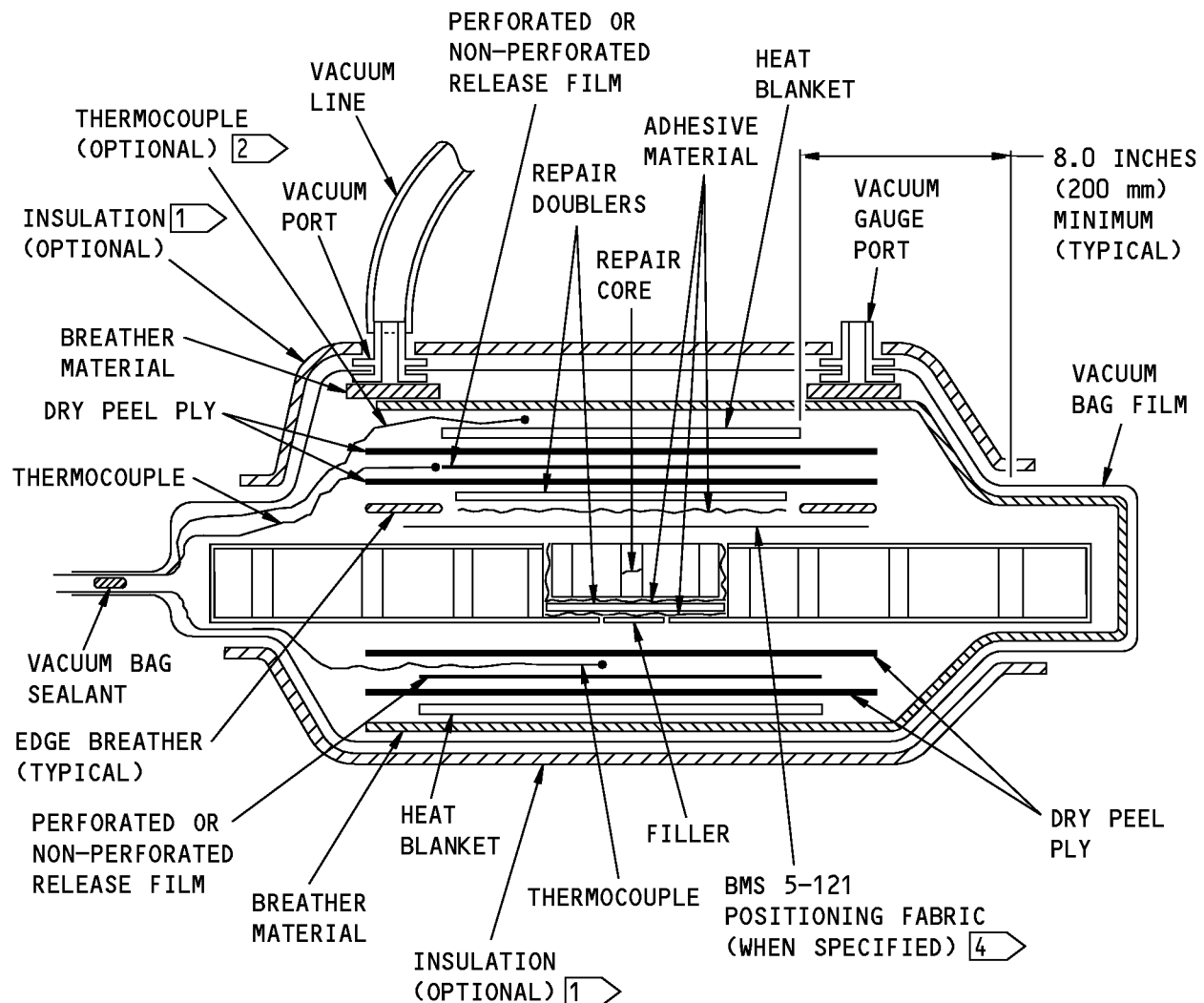


REPAIR OF DAMAGE TO BOTH SIDES
(SEPARATE VACCUM BAGS)

B

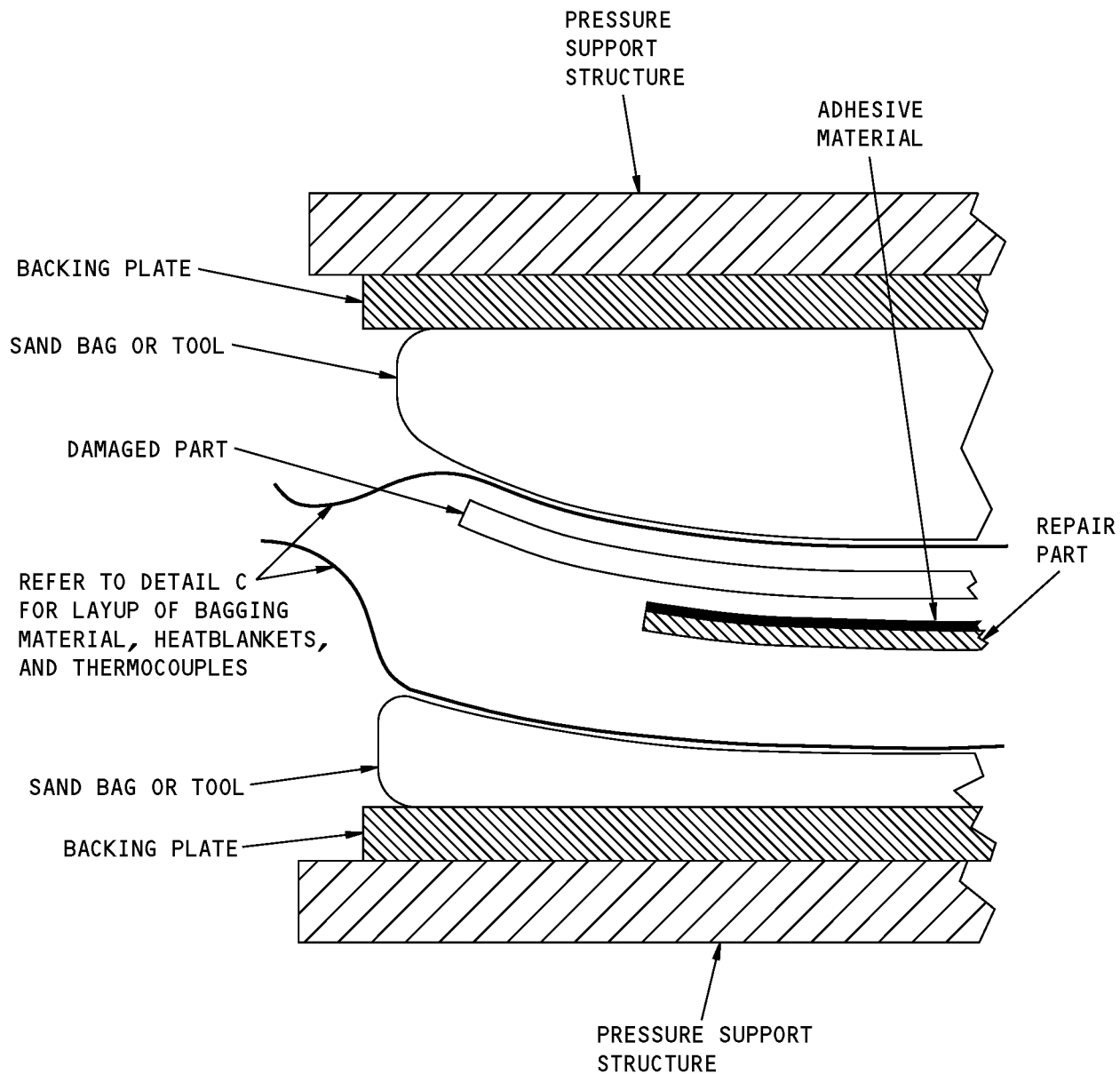
Layup of Vacuum Bagging Materials
Figure 215 (Sheet 2 of 5)

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**Layup of Vacuum Bagging Materials
Figure 215 (Sheet 3 of 5)**

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**APPLICATION OF PRESSURE FOR ROUNDED OR
CONTOURED PANELS**

D

**Layup of Vacuum Bagging Materials
Figure 215 (Sheet 4 of 5)**

STRUCTURAL REPAIR MANUAL**NOTES**

- THIS FIGURE SHOWS THE LAYUP FOR A ONE STAGE CURE PROCEDURE. THE LAYUP FOR THE SECOND STAGE OF A TWO STAGE CURE PROCEDURE IS ALMOST THE SAME. REFER TO FIGURE 210 FOR THE INSTRUCTIONS TO DO THE FIRST STAGE OF A TWO STAGE CURE PROCEDURE.
- REFER TO FIGURE 208 AND FIGURE 209 FOR REPAIR DOUBLER SPECIFICATIONS.
- REFER TO FIGURE 210 FOR CORE ALIGNMENT AND HEIGHT SPECIFICATIONS.

- 1 4-8 PLIES OF BREATHER MATERIAL IS AN EXAMPLE. YOU CAN USE OTHER INSULATING MATERIALS ALSO. THIS WILL KEEP THE HEAT IN THE REPAIR AREA.
 - 2 YOU CAN USE THESE THERMOCOUPLES TO MAKE SURE THAT IF THE HEAT BLANKET GETS TOO HOT, YOU CAN TURN OFF THE POWER SUPPLY BEFORE YOU DAMAGE THE SKIN PANEL.
 - 3 IF YOU DO A TWO STAGE CURE PROCEDURE TO REPAIR THE CORE, REFER TO FIGURE 210 FOR THE FIRST STAGE OF THE PROCEDURE. IF YOU DO THE ONE STAGE CURE PROCEDURE, THEN YOU MUST HAVE ACCESS TO EACH SIDE OF THE HONEYCOMB PANEL.
 - PUT A THERMOCOUPLE ON THE UNDAMAGED FACESHEET AT THE LOCATION OF THE REPAIR CORE. IT IS RECOMMENDED THAT YOU PUT A DRY PEEL PLY OR BREATHER AND HEAT BLANKET ABOVE THE THERMOCOUPLE ON THE UNDAMAGED SKIN.
- TWO STAGE CURE PROCEDURE IS NECESSARY TO REPAIR THE CORE IF:
- THE DAMAGE IS LARGER THAN 64 SQUARE INCHES (0.041 SQUARE METERS) OR,
 - IF YOU CAN NOT PUT A THERMOCOUPLE AT THE REPAIR CORE LOCATION ON EACH SIDE OF THE HONEYCOMB PANEL.
- 4 REFER TO FIGURE 213 TO SEE WHEN AND HOW TO USE POSITIONING FABRIC.
 - 5 THERMOCOUPLE CONFIGURATION WHEN HEAT IS NOT APPLIED TO THE UNDAMAGED SIDE. IT IS PERMITTED TO LET THE THERMOCOUPLE STAY IN POSITION AFTER THE COMPLETION OF THE CURE CYCLE. CUT OFF THE WIRE AT THE EDGE OF THE DOUBLER.

Layup of Vacuum Bagging Materials
Figure 215 (Sheet 5 of 5)



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REPAIR 1 - REPAIR OF A DISBOND AT THE EDGE OF ALUMINUM HONEYCOMB STRUCTURE

1. Applicability

- A. Repair 1 is a typical repair that is applicable to damage on the edge of an aluminum honeycomb panel.

2. General

- A. The illustrations and instructions in this repair show different examples of repairs and types of damage. You can do repairs that put together one or more of these examples. Use the correct repair procedures for each type of example.
- B. Refer to Figure 201/REPAIR 1 for this procedure.
 - (1) A disbond of a facesheet can not be deeper 0.50 inch (12.5mm) into the panel edgeband.
 - (2) The cumulative (total) length of multiple disbonds can not be longer than 30 percent of the length of the edge.
 - (3) The initial adhesive primer (between the separated skins) must be satisfactory.

3. Repair Procedures

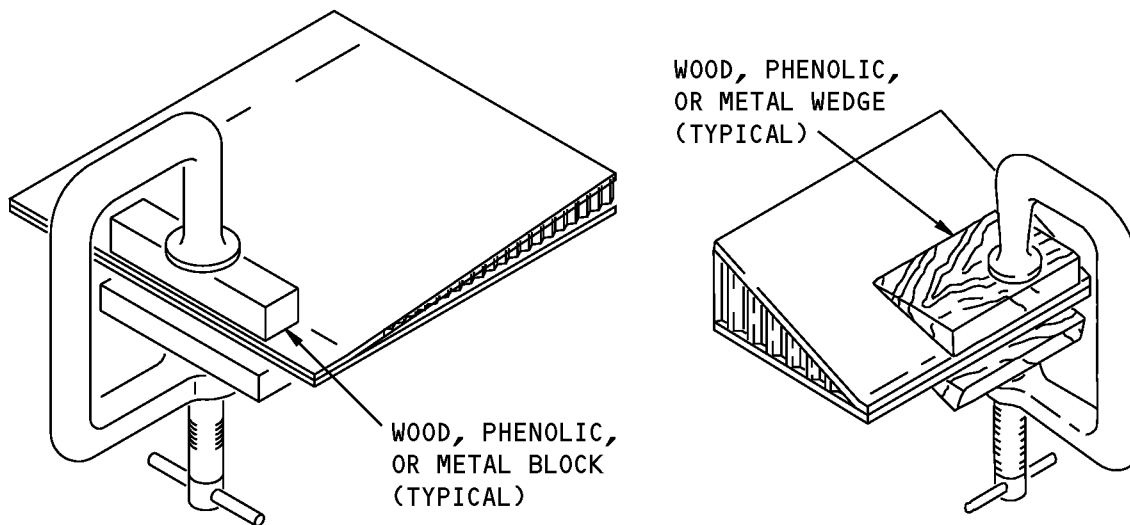
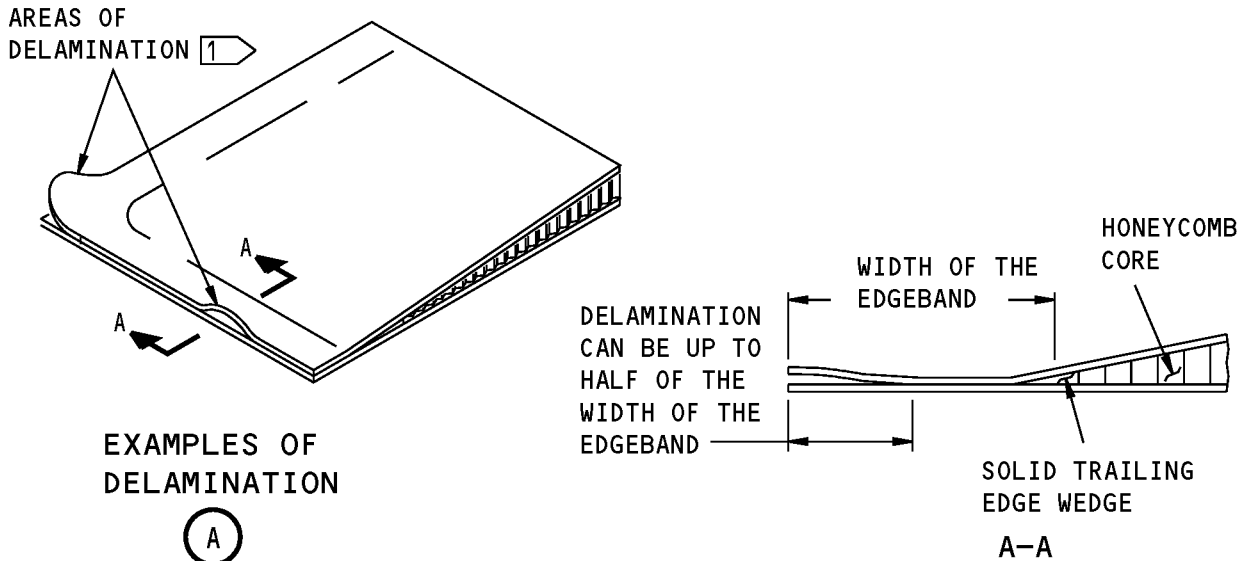
- A. Find the limits of the damage. If you have cracks or corrosion to the edge, then refer to Paragraph 6./REPAIR GENERAL Repairs to Large Damage, for the repair instructions.
- B. Remove all of the water and other contamination, in and around the damaged area.

NOTE: The area must be fully dry before you continue on with this repair procedure. If necessary, you can dry the area at a faster rate with an external heat source. Limit the temperature to a maximum of 150°F (66°C).
- C. Inspect the primer to make sure that it has not been damaged as given in Paragraph 6.B./REPAIR GENERAL.
- D. Prepare and apply a two part paste adhesive in the disbonded area as given in Paragraph 19./REPAIR GENERAL.
- E. Use a clamp to hold the skins together. Use a light clamping pressure to hold the skins together.

NOTE: To apply the clamping pressure equally, use wood, metal, or phenolic wedges (or blocks, if more applicable) between the skin and clamps.

 - (1) Make sure that there is no air caught in-between the adhesive material and the skins.
 - (2) Remove unwanted adhesive material that can appear from the edge of the disbonded area.
- F. Cure the repair as given in Paragraph 20./REPAIR GENERAL.
- G. Examine the repair as given in Paragraph 21./REPAIR GENERAL.
- H. Clean, seal and finish as given in Paragraph 22./REPAIR GENERAL.

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NOTES

- 1 THE DISBOND MUST NOT GO INTO THE HONEYCOMB CORE. DISBONDS AT FASTENER HOLES ARE NOT PERMITTED. THE CUMULATIVE (TOTAL) LENGTH OF MULTIPLE DISBONDS MUST BE LESS THAN 30% OF THE LENGTH OF THE EDGE BAND.

Repair of Disbonds at an Edge
Figure 201



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REPAIR 2 - REPAIRS TO SMALL DAMAGE

1. Applicability

- A. Repair 2 has typical repairs that are applicable to dents, nicks, creases, gouges, cracks and small holes on one side of a aluminum honeycomb sandwich structure. Refer to 51-10-02, GENERAL for the damage definitions.

NOTE: These repairs are limited to damage that is 2.0 inches (50 mm) or less in length and diameter. These repairs are interim when paste adhesive is used. Inspect paste adhesive repairs each 24 months or less, or each 3500 flight cycles or less (no later than the interval that occurs first). Refer to Figure 201/REPAIR GENERAL for other repair options.

- B. Refer to REPAIR 4 for all damage that is larger than 2.0 inches (50 mm) in length and diameter.

2. General

- A. The illustrations and instructions in this repair show different examples of repairs and types of damage. You can do repairs that put together one or more of these examples. Use the correct repair procedures for each type of example.

- B. Proximity of repairs.

(1) Repair doublers must be a minimum of 2.0 inches (50 mm) apart, edge to edge.

(2) If a repair doubler will be closer than 2.0 inches (50 mm) to an adjacent repair doubler, then use one doubler for the multiple damage areas.

NOTE: If the repair doubler will be too close to a doubler from an old repair, then you can remove the old doubler. Then use one large doubler for the old damage and the new damage.

- C. Refer to Figure 201/REPAIR GENERAL for repair sizes and options.

(1) Refer to Figure 201/REPAIR 2 for the layout of a dent repair.

(2) Refer to Figure 202/REPAIR 2 for the layout of a repair to a nick, gouge or crack in the skin.

(3) Refer to Figure 203/REPAIR 2 for the layout of a small hole repair.

- D. Refer to Table 203/REPAIR GENERAL for the cure information for the adhesive.

3. References

Reference	Title
51-10-02, GENERAL	Inspection and Removal of Damage
NDT Part 1, 51-04-00	Ultrasonic
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure

4. Repair Instructions

- A. Do a non-destructive inspection (NDI) to find the limits of the visible damage. If there is delaminated skin then cut out the damaged area and do a hole repair. Refer to NDT Part 1, 51-05-01 or NDT Part 1, 51-04-00.

- B. Remove the surface finish and all contamination as specified in REPAIR GENERAL.

- C. Repair to a surface that has a crack.

(1) Stop drill the ends of cracks as specified in 51-10-02, GENERAL.

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- (2) If there is an adhesive primer on the surface then do an inspection as specified in Paragraph 6.B./REPAIR GENERAL. If the primer is in a satisfactory condition, then permit the primer to remain. Clean the primer with a clean cloth that is moist with MEK. Some primer will come off on to the cloth. This is permitted if bare metal does not show. If bare metal shows after the surface is rubbed, then the primer must be removed from all of the surface to be bonded, and you must do the surface preparation and primer procedure again.
- (3) If there is no adhesive primer, or if the primer is not in a satisfactory condition, then do a surface preparation procedure as specified in Paragraph 11./REPAIR GENERAL.

D. Repair to a surface that has a small hole.

- (1) Remove the damaged skin and core.
- (2) The maximum size of a hole that can be filled with potting compound is 1.0 inch (25 mm) in diameter. If the hole is larger than 1.0 inch (25 mm), then make and install a repair core as specified in Paragraph 8./REPAIR GENERAL and Paragraph 9./REPAIR GENERAL.
- (3) If there is an adhesive primer on the surface then do an inspection as specified in Paragraph 6.B./REPAIR GENERAL. If the primer is in a satisfactory condition, then permit the primer to remain. Clean the primer with a clean cloth that is moist with MEK. Some primer will come off on to the cloth. This is permitted if bare metal does not show. If bare metal shows after the surface is rubbed, then the primer must be removed from all of the surface to be bonded, and you must do the surface preparation and primer procedure again.
- (4) If there is no adhesive primer, or if the primer is not in a satisfactory condition, then do a surface preparation procedure as specified in Paragraph 11./REPAIR GENERAL.

E. Repair of dents.

- (1) If the depth of a dent is equal or deeper than two times the skin thickness, then the dent repair is time-limited. Remove the doubler at 24 months (or less) or each 3500 flight cycles or less (no later than the interval that occurs first) and do a hole repair.
- (2) Apply strong finger pressure to the damaged area to see if the core compresses. If the core compresses, then the dent repair is time-limited. Remove the doubler at 24 months (or less) or each 3500 flight cycles or less (no later than the interval that occurs first) and do a hole repair.
- (3) If there is an adhesive primer on the surface then do an inspection as specified in Paragraph 6.B./REPAIR GENERAL. If the primer is in a satisfactory condition, then permit the primer to remain. Clean the primer as specified in Paragraph 6./REPAIR GENERAL.
- (4) Fill the dent. Do one of the procedures that follow:
 - (a) Potting compound procedure.
 - 1) Abrade the area of the dent with 180 grit sandpaper. Fill with BMS 5-28 Type 6 or 7 potting compound.
 - 2) Cure as specified in Table 203/REPAIR GENERAL.
 - 3) Abrade the potting compound until it is flush with the undamaged skin. If there is adhesive primer on the surface to be bonded, do not damage the primer during the sanding procedure.
 - 4) If there is no adhesive primer on the surface to be bonded, or if the primer is not in a satisfactory condition, then do a surface preparation procedure as specified in Paragraph 11./REPAIR GENERAL.
 - (b) Paste adhesive procedure.

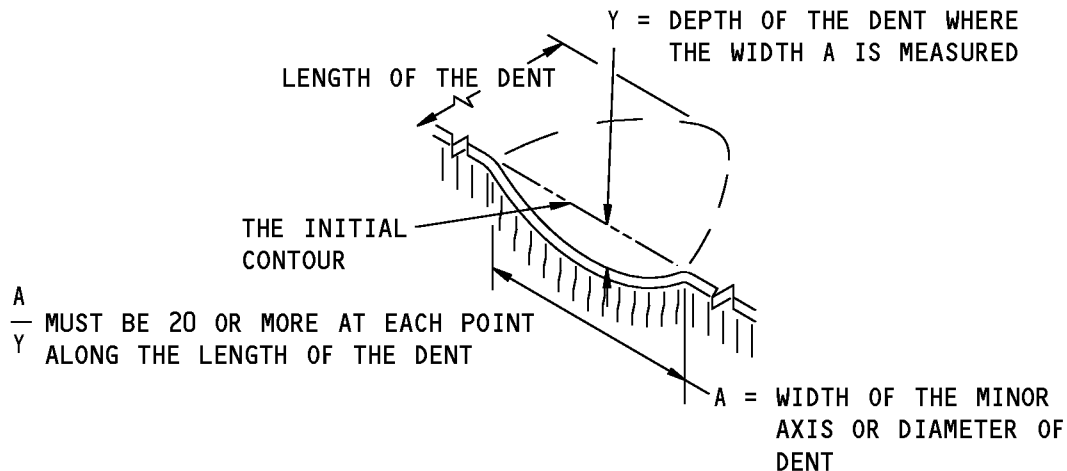


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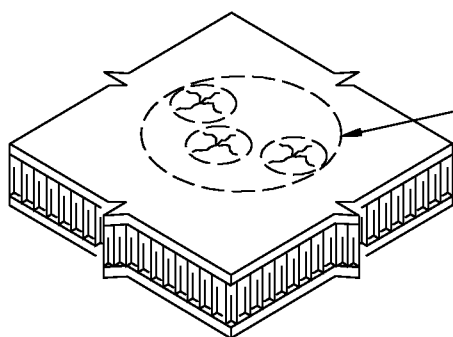
- 1) If there is no adhesive primer on the surface to be bonded, or if the primer is not in a satisfactory condition, then do a surface preparation procedure as specified in Paragraph 11./REPAIR GENERAL.
 - 2) Fill the dent with the same paste adhesive that will be used to bond the doubler.
- (c) Film adhesive procedure.
- 1) If there is no adhesive primer on the surface to be bonded, or if the primer is not in a satisfactory condition, then do a surface preparation procedure as specified in Paragraph 11./REPAIR GENERAL.
 - 2) Fill the dent with the same film adhesive that will be used to bond the doubler. You can add BMS 5-121 positioning fabric to the adhesive inside the dent, (if necessary).
- F. Refer to REPAIR GENERAL for the bonding procedure and other repair steps.

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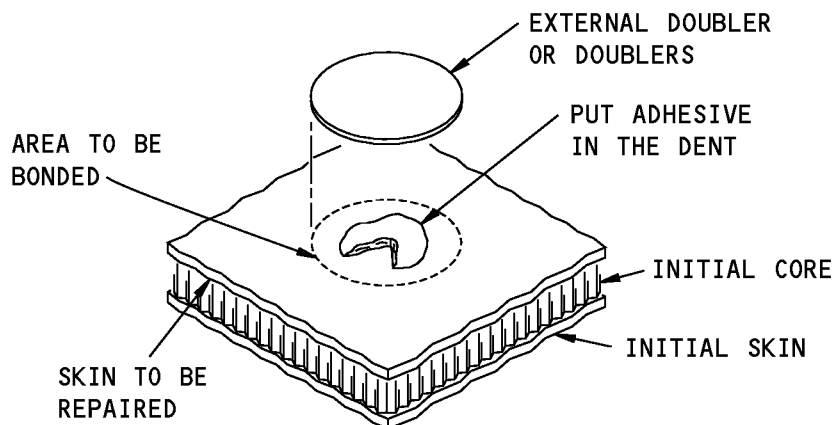
DENT THAT IS PERMITTED IN METAL HONEYCOMB STRUCTURE

(A)



SMALL DAMAGE SITES THAT ARE CLOSELY SPACED MAY BE GROUPED TOGETHER AND CONSIDERED AS ONE DAMAGE SITE

(B)

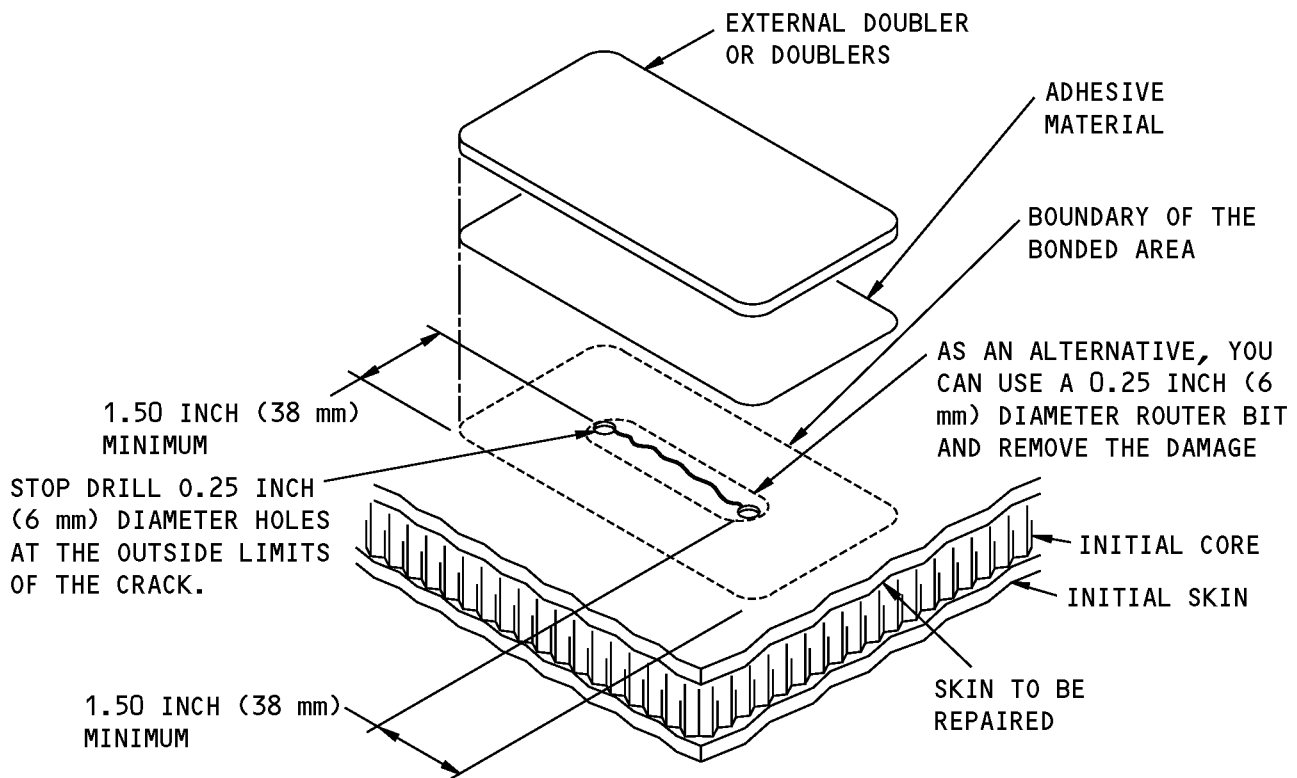


LAYOUT OF THE REPAIR PARTS

(C)

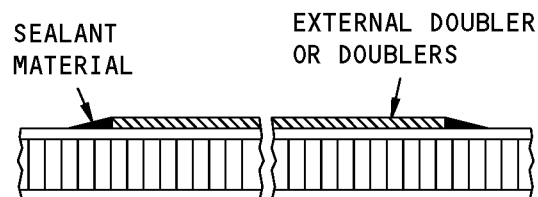
**External Doubler Repair of a Dent
Figure 201**

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LAYOUT OF THE REPAIR PARTS

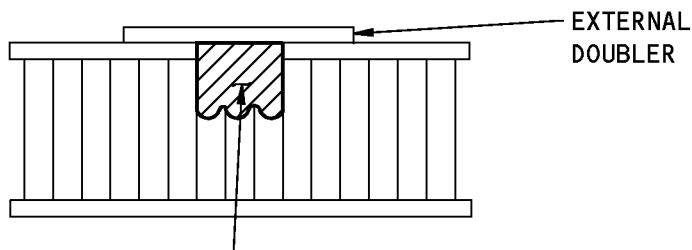
A



**SECTION THROUGH THE REPAIR
(TYPICAL)**

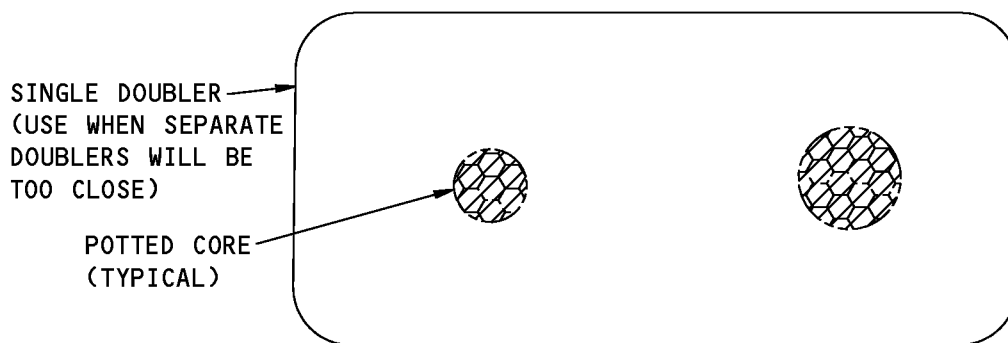
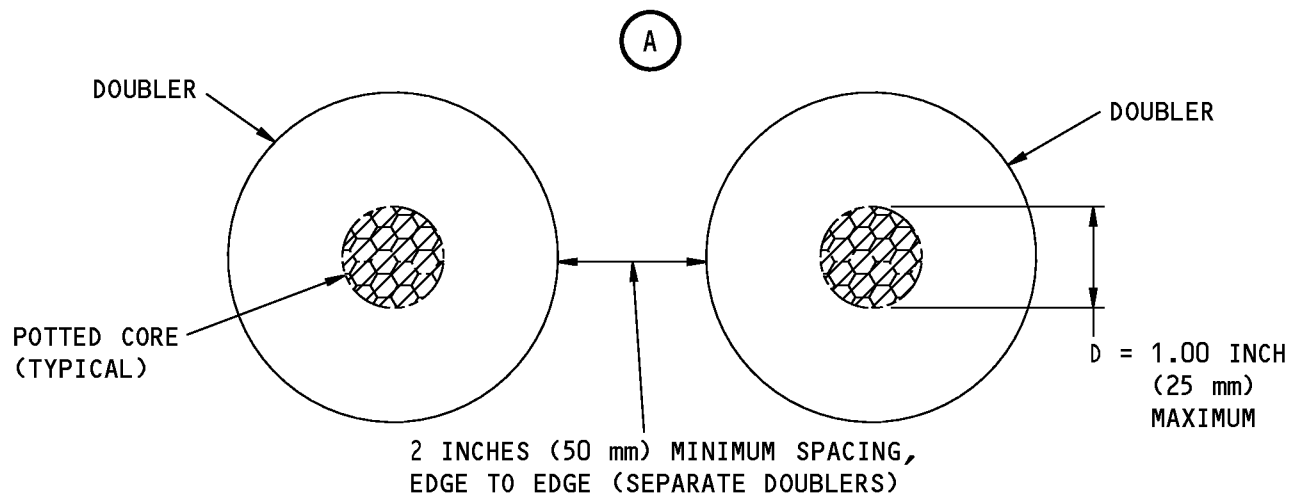
**External Doubler Repair of a Nick, Gouge, or Crack in the Skin
Figure 202**

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FILL THE CORE CELLS WITH BMS 5-28 TYPE 6 OR 7 POTTING COMPOUND
MAKE THE CELL WALLS STRAIGHT, OR CUT OUT THE CORE IF NECESSARY,
TO MAKE IT EASY TO APPLY THE POTTING COMPOUND

PERMITTED DEPTH OF POTTING COMPOUND



PERMITTED SPACING OF POTTED AREAS

(B)

Potted Core Repair for Small Damage
Figure 203



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REPAIR 3 - SEPTUMIZED CORE REPAIRS

1. Applicability

- A. Repair 3 is an alternative to the full depth honeycomb core repair.
- B. This repair uses a septum:
 - (1) To bond a partial depth core to an initial core, or
 - (2) To bond two separate cores together to make a full depth core.

2. General

- A. The illustrations and instructions in this repair show different examples of repairs and types of damage. You can do repairs that put together one or more of these examples. Use the correct repair procedures for each type of example.
- B. Refer to REPAIR GENERAL and REPAIR 4, Repairs to Large Damage, to repair the removed skin.
- C. Refer to REPAIR 3 for the configuration of the repair parts in a partial depth core replacement.
- D. Refer to Figure 202/REPAIR 3 for the configuration of the repair parts in a full depth core replacement.

3. References

Reference	Title
51-70-07, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 250°F (121°C) Cure
51-70-08, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 350°F (177°C) Cure
51-70-17, GENERAL	Repairs to 250°F (121°C) and 350°F (177°C) Cured Graphite/Aramid/Fiberglass Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Structure - 200°F (93°C) to 230°F (110°C) Wet Layup Repair Method

4. Remove the Damage

- A. Find the size limits for the damage as given in Paragraph 6./REPAIR GENERAL.
- B. Remove the damage as given in Paragraph 7./REPAIR GENERAL.
 - (1) If the core material removed is less than 1/3 the full depth of the core, then remove a sufficient quantity of the core so that the repair septum will be located at a depth of 1/3 to 2/3 the full depth of the core. Then do the steps in Paragraph 5./REPAIR 3.
 - (2) If the core material removed is more than 2/3 the full depth of the core, then do one of the steps that follow:
 - (a) Do the full depth septumized core steps in Paragraph 6./REPAIR 3 or,
 - (b) Do a full depth core repair steps as specified in Paragraph 9./REPAIR GENERAL.

5. Partial Depth Septumized Core Repair

NOTE: This repair is cured in two stages.

- A. Make the repair septum from pre-cured BMS9-3 glass fabric impregnated with BMS8-301 Class I epoxy resin, or pre-cured BMS8-79 and BMS8-139 glass fabric reinforced plastic (GFRP), or an aluminum alloy sheet.
 - (1) Applicability and Limitations.
 - (a) The septum options that follow, are permitted in aluminum honeycomb panels that were initially manufactured at 250°F (121°C):

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- 1) GFRP septum made from BMS9-3 dry fabric with BMS8-301 Class 1 resin. Refer to 51-70-17, GENERAL and Paragraph 5.A.(2)/REPAIR 3 for the procedure.
 - 2) GFRP septum made from BMS8-79 preimpregnated (preg) fabric and BMS5-129 film adhesive. Refer to 51-70-07, GENERAL and Paragraph 5.A.(2)/REPAIR 3 for the procedure.
 - 3) Aluminum and BMS5-101 film adhesive. Refer to Paragraph 5.A.(3)/REPAIR 3 for the procedure.
- (b) The septum options that follow, are permitted in aluminum honeycomb panels that were initially manufactured at 350°F (177°C):
- 1) GFRP septum made from BMS8-139 preimpregnated (preg) fabric and BMS5-154 film adhesive. Refer to 51-70-08, GENERAL and Paragraph 5.A.(2)/REPAIR 3 for the procedure.
 - 2) Aluminum and BMS5-137 film adhesive (cured at 310°F (154°C)). Refer to Paragraph 5.A.(3)/REPAIR 3 for the procedure.
- (2) Refer to 51-70-07, GENERAL or 51-70-17, GENERAL to make pre-cured GFRP.
- (a) Lightly abrade the surface resin with 180-grit or finer abrasive paper to remove the glossy surface from the pre-cured GFRP.
 - (b) Do not sand into the glass fibers.
- (3) If you use an aluminum sheet septum, then refer to REPAIR GENERAL and do the steps that follow:
- NOTE:** Do not use clad 7000 series alloy aluminum as a septum.
- (a) Do a surface preparation on each side of the septum,
 - (b) Then, put an adhesive primer on each side of the septum.
- B. Make the honeycomb repair core. Refer to Paragraph 8./REPAIR GENERAL.
- C. Apply the adhesive materials. Refer to Figure 201/REPAIR 3 for the applicable adhesive and the steps that follow:
- (1) Put film adhesive into the hole. Refer to Paragraph 9./REPAIR GENERAL.
 - (2) Put the septum in the hole.
 - (3) Put a layer of film adhesive on the septum as specified in Figure 201/REPAIR 3.
 - (4) Install the honeycomb repair core. Refer to Paragraph 9./REPAIR GENERAL.
- D. Do the first stage of the two stage cure. Refer to Paragraph 9./REPAIR GENERAL.
- E. Do a visual inspection of the repair area after the cure is completed and the thermocouples have been removed.
- (1) Look for areas of disbond in the adhesive bond between the repair core and the initial core. There must be no gaps or disbands in these areas.
- NOTE:** If you find disbands in the adhesive surface, then fill them with BMS5-28, Type 6 or Type 7 potting compound. Cure the BMS5-28 potting compound during the final stage of the cure.
- (2) Look for disbands in the adhesive materials between the septum and the repair core.
 - (a) If the diameter of the repair septum is larger than 2.0 inches, (50 mm) and you find disbands that are larger than 3/8 inch (10 mm) in diameter, then the repair is not satisfactory.

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- (b) If the diameter of the repair septum is less than 2.0 inches (50 mm), then no visible disbands are permitted.

6. Full Depth Septumized Core Repair

NOTE: This repair is cured in three stages.

- A. Cut two pieces of honeycomb core that are a minimum of 1.0 inch (25 mm) diameter larger than the hole in the component to be repaired.
- B. Each piece of honeycomb core must be a minimum of 1/3 the depth of the hole and a maximum of 2/3 the depth of the hole.
- C. The core/septum assembly must be higher than the depth of the hole.

NOTE: This will permit you to abrade the top of the core to make it flush with the skin surface.

- D. Make the repair septum from pre-cured BMS9-3 glass fabric impregnated with BMS8-301 Class 1 epoxy resin, or pre-cured BMS8-79 or BMS8-139 glass fabric reinforced plastic (GFRP), or an aluminum alloy sheet. Make the septum approximately the same size as the repair core blankets.

(1) Applicability and Limitations.

- (a) The septum options that follow, are permitted in aluminum honeycomb panels that were initially manufactured at 250°F (121°C):
 - 1) GFRP septum made from BMS9-3 dry fabric with BMS8-301 Class 1 resin. Refer to 51-70-17, GENERAL and Paragraph 6.D.(2)/REPAIR 3 for the procedure.
 - 2) GFRP septum made from BMS8-79 preimpregnated (prepreg) fabric and BMS5-129 film adhesive. Refer to 51-70-07, GENERAL and Paragraph 6.D.(2)/REPAIR 3 for the procedure.
 - 3) Aluminum and BMS5-101 film adhesive. Refer to Paragraph 6.D.(3)/REPAIR 3 for the procedure.
- (b) The septum options that follow, are permitted in aluminum honeycomb panels that were initially manufactured at 350°F (177°C):
 - 1) GFRP septum made from BMS8-139 preimpregnated (prepreg) fabric and BMS5-154 film adhesive. Refer to 51-70-08, GENERAL and Paragraph 6.D.(2)/REPAIR 3 for the procedure.
 - 2) Aluminum and BMS5-137 Type II (EA 9657 only) film adhesive cured at 310°F (154°C). Refer to Paragraph 6.D.(3)/REPAIR 3 for the procedure.
- (2) Refer to 51-70-17, GENERAL or 51-70-07, GENERAL to make pre-cured GFRP laminate.
 - (a) Lightly abrade the surface resin of the pre-cured GFRP laminate with 180-grit or finer abrasive paper to remove the glossy surface.
 - (b) Do not sand into the glass fibers.
- (3) If you use an aluminum sheet septum, then refer to REPAIR GENERAL and do the steps that follow:

NOTE: Do not use clad 7000 series alloy aluminum as a septum.

- (a) Do a surface preparation on each side of the septum,
 - (b) Then, put an adhesive primer on each side of the septum.
- E. Apply the adhesive materials. Refer to Figure 202/REPAIR 3 for the applicable adhesive and the steps that follow:



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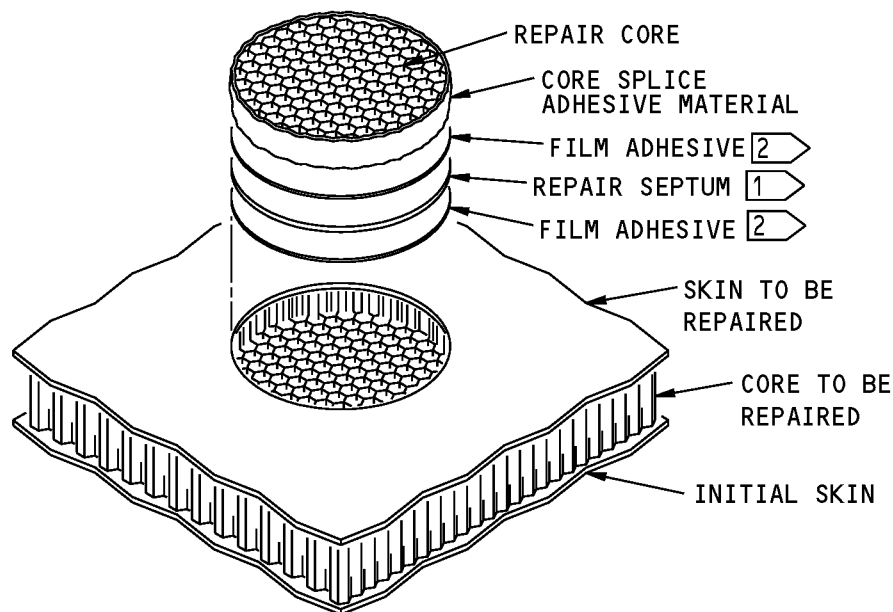
STRUCTURAL REPAIR MANUAL

- (1) Put film adhesive on the mating surface of the first honeycomb core blanket that you will bond the septum to.
 - (2) Put the septum on the first honeycomb core blanket.
 - (3) Put film adhesive on the septum.
 - (4) Put the second honeycomb core blanket on to the septum. Make sure that the ribbon direction is the same as the bottom core.
- F. Cure the honeycomb core/septum assembly. Refer to Figure 202/REPAIR 3.
- (1) Put the assembly on a clean, hard, and flat surface.
 - (2) Put edge support blocks against the edges of the assembly.
 - (3) Do the vacuum bag layup.
 - (4) Cure the assembly as specified in 51-70-07, GENERAL if the GFRP septum is used or Paragraph 20./REPAIR GENERAL if the aluminum septum is used.
- G. Cut the core/septum assembly to the necessary shape. (A core cylinder, for example).
- H. Look for disbonds in the adhesive materials between the septum and the two honeycomb repair cores.
- (1) If the diameter of the repair septum is larger than 2.0 inches, (50 mm) and you find disbonds that are larger than 3/8 inch (10 mm) in diameter, then the repair is not satisfactory.
 - (2) If the diameter of the repair septum is less than 2.0 inches (50 mm), then no visible disbonds are permitted.
- I. Install the honeycomb repair core/septum assembly and do the second stage of the three stage cure. Refer to Paragraph 9./REPAIR GENERAL.

7. Complete the Repair

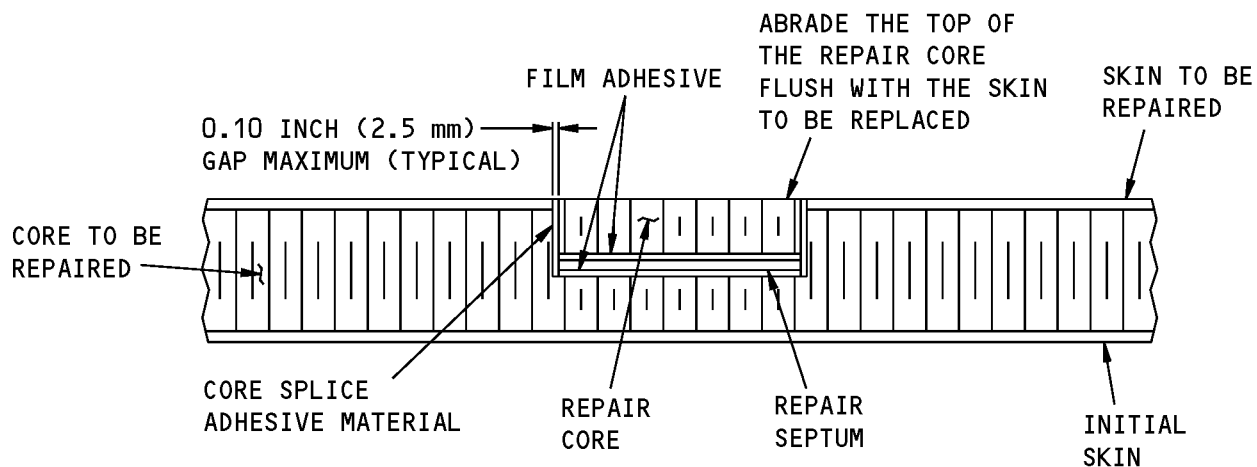
- A. Complete the repair as specified in REPAIR GENERAL and REPAIR 4, Repairs to Large Damage.

**757-200
STRUCTURAL REPAIR MANUAL**



LAYOUT OF THE REPAIR PARTS

A



SECTION THROUGH THE CENTER OF THE REPAIR AREA

**Bonded Doubler Repair That Uses an Internal Septum For a Less Than Full Depth Core Replacement
Figure 201 (Sheet 1 of 3)**

757-200
STRUCTURAL REPAIR MANUAL

NOTES

- REFER TO REPAIR GENERAL FOR REPAIR CORE INSTALLATION PROCEDURES.

1 MAKE THE SEPTUM OUT OF PRE-CURED GLASS FABRIC REINFORCED PLASTIC (GFRP) LAMINATE OR AN ALUMINUM ALLOY SHEET:

- A. TO MAKE A PRE-CURED GFRP LAMINATE FROM DRY FABRIC, REFER TO SRM 51-70-17, GENERAL. MAKE ONE OF THE LAMINATES THAT FOLLOW:
 - IMPREGNATE AND THEN CURE TWO PLIES OF BMS 9-3, TYPE H-2 GLASS FABRIC AND BMS 8-301, CLASS I EPOXY RESIN, OR
 - IMPREGNATE AND THEN CURE THREE PLIES OF BMS 9-3, TYPE D GLASS FABRIC AND BMS 8-301. CLASS I EPOXY RESIN.
- B. TO MAKE A PRE-CURED 250°F (121°C) GFRP PREPREG LAMINATE, REFER TO SRM 51-70-07, GENERAL. MAKE ONE OF THE LAMINATES THAT FOLLOW:
 - TWO PLIES OF BMS 8-79, CLASS III, STYLE 1581 OR 7781, OR
 - THREE PLIES OF BMS 8-79, CLASS III, STYLE 120 OR 220.
- C. TO MAKE A PRE-CURED 350°F (177°C) GFRP PREPREG LAMINATE, REFER TO SRM 51-70-08. MAKE ONE OF THE LAMINATES THAT FOLLOW:
 - TWO PLIES OF BMS 8-139, CLASS 1, STYLE 1581 OR 7781, OR
 - THREE PLIES OF BMS 8-139, CLASS 1, STYLE 120 OR 220.
- D. TO MAKE AN ALUMINUM ALLOY SHEET SEPTUM, USE 0.012 - 0.020 INCH THICK ALUMINUM.
 - USE THE SAME BOEING MATERIAL SPECIFICATION (BMS) ALUMINUM MATERIAL, (OR AN EQUIVALENT ALUMINUM MATERIAL). USE THE SAME (OR SIMILAR) HEAT-TREAT AS THE INITIAL ALUMINUM SKIN THAT IS TO BE REPAIRED.
 - DO NOT USE 7000 SERIES ALUMINUM THAT HAS A CLAD SURFACE. IF THE SKIN TO BE REPAIRED IS A CLAD 7000 SERIES ALUMINUM, THEN USE AN UNCLAD 7000 SERIES ALUMINUM.
 - DO A PHOSPHORIC ACID OR BOEGEL SURFACE PREPARATION.

Bonded Doubler Repair That Uses an Internal Septum For a Less Than Full Depth Core Replacement
Figure 201 (Sheet 2 of 3)



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STRUCTURAL REPAIR MANUAL

NOTES (CONT.)

2 APPLY THE ADHESIVE MATERIALS TO THE TWO MATING SURFACES OF THE REPAIR SEPTUM AS FOLLOWS:

A. FOR THE PRE-CURED 250°F (121°C) GFRP SEPTUM:

- APPLY TWO LAYERS OF BMS 5-129, TYPE IV, GRADE 10 ADHESIVE FILM.

B. FOR THE PRE-CURED 350°F (177°C) GFRP SEPTUM:

- APPLY THREE LAYERS OF BMS 5-154, GRADE 5 ADHESIVE FILM.

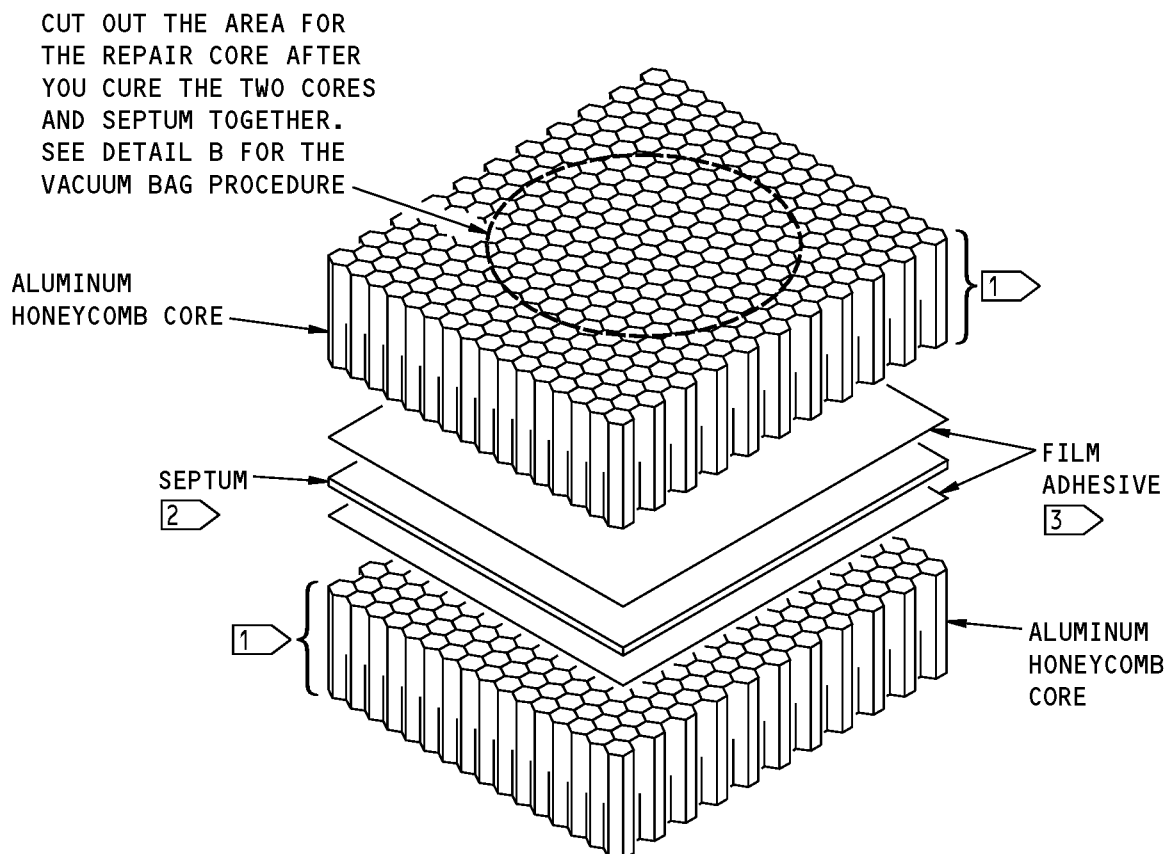
C. FOR THE ALUMINUM SEPTUM:

- APPLY TWO LAYERS OF BMS 5-101, GRADE 10 OR ONE LAYER OF BMS 5-101, GRADE 15 ADHESIVE FILM (250°F (121°C) CURE), OR

- APPLY TWO LAYERS OF BMS 5-137, TYPE II, GRADE 10 OR ONE LAYER OF BMS 5-137, TYPE II, GRADE 15 ADHESIVE FILM (310°F (154°C) CURE).

Bonded Doubler Repair That Uses an Internal Septum For a Less Than Full Depth Core Replacement
Figure 201 (Sheet 3 of 3)

757-200
STRUCTURAL REPAIR MANUAL

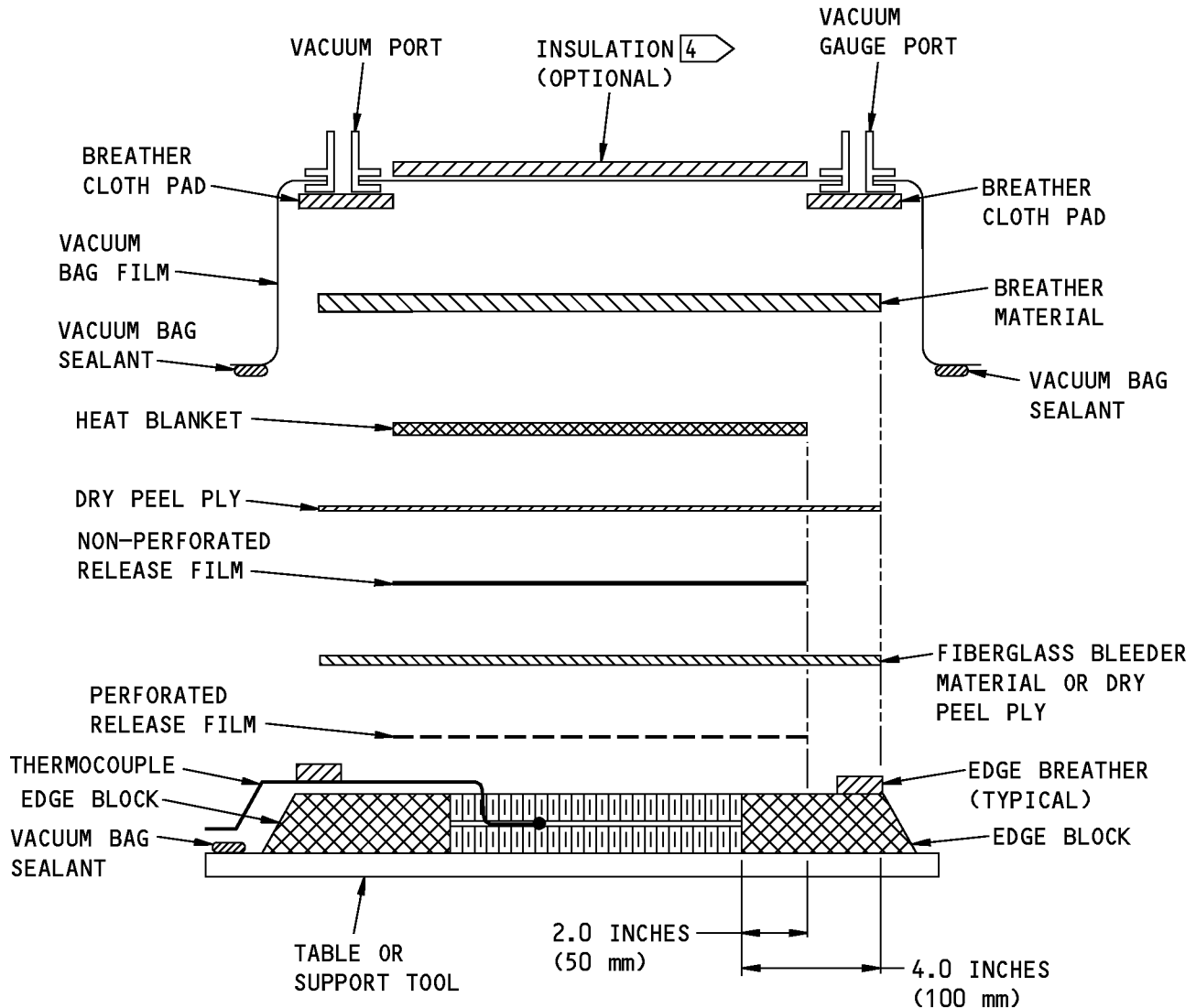


LAYOUT OF THE ALUMINUM CORE SEPTUM ASSEMBLY

(A)

Bonded Doubler Repair That Uses Two Cores and an Internal Septum for Full Core Replacement
Figure 202 (Sheet 1 of 5)

757-200 STRUCTURAL REPAIR MANUAL

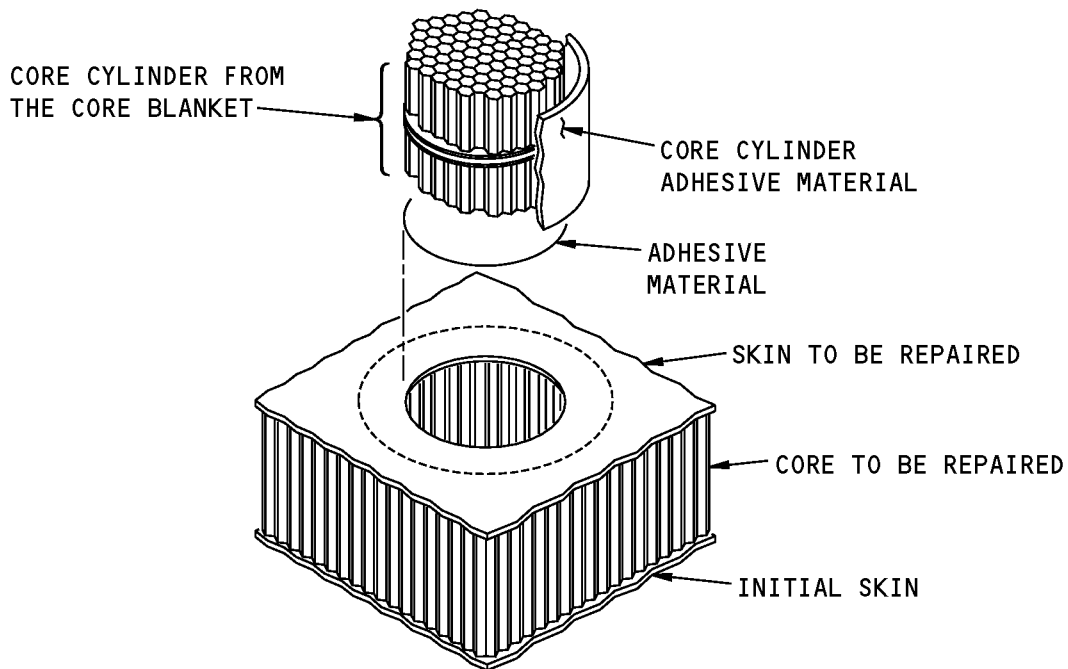


VACUUM BAG PROCEDURE

(B)

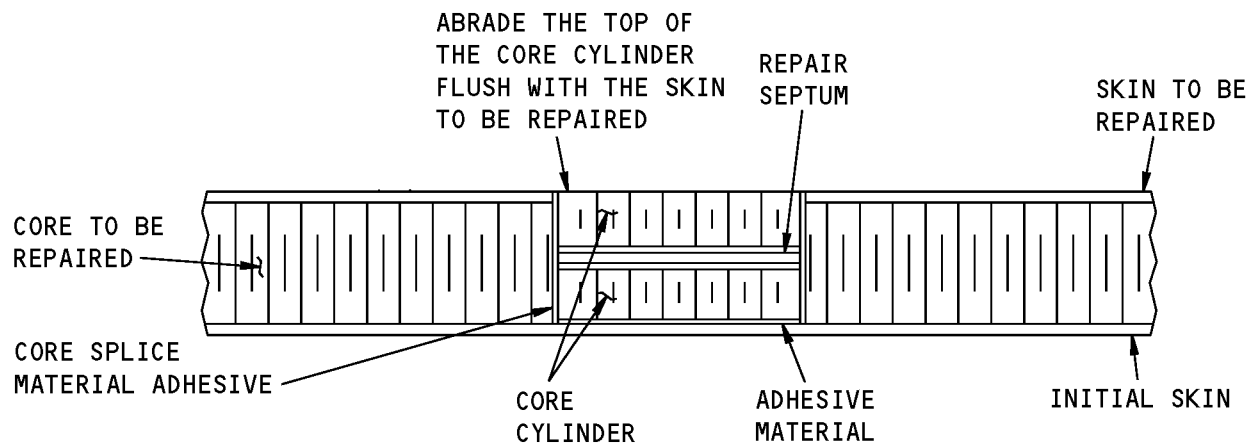
Bonded Doubler Repair That Uses Two Cores and an Internal Septum for Full Core Replacement
Figure 202 (Sheet 2 of 5)

**757-200
STRUCTURAL REPAIR MANUAL**



**LAYOUT OF THE REPAIR PARTS FOR DAMAGE
TO FULL DEPTH CORE AND ONE SKIN**

(C)



SECTION THROUGH THE CENTER OF THE REPAIR AREA

**Bonded Doubler Repair That Uses Two Cores and an Internal Septum for Full Core Replacement
Figure 202 (Sheet 3 of 5)**

STRUCTURAL REPAIR MANUAL

NOTES

- REFER TO REPAIR GENERAL FOR REPAIR CORE INSTALLATION PROCEDURES.

1 THE HEIGHT OF EACH CORE MUST BE A MINIMUM OF 1/3 THE DEPTH OF THE HOLE AND A MAXIMUM OF 2/3 THE DEPTH OF THE HOLE.

2 MAKE THE SEPTUM OUT OF PRE-CURED GLASS FABRIC REINFORCED PLASTIC (GFRP) LAMINATE OR AN ALUMINUM ALLOY SHEET:

A. TO MAKE A PRE-CURED GFRP LAMINATE FROM DRY FABRIC, REFER TO SRM 51-70-17, GENERAL. MAKE ONE OF THE LAMINATES THAT FOLLOW:

- IMPREGNATE AND THEN CURE TWO PLIES OF BMS 9-3, TYPE H-2 GLASS FABRIC AND BMS 8-301, CLASS I EPOXY RESIN, OR
- IMPREGNATE AND THEN CURE THREE PLIES OF BMS 9-3, TYPE D GLASS FABRIC AND BMS 8-301, CLASS I EPOXY RESIN.

B. TO MAKE A PRE-CURED 250°F (121°C) GFRP PREPREG LAMINATE, REFER TO SRM 51-70-07, GENERAL. MAKE ONE OF THE LAMINATES THAT FOLLOW:

- TWO PLIES OF BMS 8-79, CLASS III, STYLE 1581 OR 7781, OR
- THREE PLIES OF BMS 8-79, CLASS III, STYLE 120 OR 220.

C. TO MAKE A PRE-CURED 350°F (177°C) GFRP PREPREG LAMINATE, REFER TO SRM 51-70-08. MAKE ONE OF THE LAMINATES THAT FOLLOW:

- TWO PLIES OF BMS 8-139, CLASS 1, STYLE 1581 OR 7781, OR
- THREE PLIES OF BMS 8-139, CLASS 1, STYLE 120 OR 220.

D. TO MAKE AN ALUMINUM ALLOY SHEET SEPTUM, USE 0.012 - 0.020 INCH THICK ALUMINUM.

- USE THE SAME BOEING MATERIAL SPECIFICATION (BMS) ALUMINUM MATERIAL, (OR AN EQUIVALENT ALUMINUM MATERIAL). USE THE SAME (OR SIMILAR) HEAT-TREAT AS THE INITIAL ALUMINUM SKIN THAT IS TO BE REPAIRED.
- DO NOT USE 7000 SERIES ALUMINUM THAT HAS A CLAD SURFACE. IF THE SKIN TO BE REPAIRED IS A CLAD 7000 SERIES ALUMINUM, THEN USE AN UNCLAD 7000 SERIES ALUMINUM.
- DO A PHOSPHORIC ACID OR BOEGEL SURFACE PREPARATION.

Bonded Doubler Repair That Uses Two Cores and an Internal Septum for Full Core Replacement
Figure 202 (Sheet 4 of 5)



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STRUCTURAL REPAIR MANUAL

NOTES: (CONT.)

- 3 ➤ APPLY THE ADHESIVE MATERIALS TO THE TWO MATING SURFACES OF THE REPAIR SEPTUM AS FOLLOWS:
- A. FOR THE PRE-CURED 250°F (121°C) GFRP SEPTUM:
 - APPLY TWO LAYERS OF BMS 5-129, TYPE IV, GRADE 10 ADHESIVE FILM.
 - B. FOR THE PRE-CURED 350°F (177°C) GFRP SEPTUM:
 - APPLY THREE LAYERS OF BMS 5-154, GRADE 5 ADHESIVE FILM.
 - C. FOR THE ALUMINUM SEPTUM:
 - APPLY TWO LAYERS OF BMS 5-101, GRADE 10 OR ONE LAYER OF BMS 5-101, GRADE 15 ADHESIVE FILM (250°F (121°C) CURE), OR
 - APPLY TWO LAYERS OF BMS 5-137, TYPE II, GRADE 10 OR ONE LAYER OF BMS 5-137, TYPE II, GRADE 15 ADHESIVE FILM (310°F (154°C) CURE).
- 4 ➤ 4 - 8 PLIES OF BREATHER MATERIAL FOR EXAMPLE. YOU CAN USE OTHER INSULATION MATERIALS ALSO. THIS WILL KEEP THE HEAT IN THE REPAIR AREA.

Bonded Doubler Repair That Uses Two Cores and an Internal Septum for Full Core Replacement
Figure 202 (Sheet 5 of 5)



757-200 STRUCTURAL REPAIR MANUAL

REPAIR 4 - REPAIRS TO LARGE DAMAGE

1. Applicability

- A. This procedure has typical repairs for aluminum honeycomb sandwich structure with large damage.
- B. In these repairs, it will be necessary to remove and replace the damaged area of the skin and/or core.

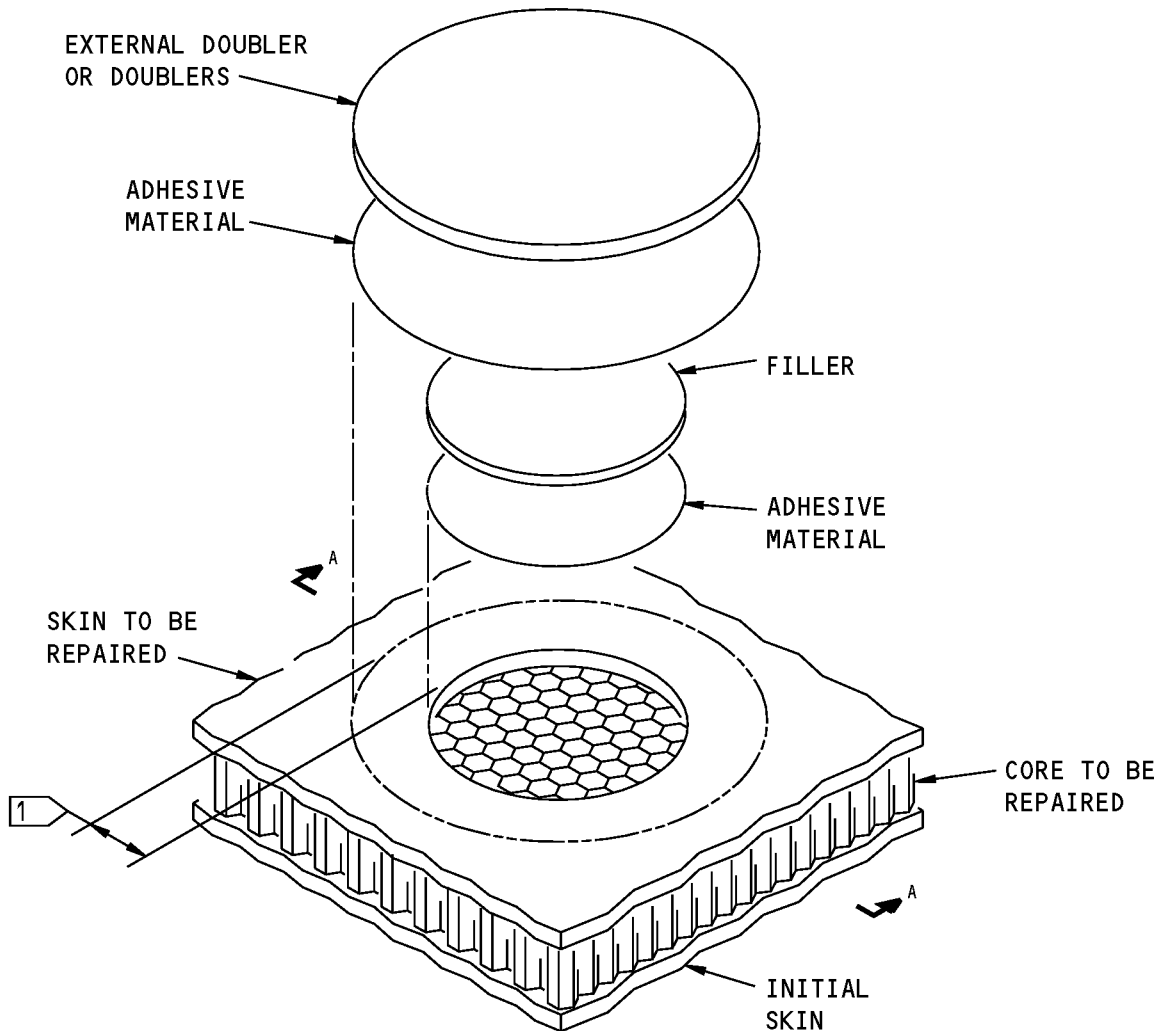
2. General

- A. The illustrations and instructions in this repair show different examples of repairs and types of damage. You can do repairs that put together one or more of these examples. Use the correct repair procedures for each type of example.
- B. If you have damage to the skin and core away from the edge, then refer to Figure 201/REPAIR 4 for the layout of the repair parts.
- C. If you have damage at the edge, then refer to Figure 202/REPAIR 4 for the layout of the repair parts.
- D. If you have damage from an edge to an edge, then refer to Figure 203/REPAIR 4 for the layout of the repair parts.
- E. Refer to Figure 204/REPAIR 4 for permitted spacing of adjacent repairs.

3. Repair Instructions

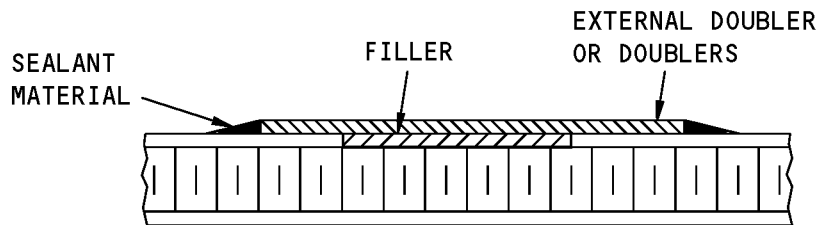
- A. Find and remove the damage as specified in Paragraph 6./REPAIR GENERAL and Paragraph 7./REPAIR GENERAL.
- B. Refer to the component engineering drawings or use NDI procedures to find the locations of internal doublers and other repairs. Refer to the repair figures for the doubler thicknesses and overlaps to use when cutouts are near a panel edgeband.
- C. If the edge of a cutout is less than 3.0 inches (75mm) from a fitting or attached structure then do one or more of the steps that follow:
 - (1) Remove the fitting or attached structure. Then remove enough skin so that all cut edges will be 3.0 inches (75mm) or more from the fitting. Then reattach the fitting.
 - (2) You can get an engineering review and replace the skin as specified in the engineering drawings.
 - (3) If you are not sure, or if these instructions will not give a satisfactory repair, then ask Boeing for help.
- D. Refer to REPAIR GENERAL for the repair steps.

**757-200
STRUCTURAL REPAIR MANUAL**



EXTERNAL DOUBLER AND FILLER REPAIR TO ONE SKIN

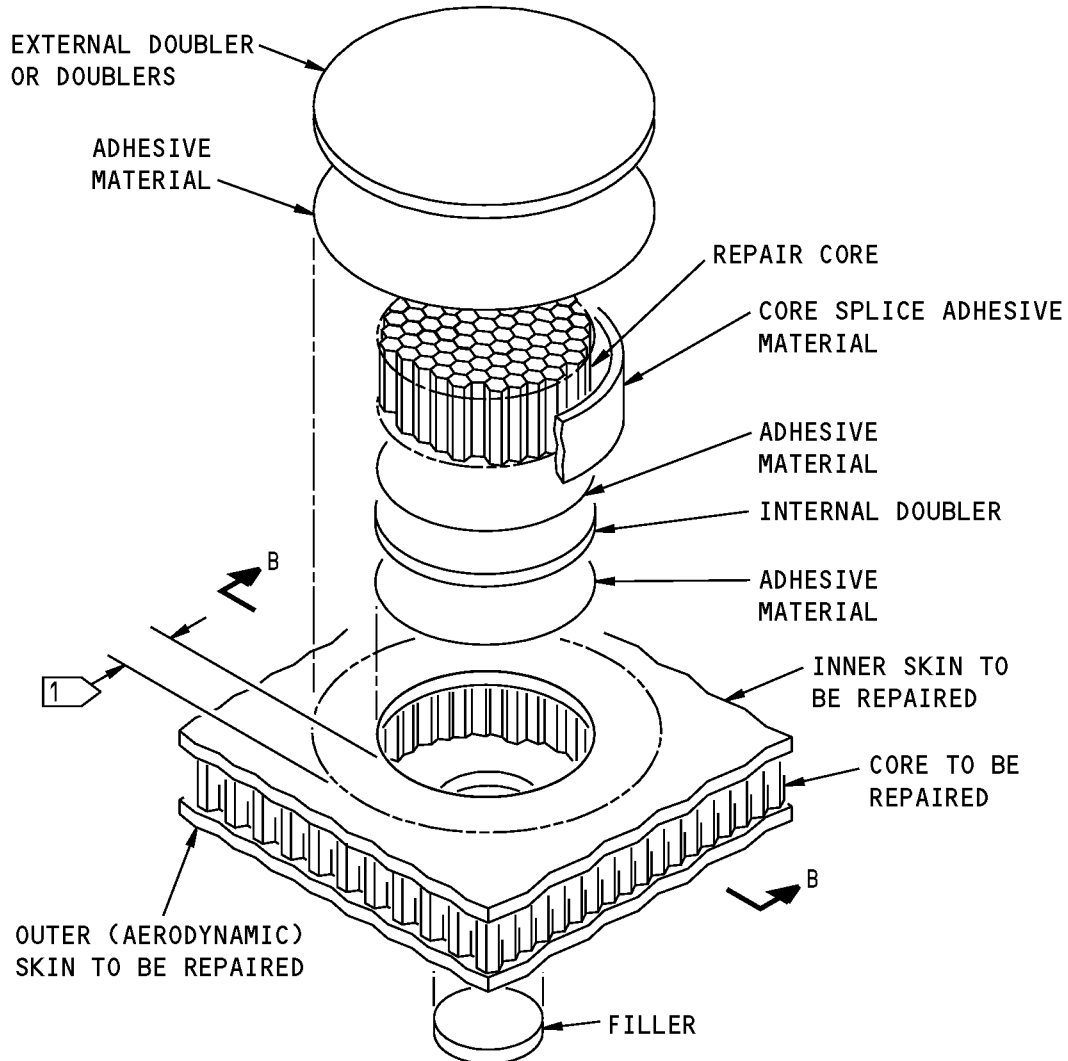
A



A-A

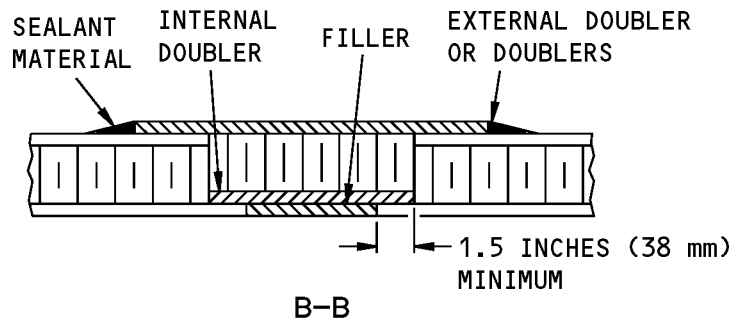
**Repair of Damage Away From the Panel Edges
Figure 201 (Sheet 1 of 5)**

757-200
STRUCTURAL REPAIR MANUAL



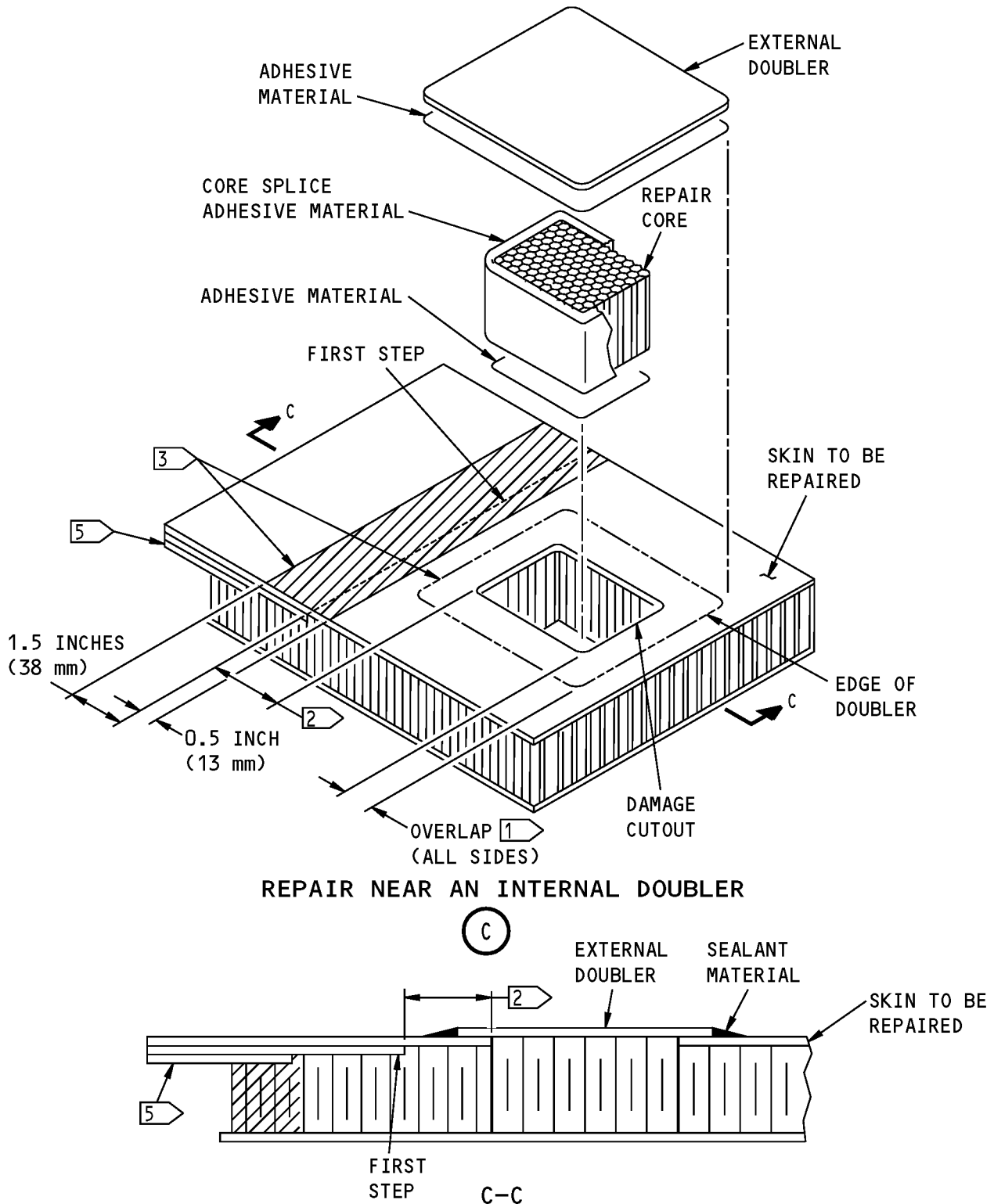
REPAIR TO CORE AND TWO SKINS

(B)



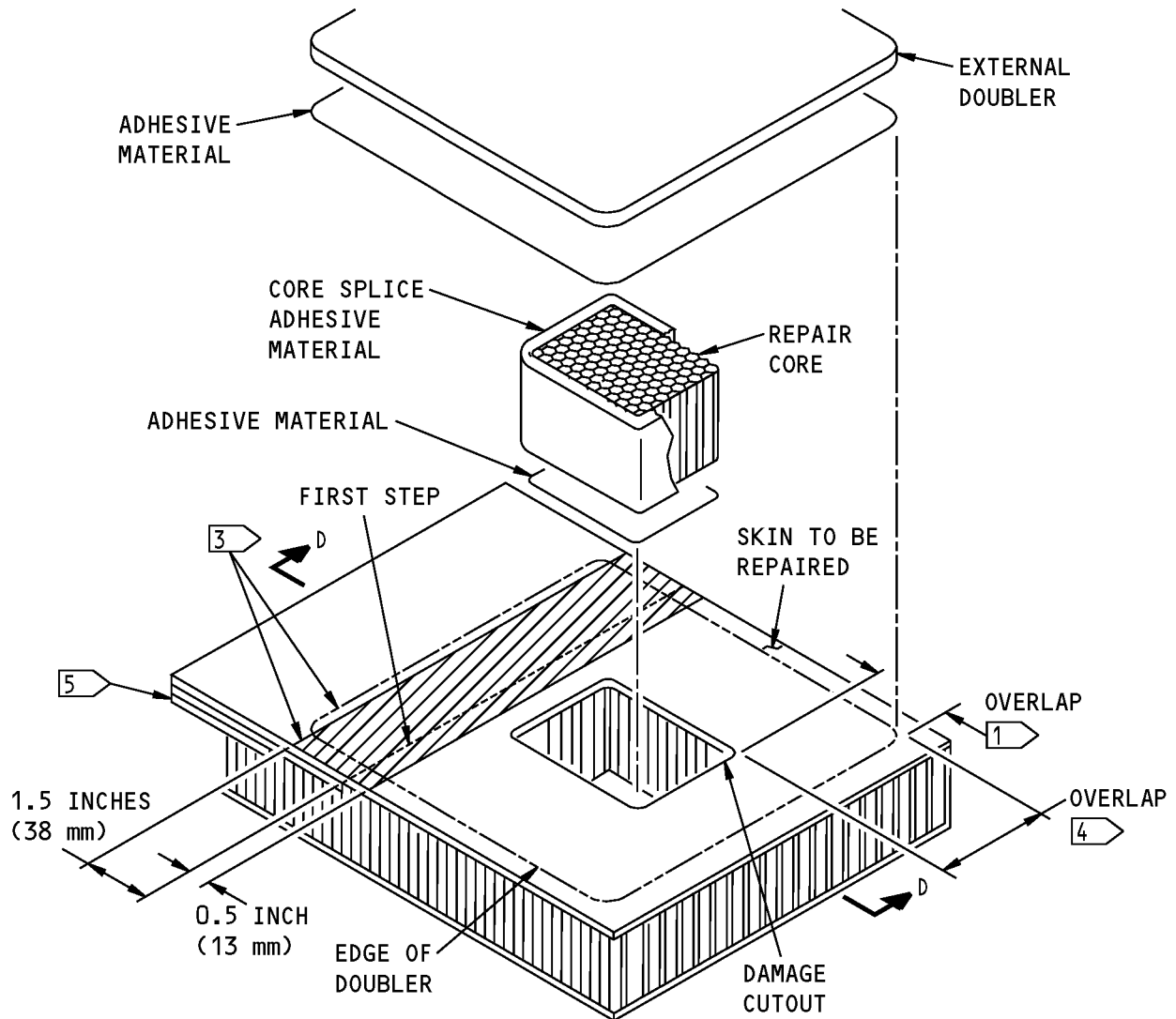
Repair of Damage Away From the Panel Edges
Figure 201 (Sheet 2 of 5)

757-200 STRUCTURAL REPAIR MANUAL



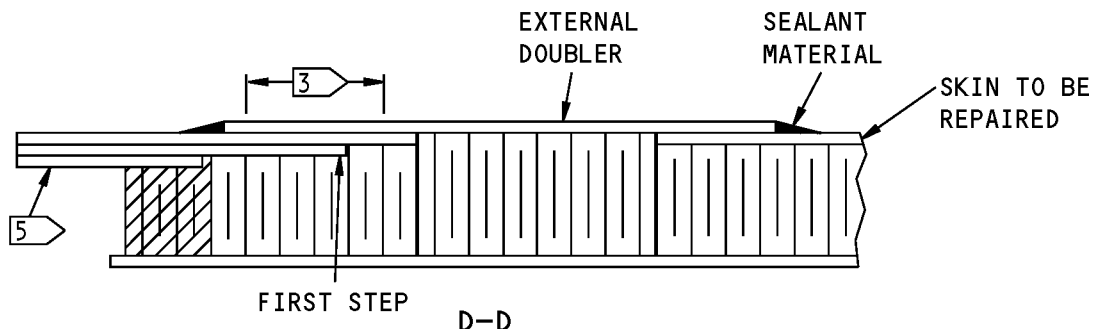
Repair of Damage Away From the Panel Edges
Figure 201 (Sheet 3 of 5)

**757-200
STRUCTURAL REPAIR MANUAL**



REPAIR TO PART OF AN INTERNAL DOUBLER

D



**Repair of Damage Away From the Panel Edges
Figure 201 (Sheet 4 of 5)**

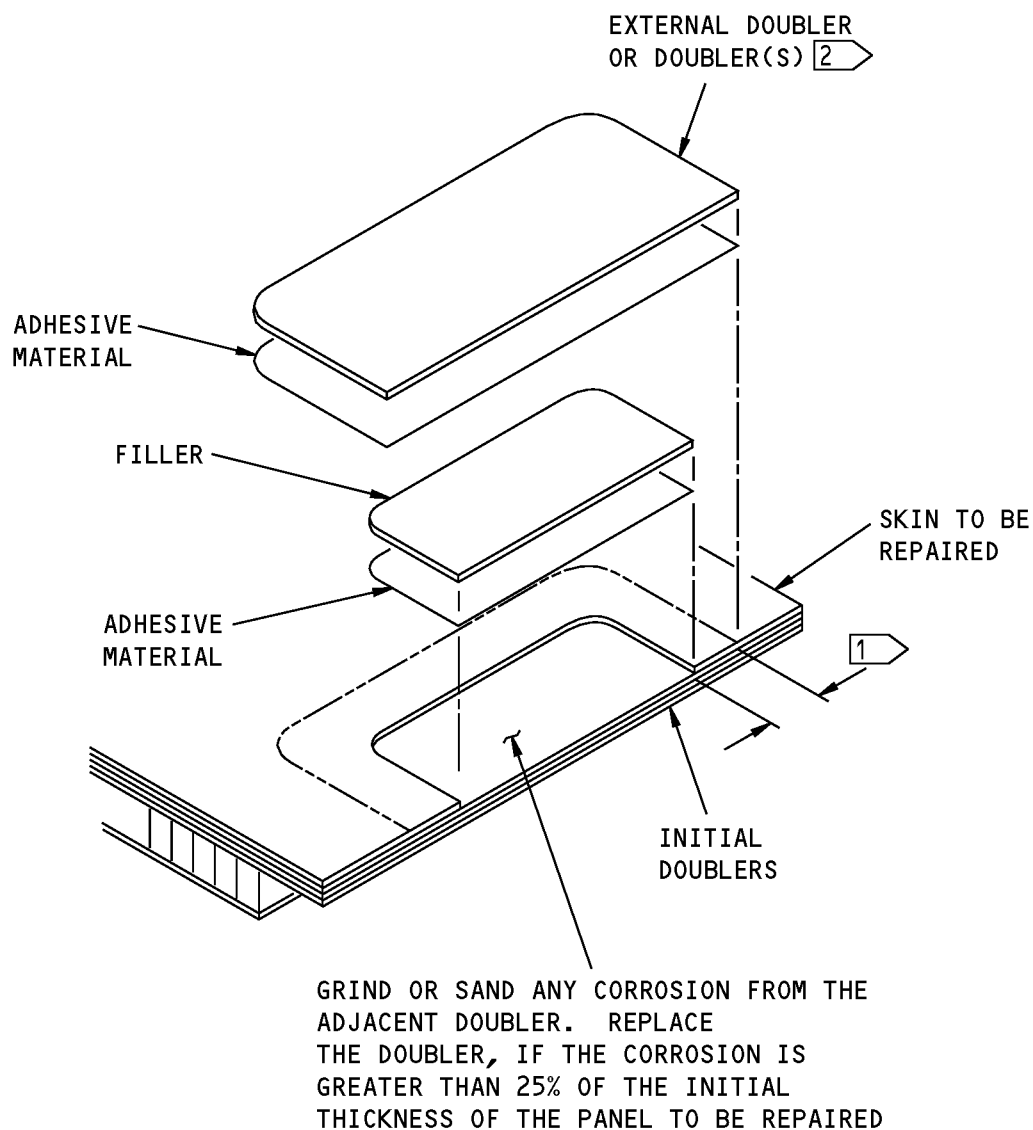
STRUCTURAL REPAIR MANUAL**NOTES**

- REFER TO REPAIR GENERAL FOR THE REPAIR STEPS.
- IT IS PERMITTED TO USE NDI PROCEDURES OR ENGINEERING DRAWINGS TO FIND THE LOCATIONS OF INTERNAL DOUBLERS AND MACHINED STEPS.

- 1 REFER TO REPAIR GENERAL, FIGURE 208 OR 209 (AS APPLICABLE) FOR THE MINIMUM OVERLAP DIMENSION.
- 2 IF THE EDGE OF THE CUTOUT IS CLOSER THAN 0.5 INCHES (13 mm) TO THE EDGE OF AN INTERNAL DOUBLER (OR THE EDGE OF A CHEM-MILLED OR MACHINED STEP) THEN DO ONE OF THE STEPS THAT FOLLOW:
 - REFER TO THE SPECIFIC COMPONENT REPAIR SECTION TO SEE IF THERE IS AN APPLICABLE REPAIR.
 - CUT OUT THE DAMAGE TO THE EDGE OF THE PANEL AND THEN DO ONE OF THE REPAIRS IN REPAIR 4, FIGURE 202.
 - ASK BOEING
- 3 IF THE EDGE OF AN EXTERNAL DOUBLER WILL BE CLOSER THAN 0.5 INCH (13 mm) TO THE FIRST STEP, OR WILL NOT BE FARTHER THAN 1.5 INCHES (38 mm) PAST THE FIRST STEP, THEN SEE DETAIL D AND DO THE STEPS THAT FOLLOW:
 - EXTEND THE EXTERNAL DOUBLER SO THAT THE EDGE OF THE DOUBLER WHICH IS CLOSEST TO THE FIRST STEP IS FARTHER THAN 1.5 INCHES (38 mm) PAST THE EDGE OF THE FIRST STEP.
- 4 INCREASE THE OVERLAP ON BOTH SIDES OF THE CUTOUT BY 0.5 INCH (13 mm).
- 5 A PANEL WITH AN EDGE BAND THAT WAS MANUFACTURED WITH MULTIPLE DOUBLERS IS SHOWN. USE THE SAME PROCEDURE TO REPAIR A PANEL WITH A MACHINED OR CHEM-MILLED SKIN. IF AN INTERNAL DOUBLER IS DAMAGED, SEE 2.

Repair of Damage Away From the Panel Edges
Figure 201 (Sheet 5 of 5)

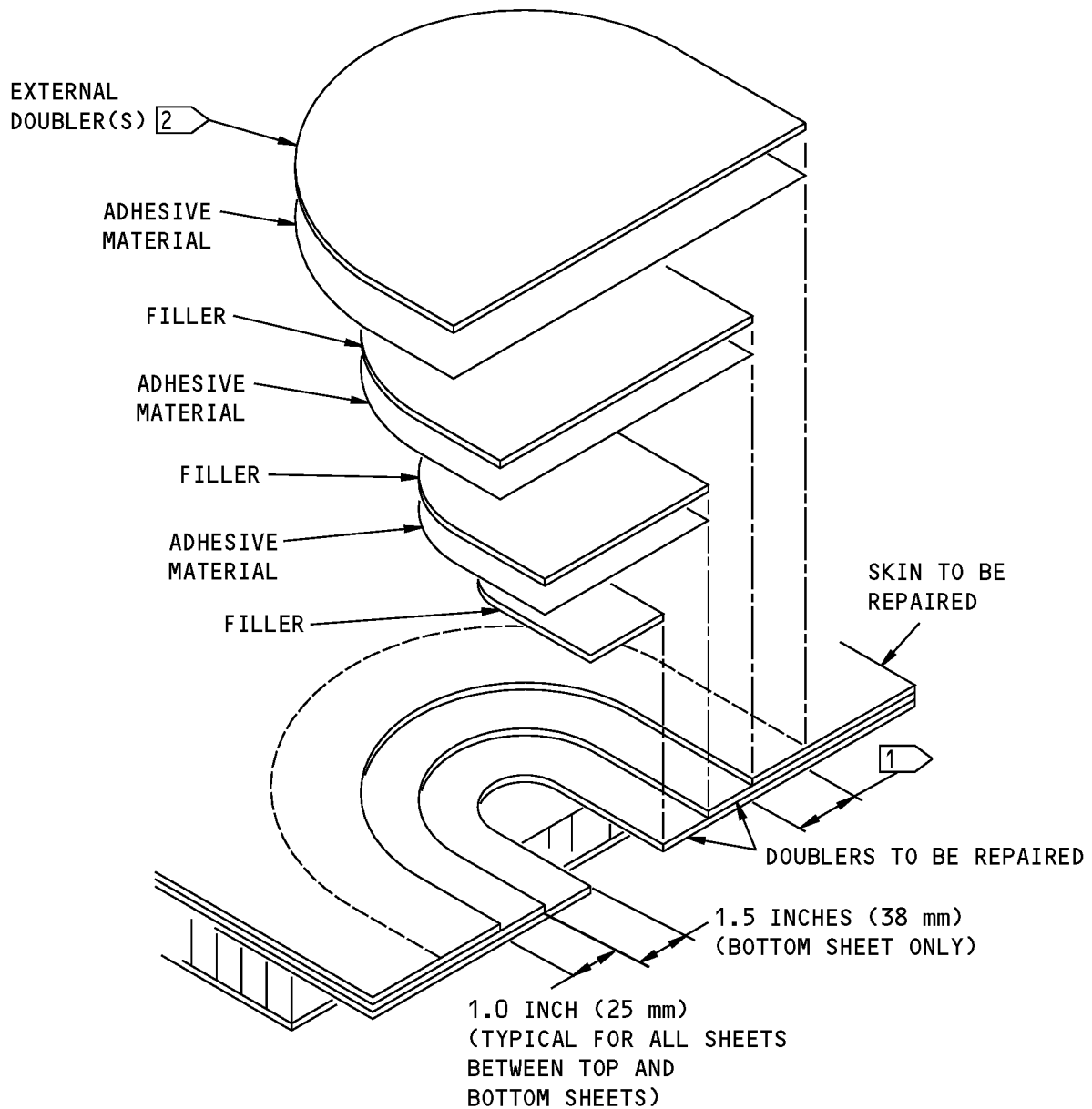
**757-200
STRUCTURAL REPAIR MANUAL**



A

**Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 1 of 9)**

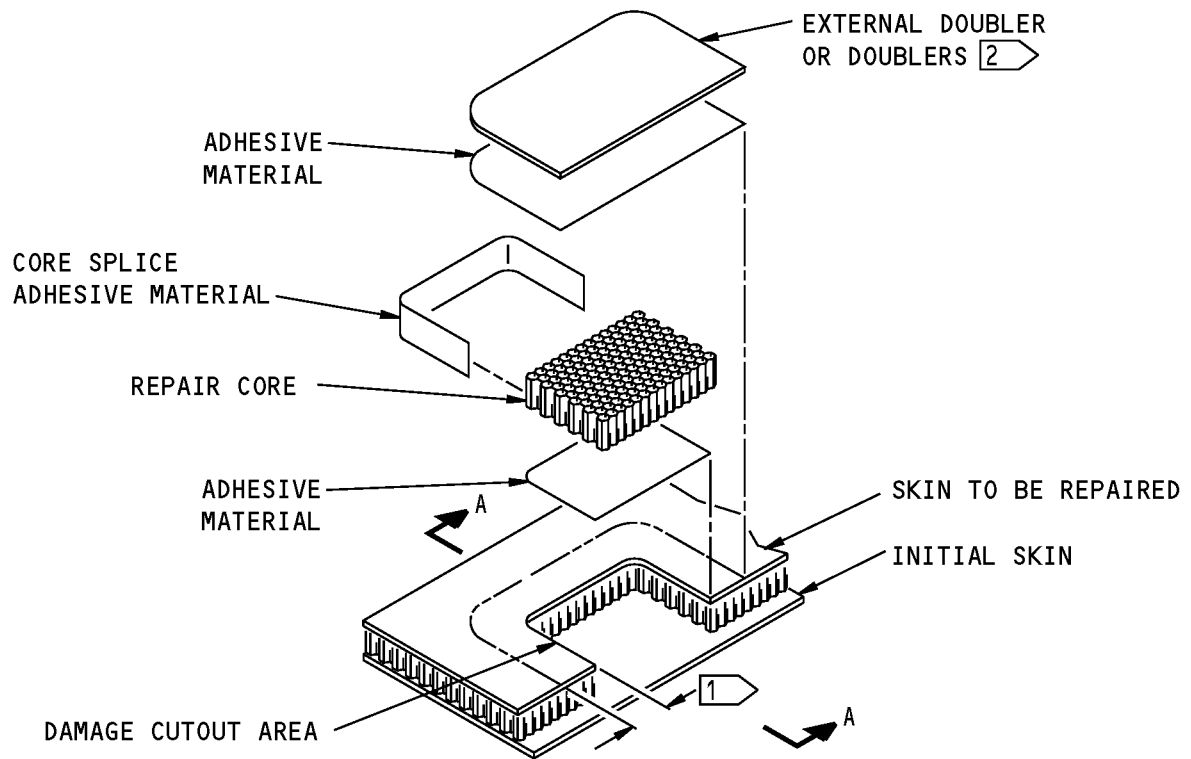
**757-200
STRUCTURAL REPAIR MANUAL**



B

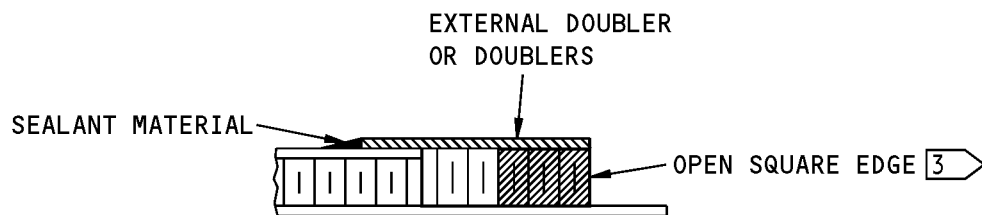
**Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 2 of 9)**

**757-200
STRUCTURAL REPAIR MANUAL**



**REPAIR TO ONE SKIN ONLY
(SQUARE EDGE CONFIGURATION)**

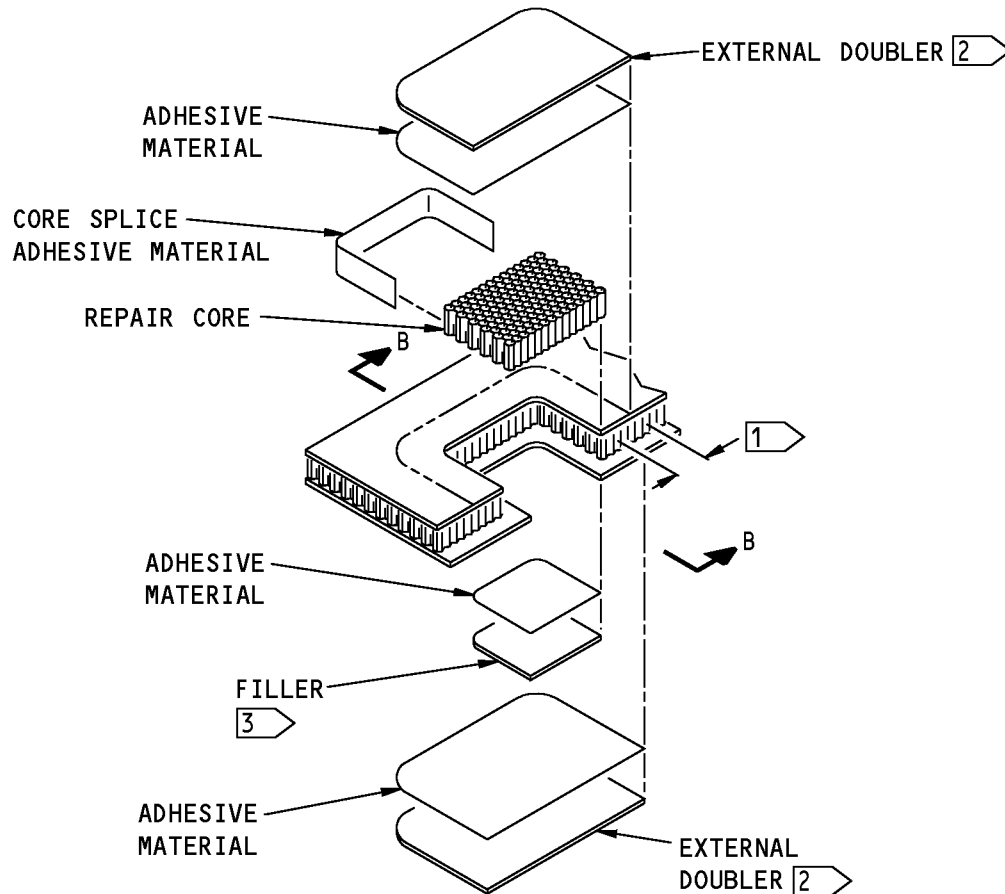
C



A-A

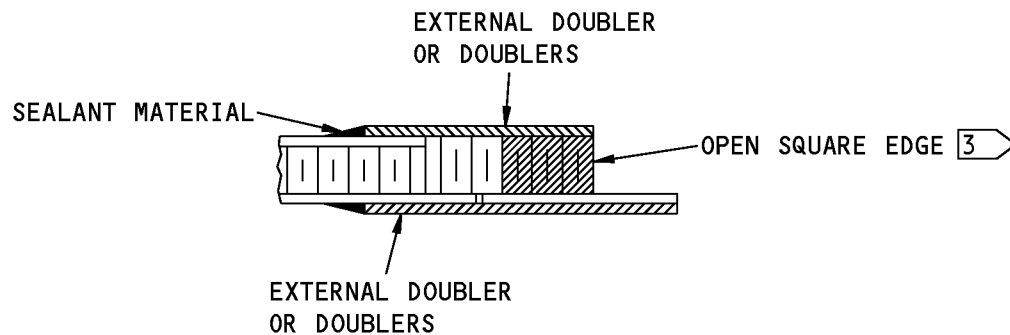
**Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 3 of 9)**

**757-200
STRUCTURAL REPAIR MANUAL**



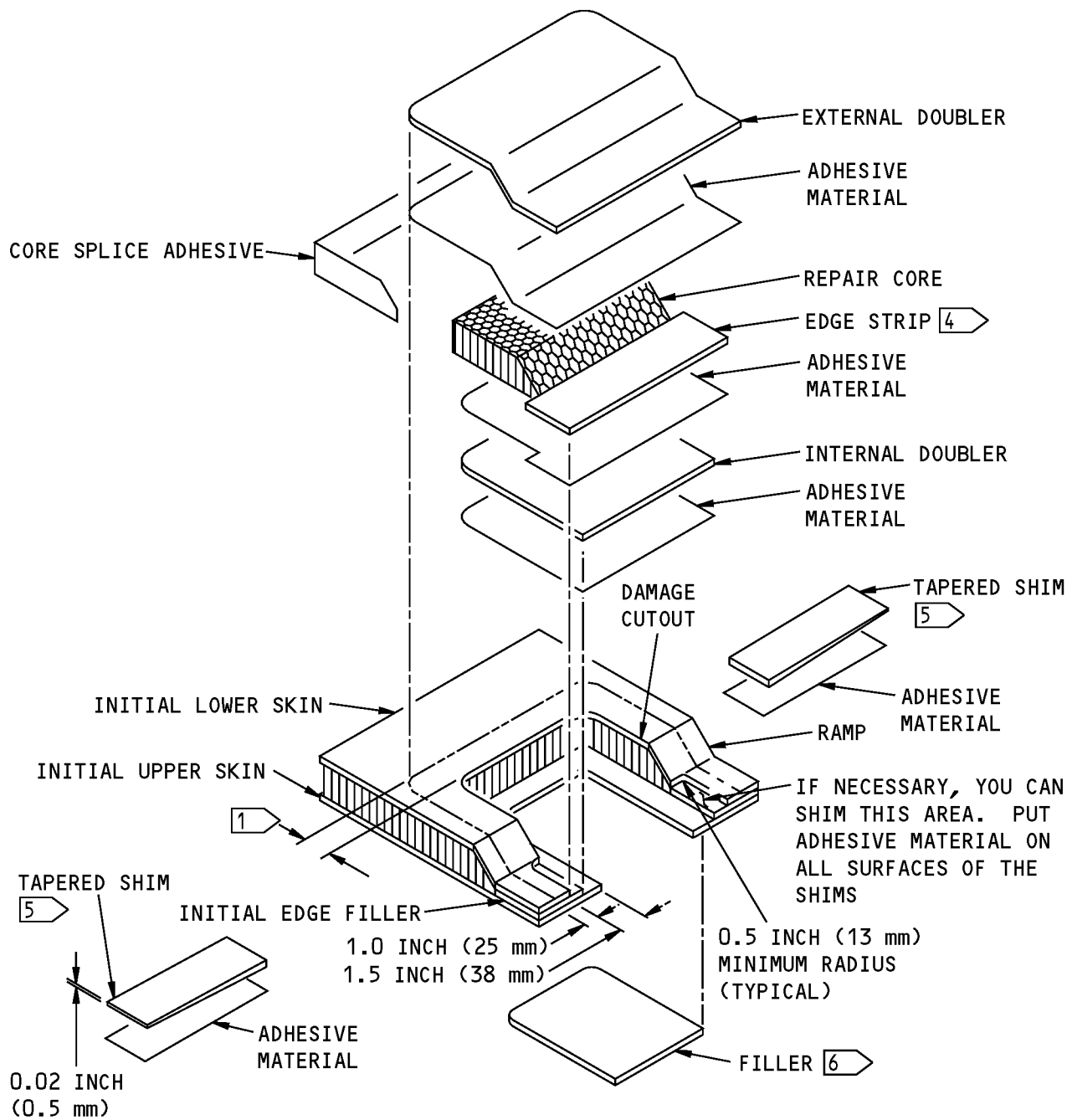
**REPAIR TO BOTH SKINS
(SQUARE EDGE CONFIGURATION)**

D



**Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 4 of 9)**

757-200 STRUCTURAL REPAIR MANUAL

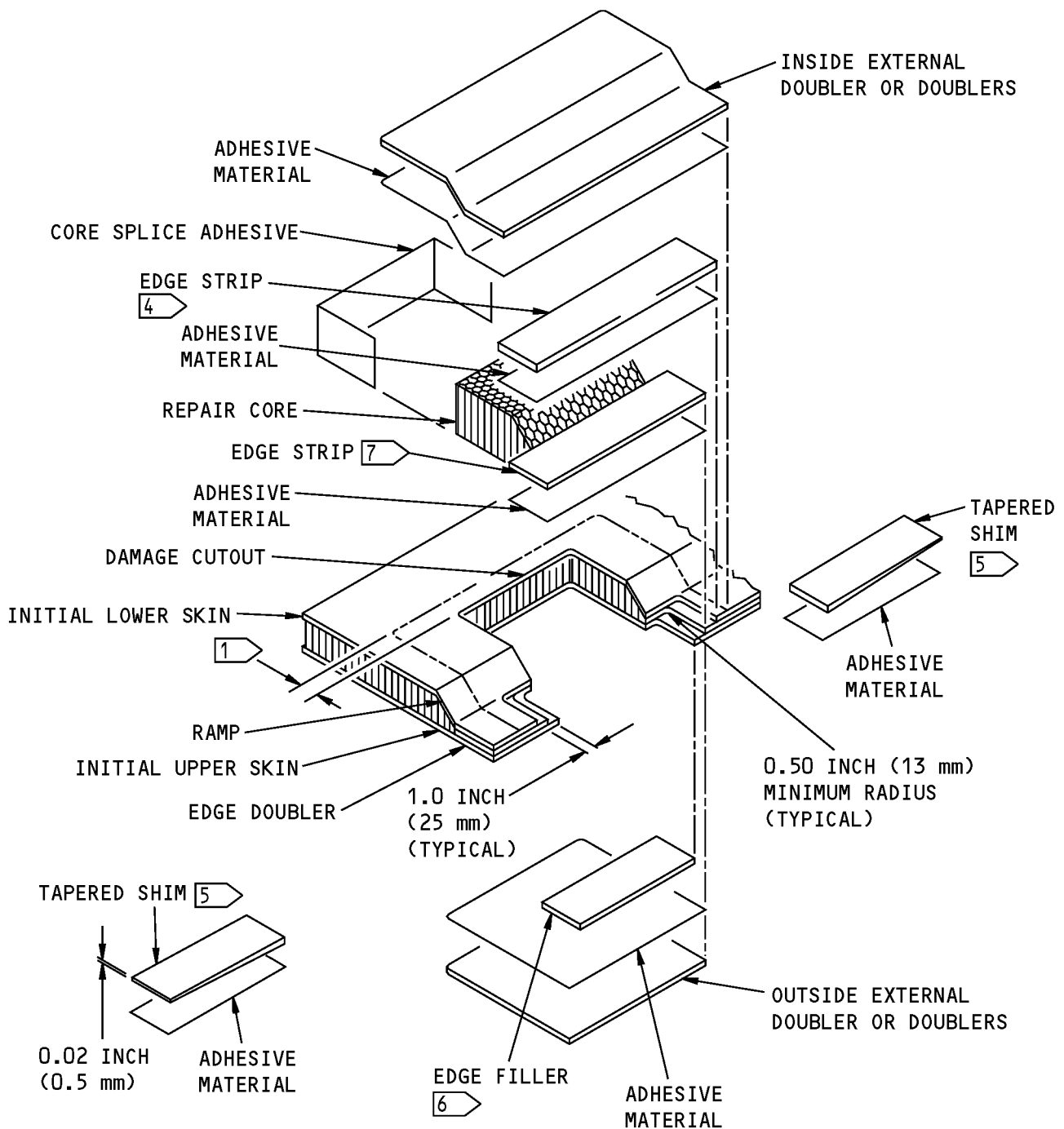


FLUSH REPAIR (RAMP CONFIGURATION)

(E)

Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 5 of 9)

**757-200
STRUCTURAL REPAIR MANUAL**

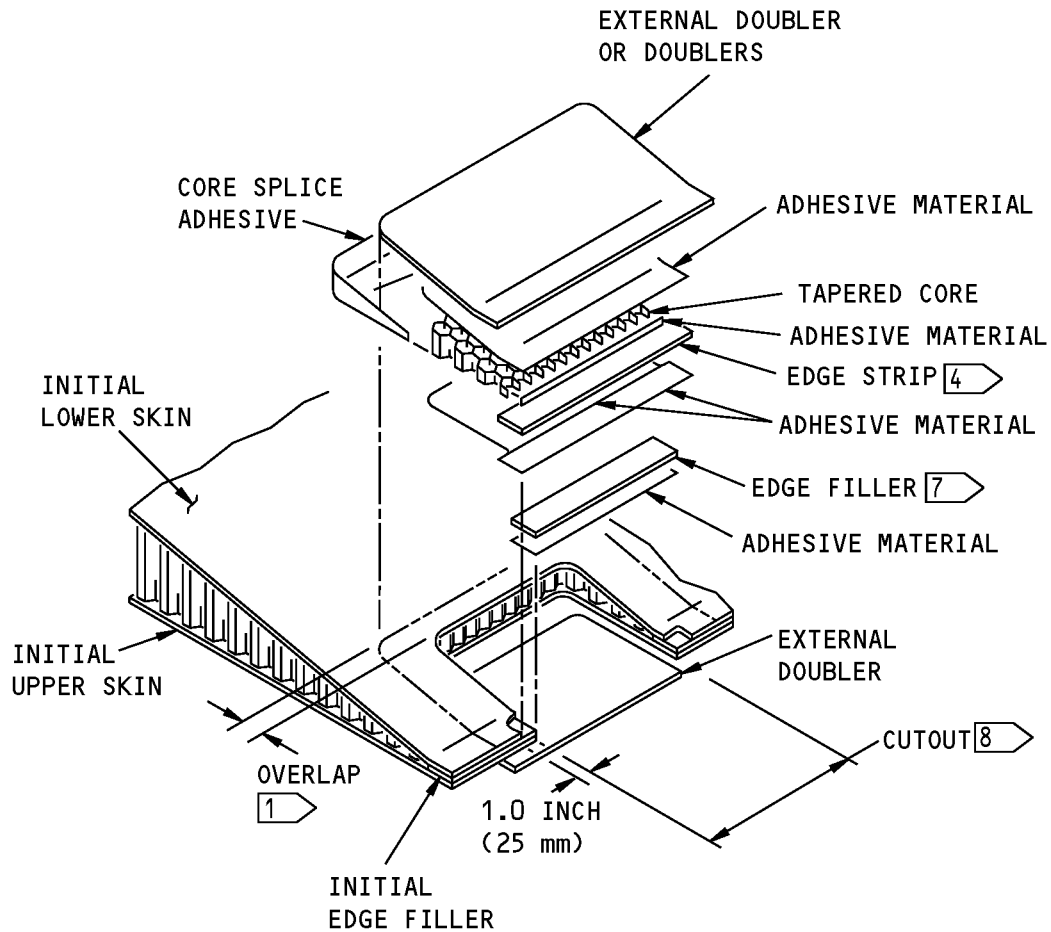


NON-FLUSH REPAIR (RAMP CONFIGURATION)

F

**Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 6 of 9)**

**757-200
STRUCTURAL REPAIR MANUAL**

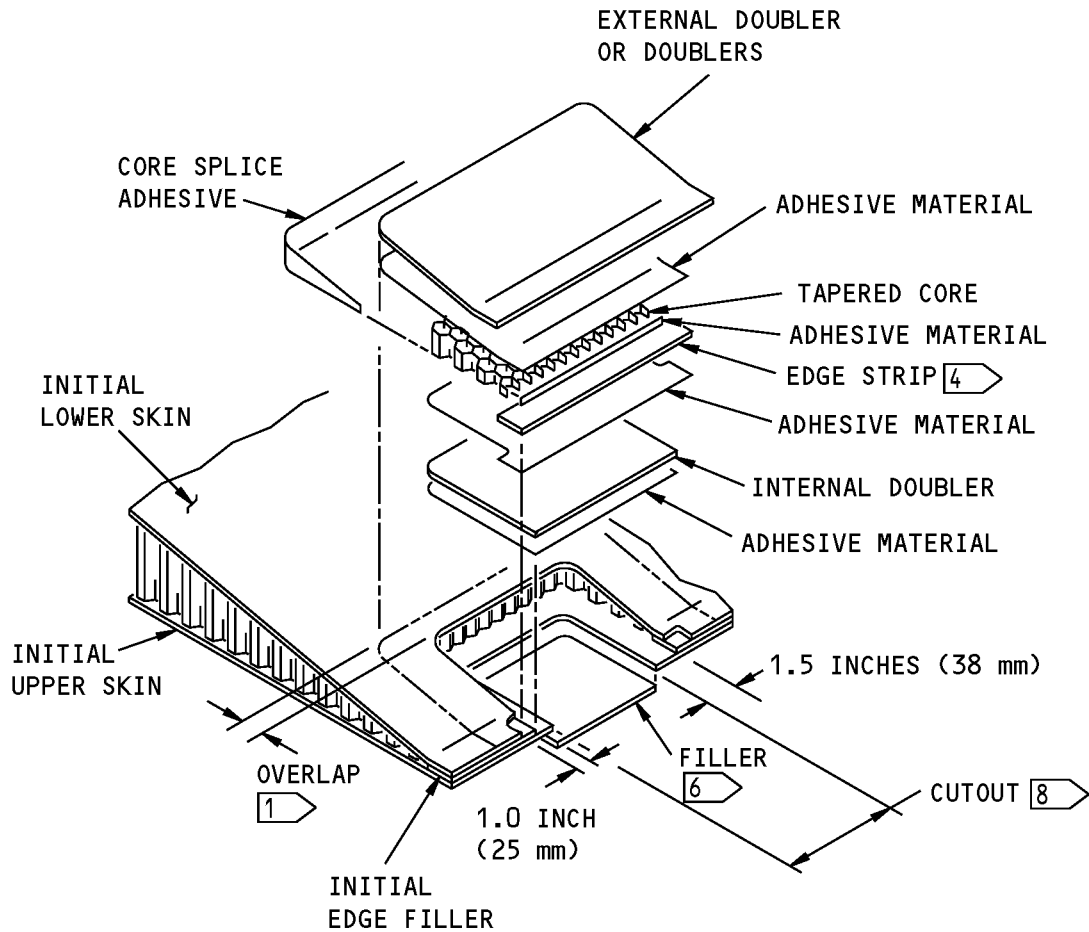


TRAILING EDGE REPAIR WITH TWO EXTERNAL DOUBLERS

G

**Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 7 of 9)**

757-200
STRUCTURAL REPAIR MANUAL



TRAILING EDGE REPAIR WITH AN EXTERNAL AND INTERNAL DOUBLER

(H)

Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 8 of 9)

STRUCTURAL REPAIR MANUAL

NOTES

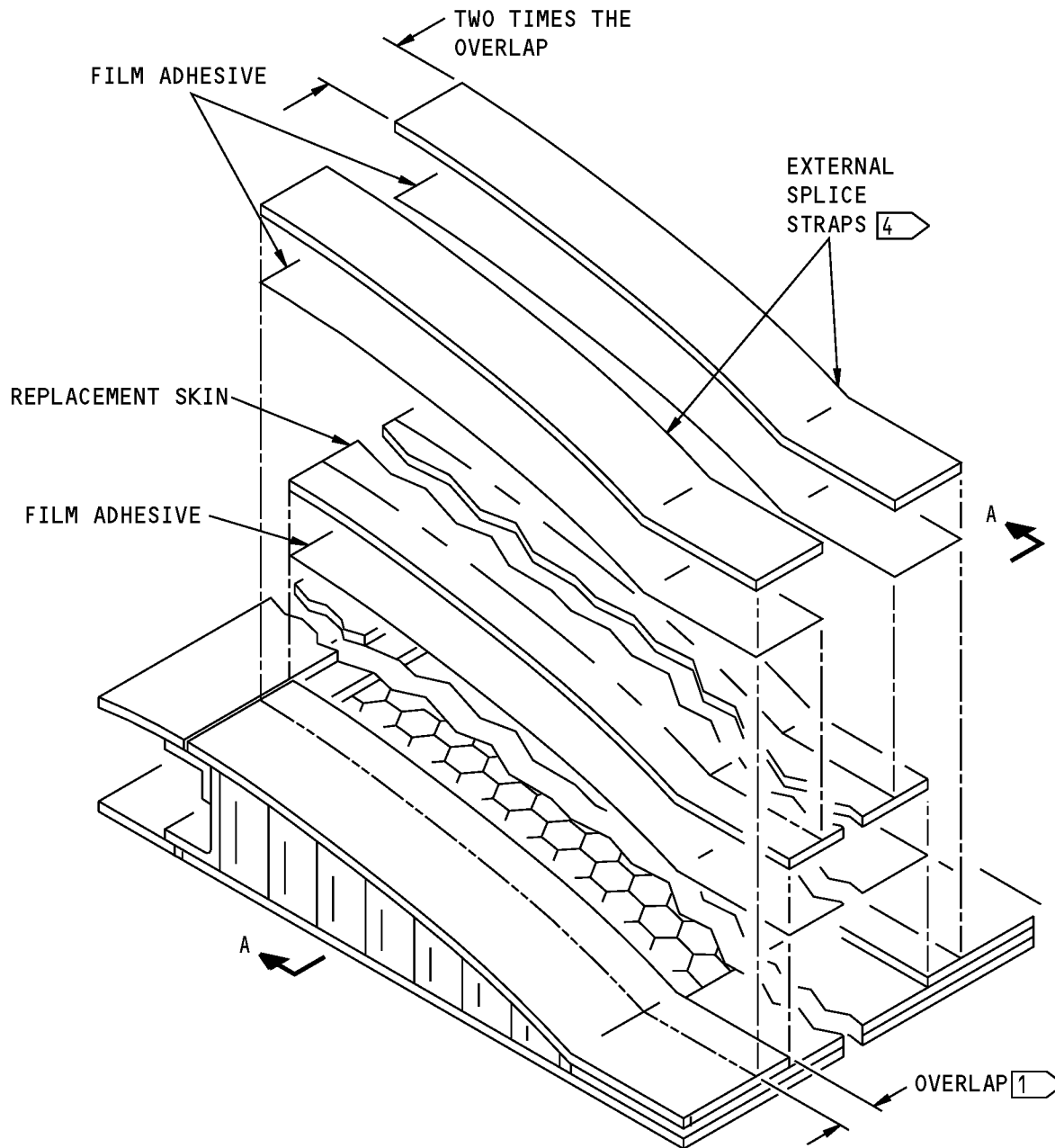
- REFER TO REPAIR GENERAL FOR THE REPAIR STEPS

- 1 REFER TO REPAIR GENERAL, FIGURE 208 OR FIGURE 209 (AS APPLICABLE) FOR THE MINIMUM OVERLAP DIMENSION.
- 2 IF THE LENGTH OR WIDTH OF THE MATERIAL THAT IS REMOVED FROM THE OUTER SKIN IS 1.0 INCH (25 mm) OR LESS, THEN USE AN EXTERNAL DOUBLER(S) THICKNESS AS SPECIFIED IN REPAIR GENERAL, FIGURE 209.

IF THE LENGTH OR WIDTH OF THE MATERIAL THAT IS REMOVED FROM THE OUTER SKIN IS MORE THAN 1.0 INCH (25 mm), THEN USE AN EXTERNAL DOUBLER(S) THICKNESS AS SPECIFIED IN REPAIR GENERAL, FIGURE 209 FOR AN INITIAL SKIN THICKNESS THAT IS ONE GAGE RANGE THICKER.
- 3 SEAL THE OPEN EDGE OF THE REPAIR CORE AS GIVEN IN REPAIR GENERAL, PARAGRAPH 9.G (4)
- 4 MAKE THE EDGE FILLER FROM THE SAME BOEING MATERIALS SPECIFICATION (BMS) MATERIAL OR AN EQUIVALENT MATERIAL THAT IS THE SAME THICKNESS AS THE INITIAL UPPER OR LOWER SKIN AS APPLICABLE.
- 5 PUT THE TAPERED SHIMS NEXT TO THE INSIDE EXTERNAL DOUBLER ON THE EDGE BAND.
- 6 MAKE THE FILLER FROM THE SAME BOEING MATERIALS SPECIFICATION (BMS) MATERIAL OR AN EQUIVALENT MATERIAL THAT IS THE SAME THICKNESS AS THE INITIAL UPPER OR LOWER SKIN AS APPLICABLE.
- 7 MAKE THE EDGE FILLER FROM THE SAME THICKNESS AS THE INITIAL EDGE FILLER.
- 8 THE LENGTH OF THE CUTOUT ALONG THE TRAILING EDGE MUST NOT BE MORE THAN 50% OF THE LENGTH OF THE TRAILING EDGE (FOR ALL REPAIR PROCEDURES TO INCLUDE ALL TYPES OF SURFACE PREPARATIONS, ADHESIVES USED, CURE TEMPERATURES, AND PRESSURE APPLICATIONS SHOWN IN REPAIR GENERAL) AND NOT MORE THAN THE LIMITS SHOWN IN REPAIR GENERAL, FIGURE 201. TO REPAIR A CUTOUT THAT IS MORE THAN 50% OF THE LENGTH OF THE TRAILING EDGE, DO THE STEPS THAT FOLLOW:
 - GET AN ENGINEERING REVIEW
 - USE APPROVED ENGINEERING DRAWINGS FOR THE COMPONENT
 - USE APPROVED MATERIALS AND MANUFACTURING PROCESSES SPECIFIED IN THE COMPONENT ENGINEERING DRAWINGS.

Repair of Damage at the Edge of a Panel
Figure 202 (Sheet 9 of 9)

757-200
STRUCTURAL REPAIR MANUAL

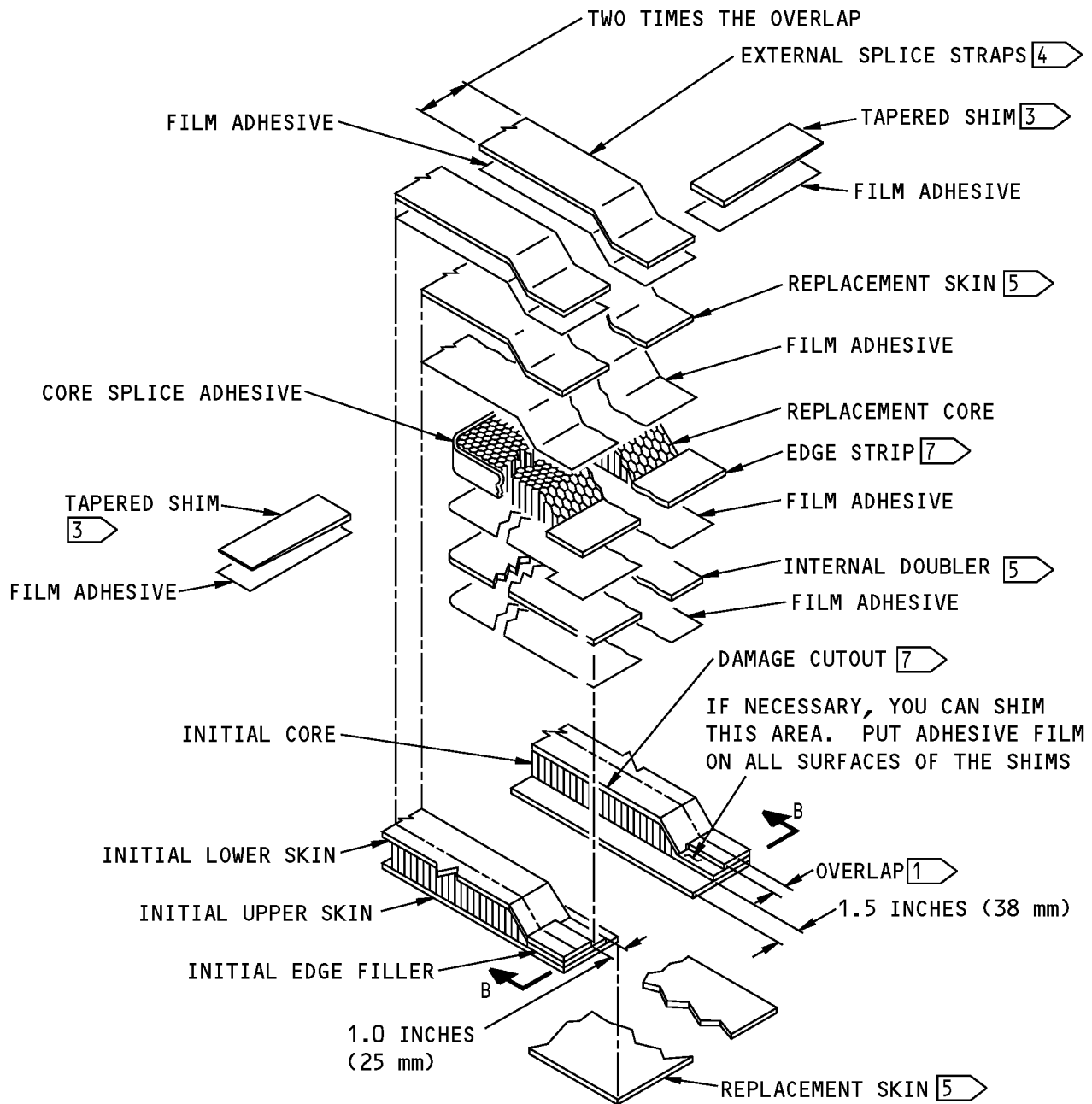


REPAIR TO ONE SKIN ONLY

A

Repair of Damage That is from Edge to Edge
Figure 203 (Sheet 1 of 5)

757-200
STRUCTURAL REPAIR MANUAL

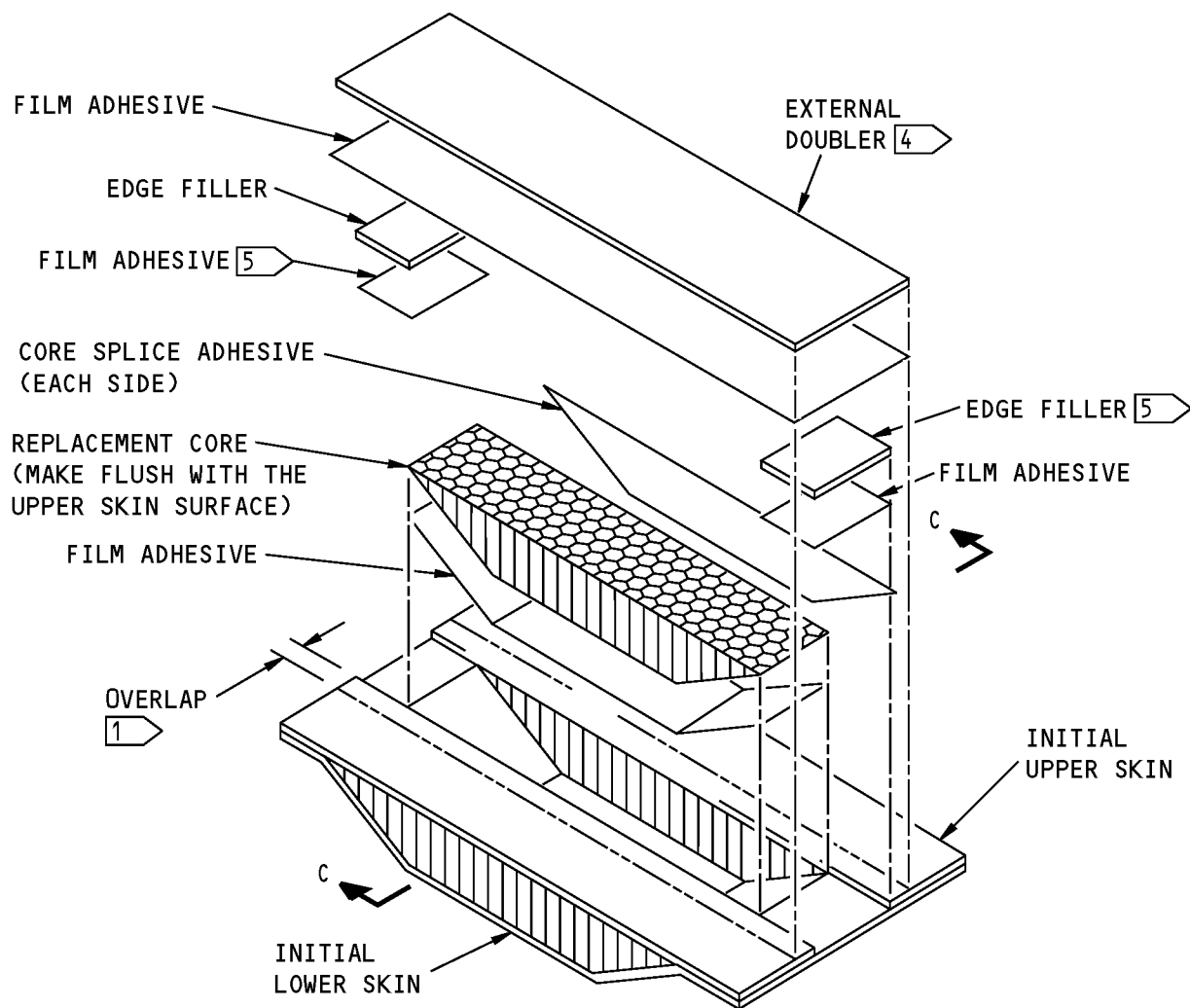


REPAIR TO TWO SKINS AND CORE
(REPLACEMENT CORE FLUSH WITH INITIAL CORE)

B

Repair of Damage That is from Edge to Edge
Figure 203 (Sheet 2 of 5)

**757-200
STRUCTURAL REPAIR MANUAL**

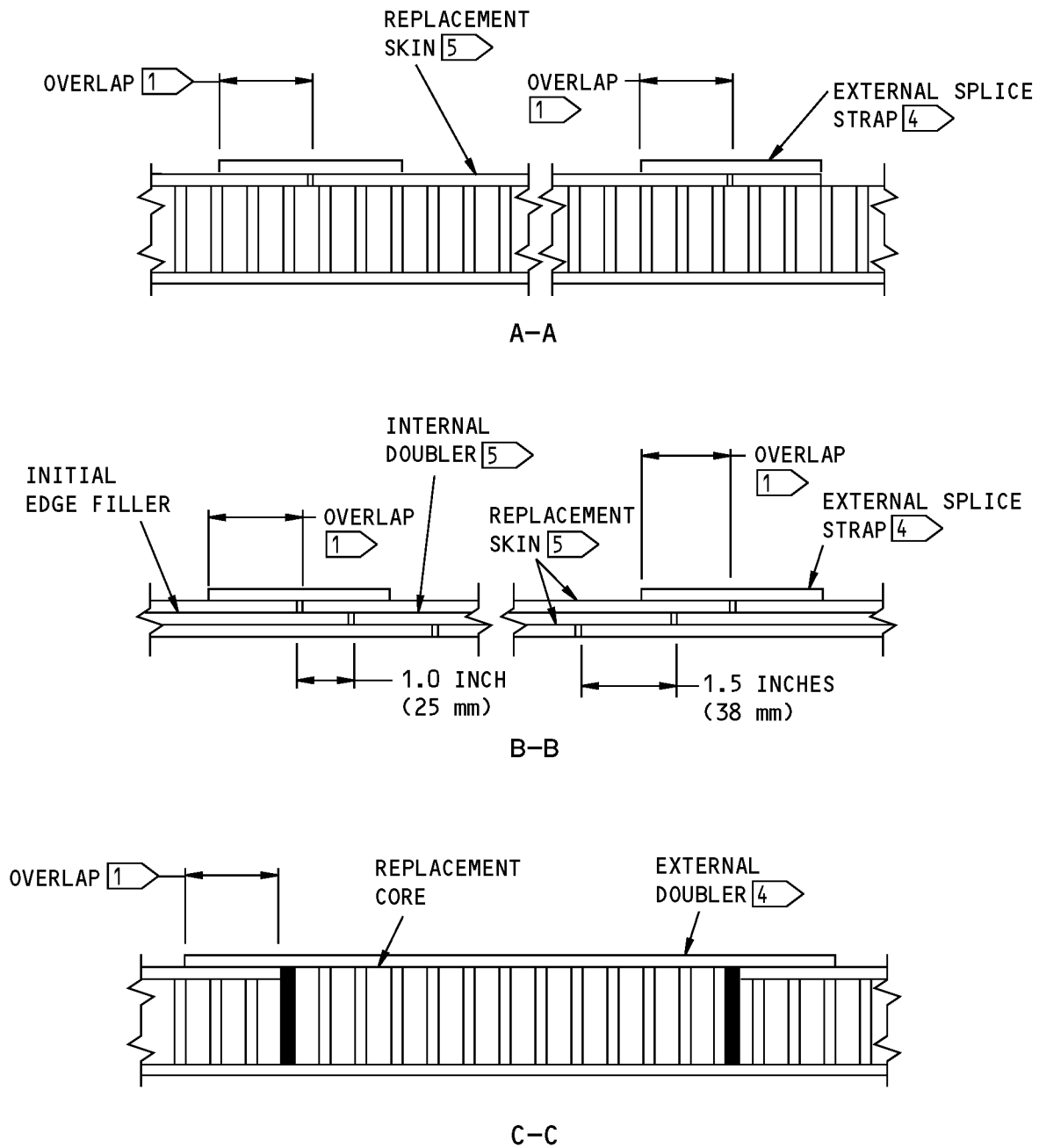


**REPAIR TO ONE SKIN AND CORE
(REPLACEMENT CORE FLUSH WITH AN INITIAL SKIN)**

C

**Repair of Damage That is from Edge to Edge
Figure 203 (Sheet 3 of 5)**

**757-200
STRUCTURAL REPAIR MANUAL**



**Repair of Damage That is from Edge to Edge
Figure 203 (Sheet 4 of 5)**



757-200
STRUCTURAL REPAIR MANUAL

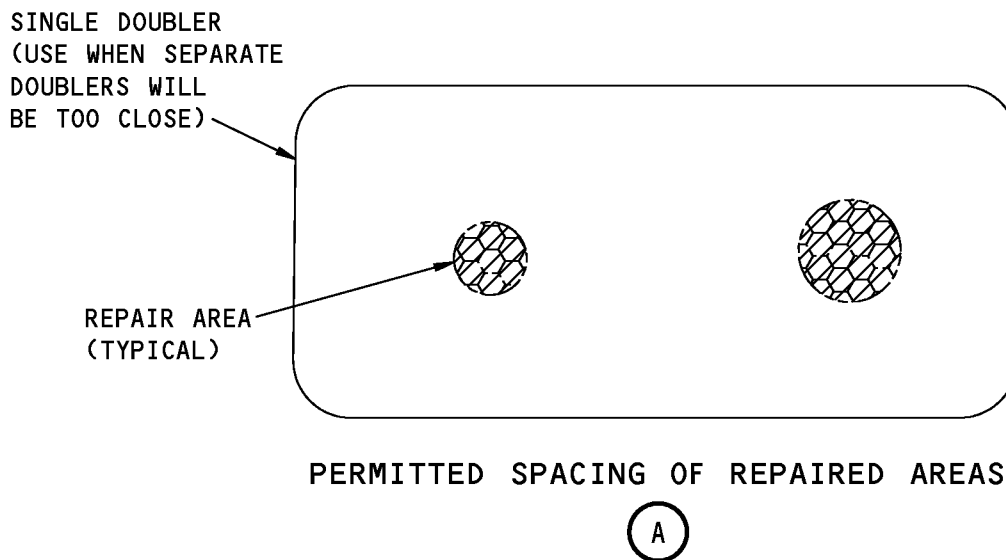
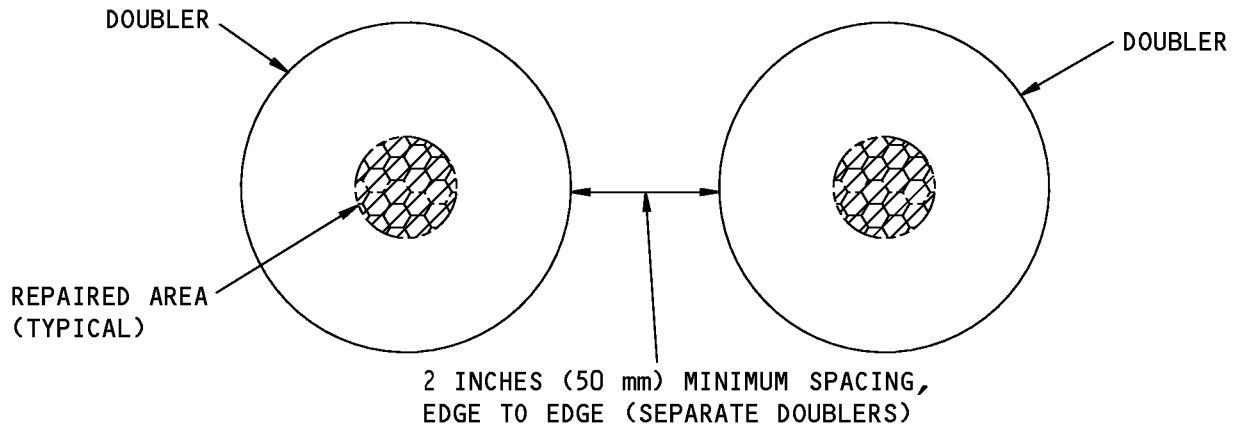
NOTES

- REFER TO REPAIR GENERAL FOR THE REPAIR STEPS.

- 1 REFER TO REPAIR GENERAL, FIGURE 208 OR FIGURE 209 (AS APPLICABLE) FOR THE MINIMUM OVERLAP DIMENSION.
- 2 USE SHIMS IF NECESSARY.
- 3 PUT A TAPERED SHIM NEXT TO EACH OF THE INSIDE EXTERNAL DOUBLERS ON THE EDGE BAND.
- 4 REFER TO REPAIR GENERAL, FIGURE 208 OR 209 FOR DOUBLER THICKNESS.
- 5 MAKE FROM THE SAME BOEING MATERIALS SPECIFICATION (BMS) MATERIAL OR AN EQUIVALENT MATERIAL THAT IS THE SAME THICKNESS AS THE INITIAL UPPER OR LOWER SKIN AS APPLICABLE.
- 6 MAKE FROM THE SAME THICKNESS AS THE INITIAL EDGE FILLER.
- 7 AS AN ALTERNATIVE, YOU CAN CUT THE INITIAL SKIN AWAY FROM THE EDGE OF THE CORE. THERE IS NO MINIMUM OR MAXIMUM DISTANCE FROM THE EDGE OF THE THE SKIN TO THE EDGE OF THE CORE.

Repair of Damage That is from Edge to Edge
Figure 203 (Sheet 5 of 5)

**757-200
STRUCTURAL REPAIR MANUAL**



**Permitted Spacing
Figure 204**

757-200 STRUCTURAL REPAIR MANUAL

GENERAL - TYPICAL FORMED SECTION REPAIRS

APPLICABILITY

THIS REPAIR IS NOT APPLICABLE TO FATIGUE CRITICAL STRUCTURES. THIS TYPE OF STRUCTURE INCLUDES FUSELAGE CROWN STRINGERS, DOOR SURROUND STRUCTURE, SPAR CHORDS, OUTER WING UPPER AND LOWER STRINGERS, LONGERONS BETWEEN STATION 1720 AND STATION 1862 THAT ARE ABOVE AND BELOW THE STABILIZER CUTOUT IN THE FUSELAGE, AND THE WING CENTER SECTION.

REPAIR INSTRUCTIONS

1. Get access to the damaged area.
2. Cut and remove the damaged part of the formed section. Refer to Details I and II. Be careful not to damage the adjacent structure. If necessary, remove additional fasteners to obtain clearance.
3. Find the number of fasteners and fastener rows that are necessary. Refer to Tables II, III, and IV.
4. Make the repair parts. See Table I.
5. Assemble the repair parts and drill the fastener holes.
6. Disassemble the repair parts
7. Remove the nicks, scratches, gouges, burrs, and sharp edges from the repair parts and the cut edges of the formed section.
8. Apply a chemical conversion coating to the repair parts and to the bare surfaces of the formed section. Refer to SRM 51-20-01.
9. Apply one layer of BMS 10-11, Type I primer to the repair parts and to the bare surfaces of the formed section. Refer to SOPM 20-41-02.
10. Install the repair parts with BMS 5-95 sealant between the mating surfaces.
11. Install the fasteners. Fasteners that are not made of aluminum must be installed wet with BMS 5-95 sealant.
12. Apply one layer of BMS 10-11, Type II finish to the repair area. Refer to SOPM 20-41-02.




NOTES

- REPAIRS ARE SHOWN WITH THE REPAIR PARTS INSTALLED ON THE INSIDE OF THE FORMED SECTION. IF THERE IS SUFFICIENT CLEARANCE, YOU CAN INSTALL THE REPAIR PARTS ON THE OUTSIDE OF THE FORMED SECTION.
- D = FASTENER DIAMETER
- WHEN YOU USE THIS REPAIR REFER TO:
 - SOPM 20-41-02 FOR APPLICATION OF CHEMICAL AND SOLVENT RESISTANT FINISHES

- SRM 51-10-01 FOR AERODYNAMIC SMOOTHNESS REQUIREMENTS
- SRM 51-10-02 FOR INSPECTION AND REMOVAL OF DAMAGE
- SRM 51-20-01 FOR PROTECTIVE TREATMENT OF METAL
- SRM 51-20-05 FOR REPAIR SEALING
- SRM 51-30-01 FOR MINIMUM BEND RADII
- SRM 51-40 FOR FASTENER CODE, INSTALLATION AND REMOVAL, HOLE SIZES, AND EDGE MARGINS
- SRM 51-60 FOR CONTROL SURFACE BALANCING

- A** EACH DAMAGED FLANGE MUST BE REPAIRED. IF THE REPAIR PARTS ARE INSTALLED ON THE OUTER SURFACE OF THE FORMED SECTION, MAKE THE REPAIR PARTS THE SAME THICKNESS AS THE FORMED SECTION. IF THE REPAIR PARTS ARE INSTALLED ON THE INNER SURFACE OF THE FORMED SECTION, MAKE THE REPAIR PARTS A MINIMUM OF 0.012 INCH THICKER THAN THE FORMED SECTION.
- B** USE INITIAL FASTENER LOCATIONS WHERE FLANGES WERE ATTACHED, OTHERWISE USE THE FASTENER SPACING SHOWN IN TABLE II.
- C** DO NOT USE LESS THAN THREE FASTENERS IN A ROW. USE THE ROW SPACING IN TABLE II. FOR THE NUMBER OF FASTENERS, REFER TO TABLES III OR IV.
- D** INSTALL THE FILLER WHERE THE FLANGES ATTACH TO THE WEB OR SKIN.
- E** THIS REPAIR IS APPLICABLE WHEN LESS THAN 50 PERCENT OF THE CROSS-SECTIONAL AREA IS REMOVED. REFER TO DETAIL II, IF MORE THAN 50 PERCENT OF THE CROSS-SECTIONAL AREA IS REMOVED.
- F** THE OUTSIDE RADIUS OF THE REPAIR PART MUST NOT BE LESS THAN THE INSIDE RADIUS OF THE INITIAL FORMED SECTION.

FASTENER SYMBOLS

-  INITIAL FASTENER LOCATION. INSTALL THE SAME TYPE AND DIAMETER FASTENER AS THE INITIAL FASTENER (UP TO 1/32 INCH (0.76 mm) DIAMETER OVERSIZE).
-  INITIAL OR REPAIR FASTENER LOCATION.
-  REPAIR FASTENER LOCATION. THESE FASTENERS ARE NECESSARY FOR THE COMPRESSION STABILITY OF THE REPAIR ANGLE AND SHOULD BE EXTENDED A MINIMUM OF TWO FASTENER LOCATIONS BEYOND THE TRIMMED OUT REGION AS SHOWN IN DETAIL I. DO NOT INCLUDE THESE FASTENERS IN THE NUMBER OF FASTENERS NECESSARY TO MAKE THE REPAIR.

Typical Formed Section Repair
Figure 1 (Sheet 1 of 7)



757-200
STRUCTURAL REPAIR MANUAL

REPAIR MATERIAL			
PART		QTY	MATERIAL
1	ANGLE	1	USE THE SAME MATERIAL AS THE INITIAL FORMED SECTION A
2	ANGLE	1	USE THE SAME MATERIAL AS THE INITIAL FORMED SECTION A
3	ANGLE	1	USE THE SAME MATERIAL AS THE INITIAL FORMED SECTION A
4	CHANNEL	1	USE THE SAME MATERIAL AS THE INITIAL FORMED SECTION A
5	CHANNEL	1	USE THE SAME MATERIAL AS THE INITIAL FORMED SECTION A
6	FILLER	AS NECESSARY	USE THE SAME MATERIAL AS THE INITIAL FORMED SECTION D
7	ANGLE	1	USE THE SAME MATERIAL AS THE INITIAL FORMED SECTION A

TABLE I

FASTENER SPACING												
SHEET GAGE	5/32			3/16			1/4			5/16		
	FASTENER SPACING B		ROW SPAC- ING C	FASTENER SPACING B		ROW SPAC- ING C	FASTENER SPACING B		ROW SPAC- ING C	FASTENER SPACING B		ROW SPAC- ING C
	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MAX	MIN
0.020 0.022	0.50 0.50	0.50 0.50	0.62 0.62									
0.025 0.028	0.60 0.60	0.60 0.60	0.62 0.62									
0.032 0.035	0.60 0.60	0.60 0.60	0.62 0.62	0.75 0.75	0.75 0.75	0.75 0.75						
0.040 0.045	0.60 0.60	0.65 0.75	0.62 0.62	0.75 0.75	0.75 0.75	0.75 0.75						
0.050 0.056	0.60 0.60	0.85 0.95	0.62 0.62	0.75 0.75	0.85 0.95	0.75 0.75	1.00 1.00	1.00 1.00	1.00 1.00			
0.063 0.071	0.60 0.60	0.95 0.95	0.62 0.62	0.75 0.75	1.05 1.20	0.75 0.75	1.00 1.00	1.05 1.20	1.00 1.00	1.20 1.20	1.20 1.20	1.25 1.25
0.080 0.090	0.60	0.95	0.62	0.75 0.75	1.20 1.20	0.75 0.75	1.00 1.00	1.35 1.50	1.00 1.00	1.20 1.20	1.35 1.50	1.25 1.25
0.100 0.112				0.75 0.75	1.20 1.20	0.75 0.75	1.00 1.00	1.50 1.50	1.00 1.00	1.20 1.20	1.70 1.90	1.25 1.25
0.125 0.140				0.75 0.75	1.20 1.20	0.75 0.75	1.00 1.00	1.50 1.50	1.00 1.00	1.20 1.20	1.90 1.90	1.25 1.25
0.160 0.180				0.75 0.75	1.20 1.20	0.75 0.75	1.00 1.00	1.50 1.50	1.00 1.00	1.20 1.20	1.90 1.90	1.25 1.25

TABLE II

Typical Formed Section Repair
Figure 1 (Sheet 2 of 7)

757-200 STRUCTURAL REPAIR MANUAL

FASTENER PER INCH WIDTH, 2024-T3 OR T4 MATERIAL														
SHEET GAGE	PROTRUDING HEAD							100° COUNTERSUNK (SHEAR) HEAD						
	BACR15BB() D OR MS20470D()				A286 CRES OR TITANIUM 160 KSI TENSILE STRENGTH BOLTS			BACR15CE() D				A286 CRES OR TITANIUM 160 KSI TENSILE STRENGTH BOLTS		
	5/32	3/16	1/4	5/16	3/16	1/4	5/16	5/32	3/16	1/4	5/16	3/16	1/4	5/16
0.032 0.036	4 4													
0.040 0.045	4 4	3 3			3 3									
0.050 0.056	4 4	3 3	3 3		3 3	3 3		5 5				3 3	3 3	
0.063 0.071	5 5	3 4	3 3	2 2	3 3	3 3	2 2	5 5	4 5		2 2	3 3	3 3	2 2
0.080 0.090		4 5	3 3	2 2	3 3	3 3	2 2	6 5	5 5	4 4	2 3	3 3	3 3	2 2
0.100 0.112		5 3	3 3	2 2	3 3	3 3	2 2		5 4	4 4	3 3	3 3	3 3	2 2
0.125 0.140			4 4	3 3	3 3	3 3	2 2			4 4	3 3	3 3	3 3	2 2
0.160 0.180			5 5	3 4	3 4	3 3	2 2			5 5	3 4	3 4	3 3	3 3

TABLE III

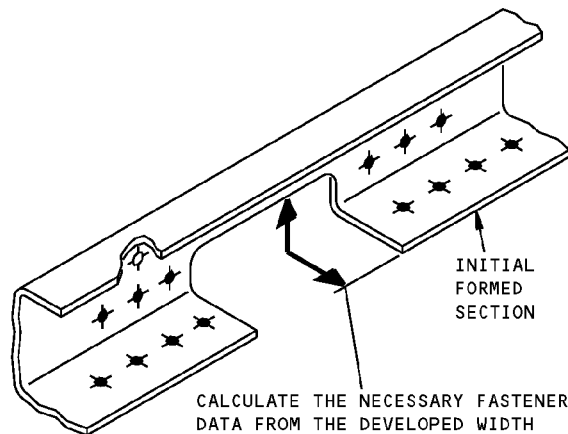
EXAMPLE OF HOW TO FIND THE NUMBER OF FASTENERS NECESSARY TO REPAIR A PARTIALLY SEVERED FORMED SECTION.

REFER TO DETAIL I.

ASSUME THE DAMAGE IS IN A 0.071 INCH THICK 2024-T3 ALUMINUM CHANNEL. MEASURE ALONG THE OUTER SURFACE TO FIND THE WIDTH OF THE DAMAGE. ASSUME THE DEVELOPED WIDTH OF THE DAMAGE IS 1.58 INCHES. NEXT, REFER TO TABLE III FOR THE NUMBER OF FASTENERS THAT ARE NECESSARY PER INCH OF WIDTH.

ASSUME THE REPAIR IS TO BE MADE WITH 3/16-INCH DIAMETER MS20470D6() RIVETS. TABLE III SHOWS THAT FOUR 3/16-INCH DIAMETER RIVETS ARE NECESSARY. TO FIND THE TOTAL NUMBER OF FASTENERS THAT ARE NECESSARY ON EACH SIDE OF THE CUTOUT, MULTIPLY THE WIDTH OF THE DAMAGE BY THE NUMBER OF FASTENERS SHOWN IN TABLE III. USE THE NEXT HIGHER WHOLE NUMBER.

1.58 INCHES MULTIPLIED BY FOUR RIVETS = 6.32 RIVETS. USE SEVEN RIVETS ON EACH SIDE OF THE DAMAGE.



CALCULATE THE NECESSARY FASTENER DATA FROM THE DEVELOPED WIDTH DATA. FOR THIS EXAMPLE, THE DEVELOPED WIDTH IS EQUAL TO 1.58 INCHES OR 40 MILLIMETERS

NOTE: IF YOU NEED TO MAKE AN EQUIVALENT REPAIR WITH 7075-T6 ALUMINUM MATERIAL, THEN YOU CAN USE THE REPAIR PROCEDURE GIVEN IN THIS EXAMPLE. BUT, YOU MUST USE THE REPAIR DATA FOR 7075-T6 ALUMINUM GIVEN IN TABLE IV.

EXAMPLE OF A PARTIALLY SEVERED MEMBER

Typical Formed Section Repair
Figure 1 (Sheet 3 of 7)



757-200
STRUCTURAL REPAIR MANUAL

FASTENER PER INCH WIDTH, 7075-T6 OR T4 MATERIAL													
SHEET GAGE	PROTRUDING HEAD							100° COUNTERSUNK (SHEAR) HEAD					
	BACR15BB() D OR MS20470D()				A286 CRES OR TITANIUM 160 KSI TENSILE STRENGTH BOLTS			BACR15CE() D			A286 CRES OR TITANIUM 160 KSI TENSILE STRENGTH BOLTS		
	5/32	3/16	1/4	5/16	3/16	1/4	5/16	3/16	1/4	5/16	3/16	1/4	5/16
0.016 0.018	4 4												
0.020 0.022	4 4												
0.025 0.028	4 4												
0.032 0.036	4 4	3 3											
0.040 0.045	4 4	3 3			3 3			4 5			3 3		
0.050 0.056	5 5	3 4	3 3		3 3	3 3		5 5	4 4		3 3	3 3	
0.063 0.071		4 5	3 3	2 2	3 3	3 3	2 2	5 5	4 4	3 3	4 4	3 3	2 2
0.080 0.090		5	3 3	2 2	3 3	3 3	2 2		4 4	3 3	4 4	3 3	2 2
0.100 0.112			4 4	3 3	3 3	3 3	2 2		4 4	3 3	4 4	3 3	2 2
0.125 0.140			5 5	3 3	3 4	3 3	2 2		5 5	3 3	4 4	3 3	2 2
0.160 0.180				4 4	4 4	3 3	2 2			3 4	4 4	3 3	2 2

TABLE IV

Typical Formed Section Repair
Figure 1 (Sheet 4 of 7)

757-200 STRUCTURAL REPAIR MANUAL

EXAMPLE OF HOW TO FIND THE NUMBER OF FASTENERS NECESSARY TO REPAIR A FULLY SEVERED FORMED SECTION.

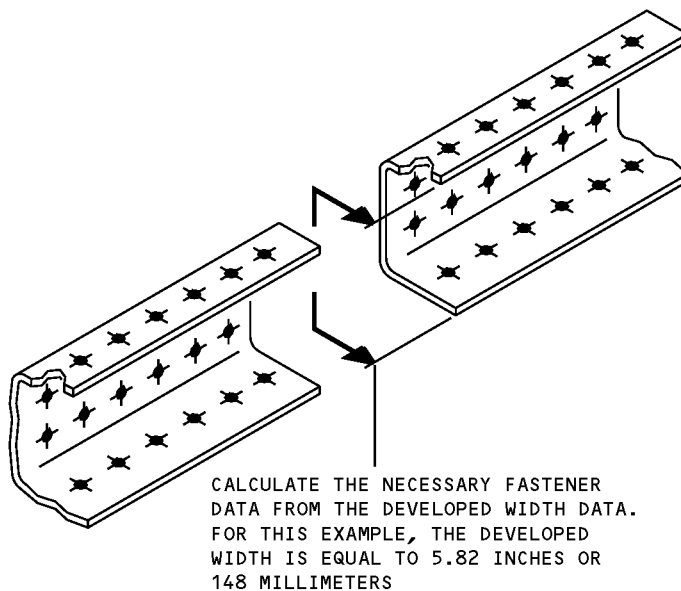
REFER TO DETAIL II.

ASSUME THE DAMAGE IS IN A 0.063 INCH THICK 7075-T6 ALUMINUM CHANNEL. MEASURE ALONG THE OUTER SURFACE TO FIND THE WIDTH OF THE DAMAGE. ASSUME THE DEVELOPED WIDTH OF THE DAMAGE IS 5.82 INCHES. NEXT, REFER TO TABLE IV FOR THE NUMBER OF FASTENERS THAT ARE NECESSARY PER INCH OF WIDTH.

ASSUME THE REPAIR IS TO BE MADE WITH 3/16-INCH DIAMETER MS20470D6() RIVETS. TABLE IV SHOWS THAT FOUR 3/16-INCH DIAMETER RIVETS ARE NECESSARY. TO FIND THE TOTAL NUMBER OF FASTENERS THAT ARE NECESSARY ON EACH SIDE OF THE CUTOUT, MULTIPLY THE WIDTH OF THE DAMAGE BY THE NUMBER OF FASTENERS SHOWN IN TABLE IV. USE THE NEXT HIGHER WHOLE NUMBER.

5.82 INCHES MULTIPLIED BY FOUR RIVETS = 23.28 RIVETS. USE TWENTY-FOUR RIVETS ON EACH SIDE OF THE DAMAGE.

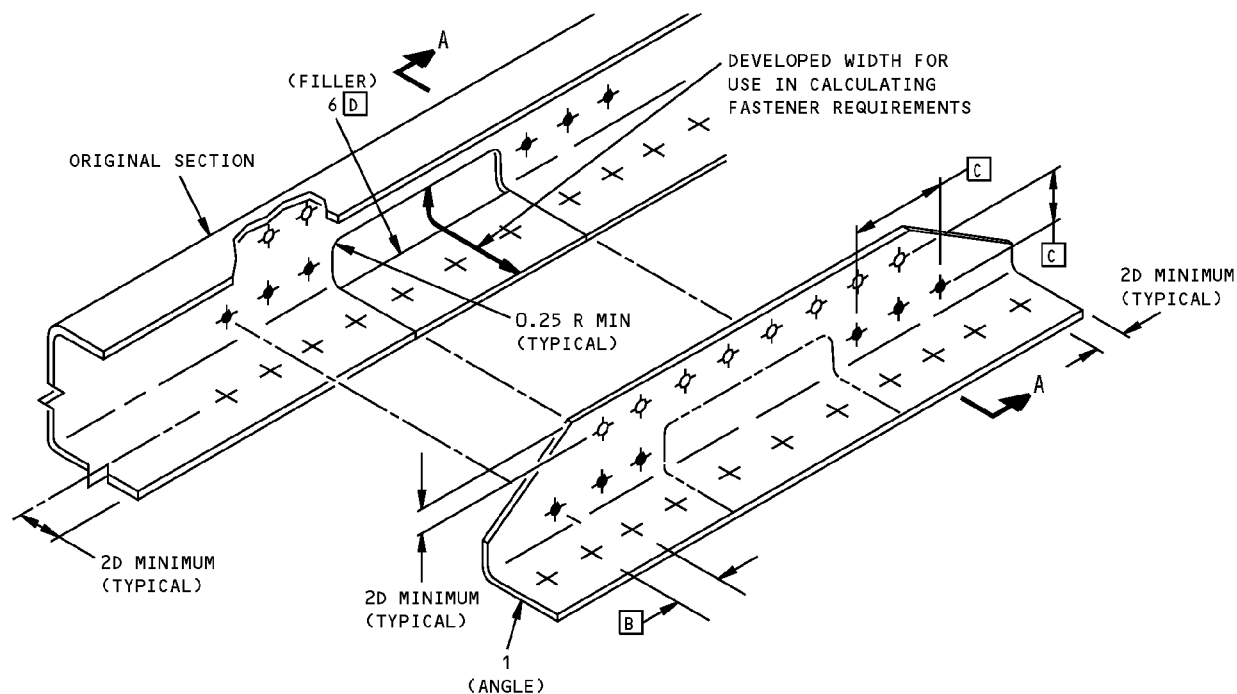
NOTE: IF YOU NEED TO MAKE AN EQUIVALENT REPAIR WITH 2024-T3/-T4 ALUMINUM MATERIAL, THEN YOU CAN USE THE REPAIR PROCEDURE GIVEN IN THIS EXAMPLE. BUT, YOU MUST USE THE REPAIR DATA FOR 2024-T3/-T4 ALUMINUM GIVEN IN TABLE III.



EXAMPLE OF A FULLY SEVERED MEMBER

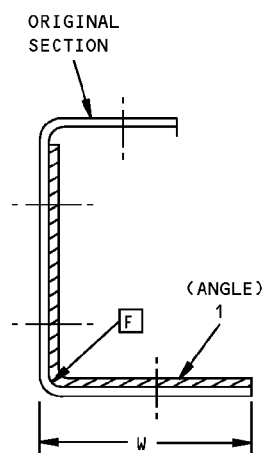
**Typical Formed Section Repair
Figure 1 (Sheet 5 of 7)**

757-200 STRUCTURAL REPAIR MANUAL

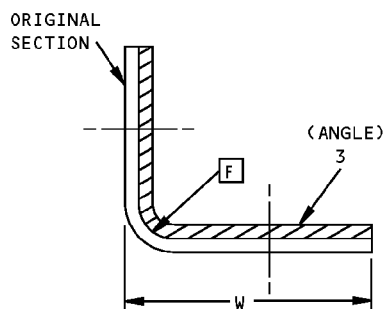


PARTIALLY SEVERED MEMBER
TYPICAL FORMED CHANNEL REPAIR SHOWN
OTHER FORMED SECTIONS SIMILAR

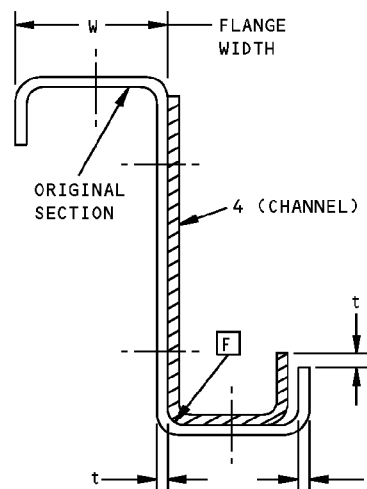
DETAIL I [E]



CHANNEL



ANGLE
SECTION A-A



ZEE SECTION

Typical Formed Section Repair
Figure 1 (Sheet 6 of 7)

757-200 STRUCTURAL REPAIR MANUAL

GENERAL - TYPICAL EXTRUDED SECTION REPAIRS

APPLICABILITY
THIS REPAIR DOES NOT APPLY TO WING STRINGERS, WING SPAR CHORDS, WING CENTER SECTION, WING SPANWISE BEAM CHORDS, STRUCTURE IN FUEL TANKS, OR PRESSURE WEB STIFFENERS.

REPAIR INSTRUCTIONS

1. Cut and remove the damaged portion of the extrusion.
2. Make the repair parts. **[J]**
3. Assemble the repair parts and drill the fastener holes.
4. Disassemble the repair parts.
5. Remove the nicks, scratches, gouges, burrs, sharp edges and corners from the repair parts and the initial parts.
6. Apply a chemical conversion coating to the repair parts and the bare surfaces of the initial parts. Refer to SRM 51-20-01.
7. Apply one layer of BMS 10-11, Type 1 primer to the repair parts and the bare surfaces of the initial parts. Refer to SOPM 20-41-02.
8. Install the repair parts with BMS 5-95 sealant, between the mating surfaces.
9. Install the fasteners wet with BMS 5-95 sealant.
10. Restore the initial finish as specified in AMM 51-21.

NOTES

- WHEN YOU USE THIS REPAIR REFER TO:
 - AMM 51-21 FOR INTERIOR AND EXTERIOR FINISHES
 - AMM 51-31 FOR SEALS AND SEALING
 - SRM 51-20-01 FOR PROTECTIVE TREATMENT OF METALS
 - SRM 51-20-05 FOR SEALING OF REPAIRS
 - SRM 51-40 FOR FASTENER CODE, REMOVAL, INSTALLATION, HOLE SIZES AND EDGE MARGINS.

[A] SELECTION OF GAGE DETERMINED IN CONJUNCTION WITH PART 3 TO GIVE A COMBINED CROSS-SECTIONAL AREA OF ALL PLATES 1.25 TIMES GREATER THAN THE ORIGINAL 2024-T3 EXTRUSION OR 1.35 TIMES GREATER THAN THE ORIGINAL 7075-T6 EXTRUSION. EACH LEG OF THE EXTRUSION MUST BE JOINED BY MATERIAL PROPORTIONATELY GREATER THAN THE ORIGINAL AREA.

[B] SELECTION OF GAGE DETERMINED BY FASTENER SPACING FROM TABLE I AND AREA REQUIREMENTS IN CONJUNCTION WITH OTHER REPAIR PARTS AS SHOWN IN NOTE **[A]**. IF NECESSARY FOR AREA REQUIREMENTS, ADDITIONAL PLATES MAY BE FITTED USING TABLE I AS A GUIDE TO MINIMUM GAGE.

[C] ALL FASTENERS IN REPAIR TO BE OF SAME NOMINAL DIAMETER, WHICH IS TO BE DETERMINED BY AVAILABLE EDGE MARGINS AND SKIN THICKNESS AVAILABLE FOR COUNTERSINKING. EDGE MARGINS MUST NOT BE LESS THAN 2D. RECOMMENDED FASTENER SPACING 4D. (D = DIAMETER OF FASTENER).

[D] INSTALL IN SUCH A SEQUENCE, OR COMBINATION OF SUITABLE FASTENERS AND NUTS, THAT WILL PREVENT INTERFERENCE OF NUTS. INTERFERENCE MAY BE PREVENTED BY DIMENSIONAL CONTROL, PROVIDED THAT MINIMUM EDGE MARGIN AND SPACING IS MAINTAINED.

[E] SUITABLE PROTRUDING HEAD FASTENERS:

BOLT	MATING COLLAR	APPLICATION
BACB30NX()K	BACC30X	TENSION
BACB30MY()K	BACC30M	SHEAR

[F] SUITABLE FLUSH HEAD FASTENERS:

BOLT	MATING COLLAR	APPLICATION
BACB30NY()K	BACC30X	TENSION
BACB30NW()K	BACC30M	SHEAR
BACB30NZ()K	BACC30M	SHEAR

[G] SELECTION OF GAGE DETERMINED IN CONJUNCTION WITH PART 6 TO GIVE A COMBINED CROSS-SECTIONAL AREA OF ALL PLATES 1.25 TIMES GREATER THAN THE ORIGINAL 2024-T3 EXTRUSION OR 1.35 TIMES GREATER THAN THE ORIGINAL 7075-T6 EXTRUSION. EACH LEG OF THE EXTRUSION MUST BE JOINED BY MATERIAL PROPORTIONATELY GREATER THAN THE ORIGINAL AREA.

[H] SELECTION OF GAGE DETERMINED BY FASTENER SPACING FROM TABLE II AND AREA REQUIREMENTS IN CONJUNCTION WITH OTHER REPAIR PARTS AS IN NOTE **[G]**. IF NECESSARY FOR AREA REQUIREMENTS, ADDITIONAL PLATES MAY BE FITTED USING TABLE II AS A GUIDE TO MINIMUM GAGE.

[J] THE BEND RADIUS OF REPAIR PART MUST BE MADE SO THAT THE OUTSIDE READIUS OF THE INNER NESTING PART IS GREATER THAN THE INSIDE RADIUS OF ADJACENT PART.

SYMBOLS

 REPAIR FASTENER LOCATION.

Typical Extruded Section Repair
Figure 1 (Sheet 1 of 6)



757-200
STRUCTURAL REPAIR MANUAL

REPAIR MATERIAL					
		2024 EXTRUSIONS		7075 EXTRUSIONS	
PART		QTY	MATERIAL	QTY	MATERIAL
1	PLATE	AS REQ	0.040 CLAD 2024-T3	AS REQ	0.040 CLAD 7075-T6
2	PLATE	AS REQ	0.040 TO 0.063 CLAD 2024-T3 A	AS REQ	0.040 TO 0.063 CLAD 7075-T6 A
3	PLATE	AS REQ	0.050 TO 0.125 CLAD 2024-T3 B	AS REQ	0.050 TO 0.125 CLAD 7075-T6 B
4	FILLER	AS REQ	SAME AS ORIGINAL EXTRUSION	AS REQ	SAME AS ORIGINAL EXTRUSION
5	PLATE	AS REQ	0.040 TO 0.063 CLAD 2024-T3 G	AS REQ	0.040 TO 0.063 CLAD 7075-T6 G
6	PLATE	AS REQ	0.040 TO 0.063 CLAD 2024-T3 H	AS REQ	0.040 TO 0.063 CLAD 7075-T6 H

MINIMUM THICKNESS OF REPAIR PART 3	
FASTENER SPACING	REPAIR PLATE GAGE
UP TO 0.75	0.050
OVER 0.75 TO 0.84	0.056
OVER 0.84 TO 0.94	0.063
OVER 0.94 TO 1.06	0.071
OVER 1.06 TO 1.20	0.080
OVER 1.20 TO 1.35	0.090
OVER 1.35 TO 1.50	0.100
OVER 1.50 TO 1.68	0.112
OVER 1.68 TO 1.77	0.125

TABLE I

MINIMUM THICKNESS OF REPAIR PART 6	
FASTENER SPACING	REPAIR PLATE GAGE
UP TO 0.75	0.040
OVER 0.75 TO 0.84	0.056
OVER 0.84 TO 1.75	0.063

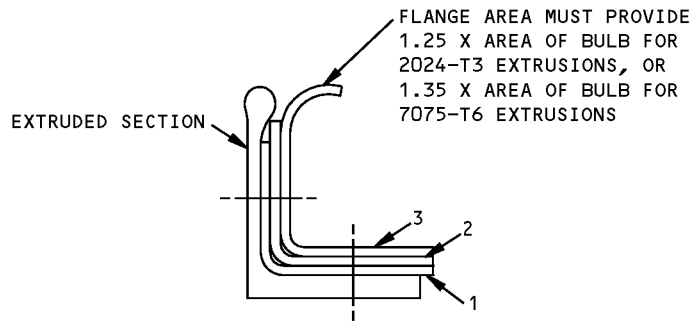
TABLE II

FASTENER DIAMETER	FASTENERS PER INCH WIDTH OF FLANGE OR WEB OF ORIGINAL EXTRUSION C	
	2024 EXTRUSION	7075 EXTRUSION
5/32	5.0	5.3
3/16	4.2	4.4
1/4	3.1	3.3

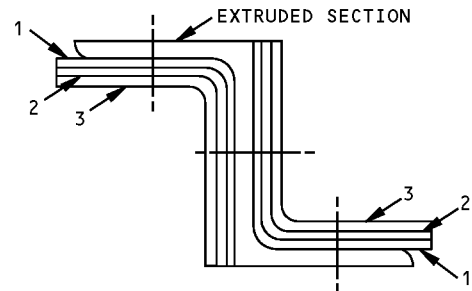
TABLE III

Typical Extruded Section Repair
Figure 1 (Sheet 2 of 6)

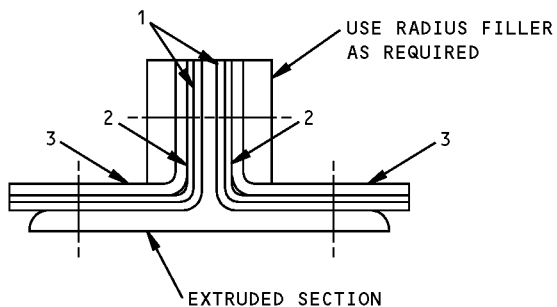
757-200 STRUCTURAL REPAIR MANUAL



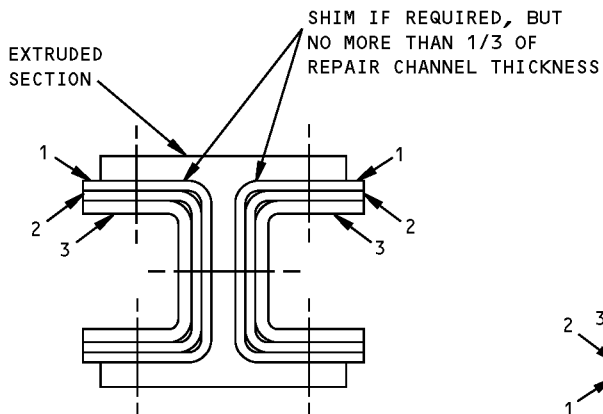
DETAIL I



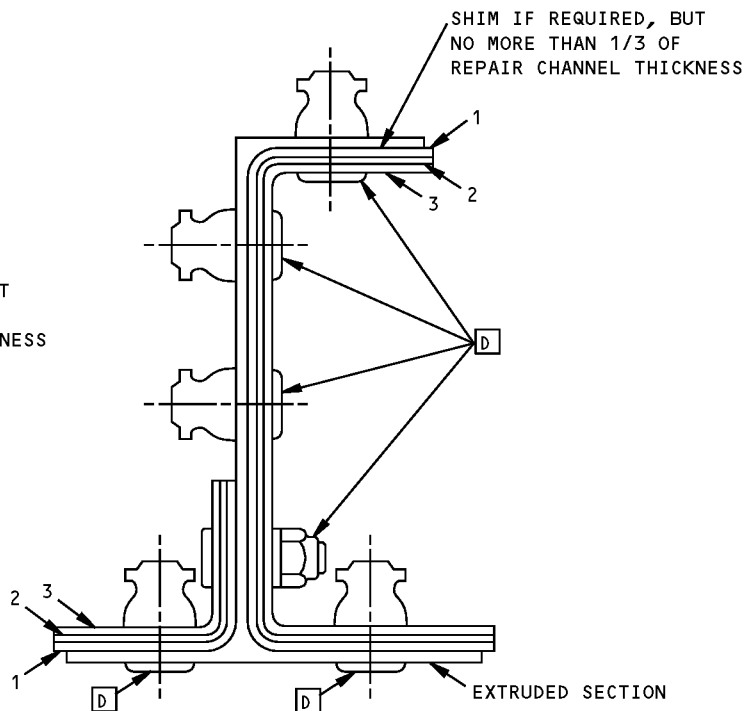
DETAIL II



DETAIL III



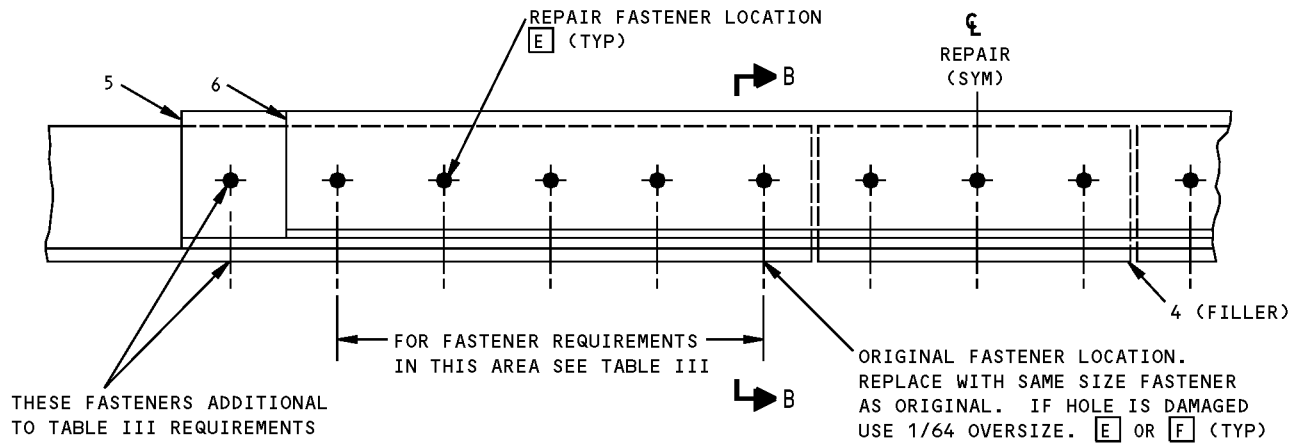
DETAIL IV



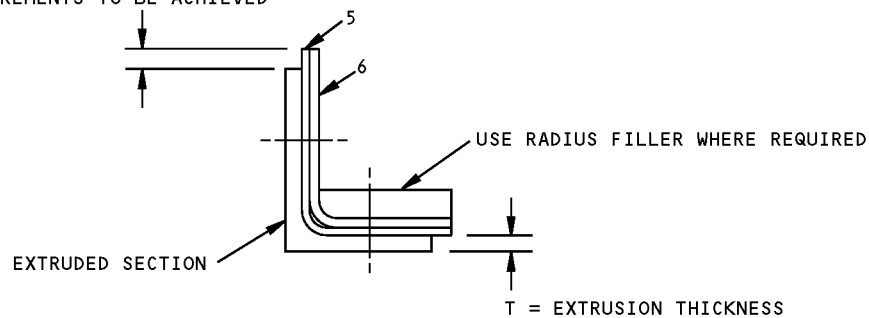
DETAIL V

Typical Extruded Section Repair
Figure 1 (Sheet 4 of 6)

757-200 STRUCTURAL REPAIR MANUAL



REPAIR PLATES MAY PROJECT BY THICKNESS "T" TO ENABLE AREA REQUIREMENTS TO BE ACHIEVED



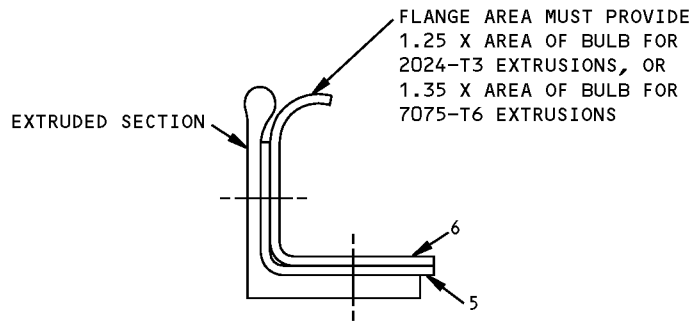
SEE DETAILS VI, VII, VIII, IX AND X
FOR TYPICAL REPAIRS OF OTHER SECTIONS

SECTION B-B

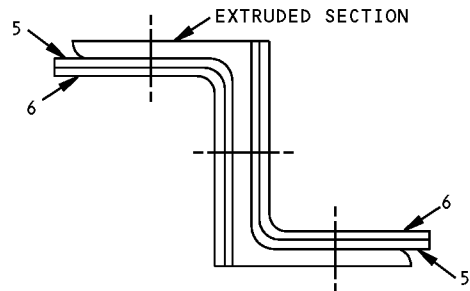
TYPICAL REPAIR OF EXTRUSIONS 0.080 GAGE AND LESS

**Typical Extruded Section Repair
Figure 1 (Sheet 5 of 6)**

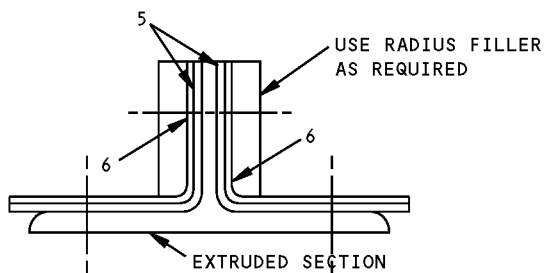
STRUCTURAL REPAIR MANUAL



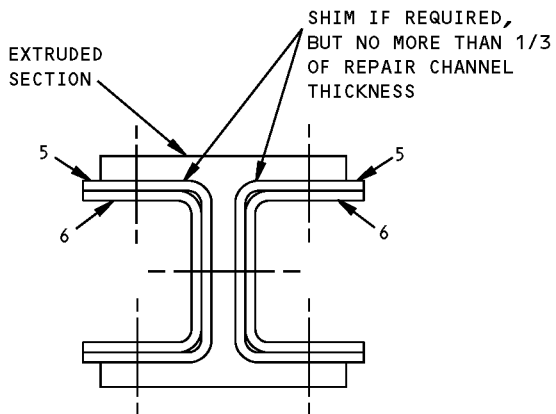
DETAIL VI



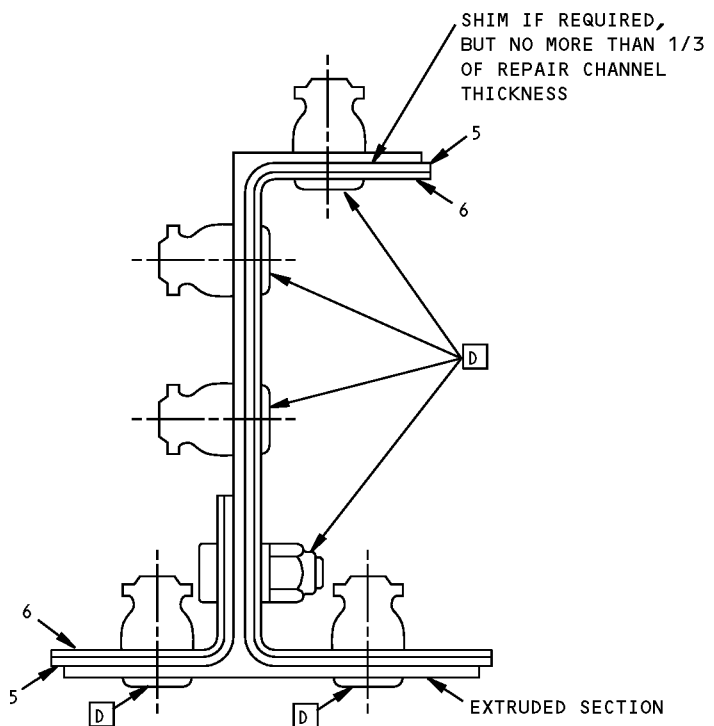
DETAIL VII



DETAIL VIII



DETAIL IX



DETAIL X

Typical Extruded Section Repair
Figure 1 (Sheet 6 of 6)

757-200 STRUCTURAL REPAIR MANUAL

APPLICABILITY

THIS REPAIR DOES NOT APPLY TO WING STRINGERS, WING SPAR CHORDS, WING CENTER SECTION, WING SPANWISE BEAM CHORDS, PRESSURE WEB STIFFENERS, OR STRUCTURE IN FUEL TANK AREAS. THIS REPAIR MAY BE USED TO PARTIALLY REPLACE AN EXTRUSION OR TO SPLICE AN EXTRUSION WITH A CROSS-SECTION CRACK INCLUDING A COMPLETE BREAK.

REPAIR INSTRUCTIONS

1. Remove fasteners and sealant over the area to be repaired.
2. Cut out the damaged portion of the extrusion in such a manner that fastener edge margins are maintained.
3. Calculate the gages of repair parts. Thickness of repair part flanges (at constant section) shall be at least 1.25 times thickness of original extrusion and area shall be at least 1.25 times area of original. Refer to sample calculation.
4. Calculate the number of fasteners to develop the strength of the repair parts. Refer to sample calculation.
5. Make the repair parts. Do not machine repair parts from large sections with strength properties reduced from those of the part repaired.
6. Assemble the repair parts and drill and ream the fastener holes in existing and new locations.
7. Disassemble the repair parts.
8. Remove the nicks, scratches, gouges, burrs, sharp edges, and corners from the repair parts and the initial parts.
9. Apply a chemical conversion coating to the repair parts and the bare surfaces of the initial parts. Refer to SRM 51-20-01.
10. Apply one layer of BMS 10-11, Type I primer to the repair parts and to the bare surfaces of the initial parts. Refer to SOPM 20-41-02.
11. Install prepack seals between the original extrusions and the repair parts, making BMS 5-95 faying surface seals between mating faces. Fasteners must be installed wet with BMS 5-95 injection sealant in gap between original and filler extrusion.
12. Restore the initial finish as specified in AMM 51-21.

NOTES

- REPAIR IS SYMMETRICAL ON EACH SIDE OF JOINT.
- EXTRUSION REPAIRS MADE WITH "AND" EXTRUDED SECTIONS ARE PREFERRED.
- EXISTING TENSION TYPE FASTENERS MUST BE REPLACED WITH TENSION TYPE FASTENERS.

- COLD WORK HOLES PER SRM 51-40-09 USING HIGH INTERFERENCE METHOD FOR THE FOLLOWING:
 - PRESSURE BULKHEADS
 - STABILIZER PIVOT BULKHEAD
 - JACKSCREW SUPPORT STRUCTURE
- REPAIRS SHOWN ARE CONSTANT SECTION EXTRUSIONS.
- THIS REPAIR PROCEDURE IS A SUPPLEMENT TO THE EXISTING REPAIR PROCEDURE(S) IN SRM 51-70-12.
- EXISTING REPAIRS MADE ACCORDING TO OTHER FIGURE(S) IN SRM 51-70-12 ARE SATISFACTORY AND ARE NOT AFFECTED BY THIS PROCEDURE.
- THIS REPAIR IS LIMITED TO THOSE LOCATIONS WHERE SPACE AND ADJACENT STRUCTURE PERMIT THE DEVELOPMENT OF THE REPAIR.
- WHEN YOU USE THIS REPAIR REFER TO:
 - AMM 51-21 FOR INTERIOR AND EXTERIOR FINISHES
 - AMM 51-24 FOR SEALS AND SEALING
 - SRM 51-10-02 FOR INSPECTION AND REMOVAL OF DAMAGE
 - SRM 51-20-01 FOR PROTECTIVE TREATMENT OF METALS
 - SRM 51-20-05 FOR SEALING OF REPAIRS
 - SRM 51-40 FOR FASTENER CODE, REMOVAL, INSTALLATION, HOLE SIZES, AND EDGE MARGINS.

- A** FASTENERS IN ROW X AND Y MAY BE STAGGERED TO SUIT DEPTH OF EXTRUSION AND TO SUIT 3.5D TO 5D REQUIREMENT (D = DIAMETER OF FASTENER). THE TOTAL NUMBER OF FASTENERS THRU WEB INCLUDES ROWS X AND Y.
- B** MACHINE TAPER AT 20 TO 1 SLOPE AND TO 0.040 INCH (1.0 mm) MINIMUM THICKNESS OR TO MAXIMUM THICKNESS EQUAL TO 1/3 THE THICKNESS OF THE FLANGE BEING SPLICED
- C** RADIUS OR CHAMFER TO SUIT RADIUS OF INITIAL EXTRUSION AND INSTALL PREPACK SEAL (TYPICAL).
- D** DETERMINE DIAMETER FROM TABLE I AND THE FOLLOWING CRITERIA:
 - WHERE FLUSH HEAD FASTENERS ARE SPECIFIED, USE BACB30NW()K HEX-DRIVE BOLTS FOR APPLICATIONS AND BACB30NY()K FOR TENSION PPLICATIONS
 - WHERE PROTRUDING HEAD FASTENERS ARE SPECIFIED, USE BACB30MY()K HEX-DRIVE BOLTS FOR SHEAR APPLICATIONS AND BACB30NX()K FOR TENSION APPLICATIONS
 - FASTENER DIAMETER SHOULD NOT EXCEED 1/16 INCH GREATER THAN ORIGINAL FASTENER DIAMETER UNLESS ADEQUATE EDGE MARGINS CAN BE MAINTAINED.
- E** INSTALL SHIMS TO FILL GAP TO WITHIN 0.005 INCH (0.13 mm) BEFORE FASTENER INSTALLATION

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 1 of 11)

757-200 STRUCTURAL REPAIR MANUAL

SYMBOLS

G	= UPPER FLANGE THICKNESS (ORIGINAL SECTION)
G ₁	= UPPER FLANGE THICKNESS (REPAIR SECTION)
H	= LOWER FLANGE THICKNESS (ORIGINAL SECTION)
H ₁	= LOWER FLANGE THICKNESS (REPAIR SECTION)
T	= WEB THICKNESS (ORIGINAL SECTION)
T ₁	= WEB THICKNESS (REPAIR SECTION WHERE ONE REPAIR SECTION IS USED)
T ₂	= WEB THICKNESS (REPAIR SECTION WHERE TWO REPAIR SECTIONS ARE USED)
AG	= UPPER FLANGE AREA (ORIGINAL SECTION)
AG ₁	= UPPER FLANGE AREA (REPAIR SECTION)
AH	= LOWER FLANGE AREA (ORIGINAL SECTION)
AH ₁	= LOWER FLANGE AREA (REPAIR SECTION)
AW	= WEB AREA (REPAIR SECTION)
L	= WEB LENGTH (ORIGINAL SECTION)
LW	= WEB LENGTH (REPAIR SECTION)
LG	= UPPER FLANGE LENGTH (ORIGINAL SECTION)
LG ₁	= UPPER FLANGE LENGTH (REPAIR SECTION)
LH	= LOWER FLANGE LENGTH (ORIGINAL SECTION)
LH ₁	= LOWER FLANGE LENGTH (REPAIR SECTION)
D	= ONE FASTENER DIAMETER
F _{TU}	= ULTIMATE TENSILE STRENGTH
F _{BRU}	= ULTIMATE BEARING STRENGTH
PSI	= POUNDS PER SQUARE INCH
n	= NUMBER OF FASTENER ROWS
+	ORIGINAL FASTENER LOCATIONS
⊙	REPAIR FASTENER LOCATION. D

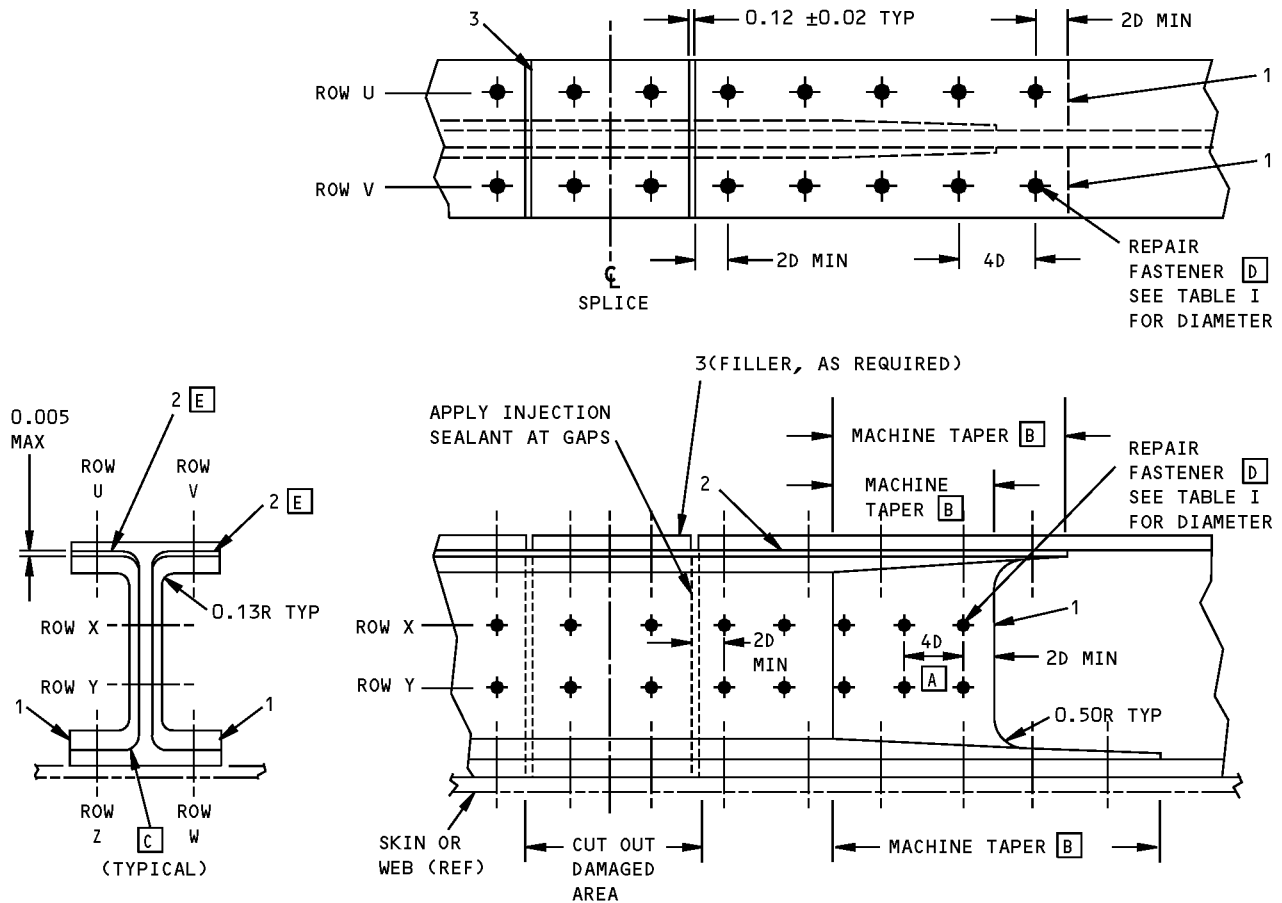
REPAIR MATERIAL			
PART		QTY	MATERIAL
1	REPAIR SECTION	1 OR 2	SAME AS MEMBER BEING REPAIRED OR EQUIVALENT. SEE REPAIR INSTRUCTIONS, STEP 5
2	SHIM	1 OR 2	
3	FILLER	1	
4	REPAIR SECTION	1	

TOTAL MATERIAL THICKNESS (INCHES)	FASTENER DIAMETER (INCHES)
UNDER 0.50	3/16 OR 1/4
0.50 TO 0.65	1/4 OR 5/16
0.66 TO 0.80	5/16 OR 3/8
0.81 AND OVER	3/8

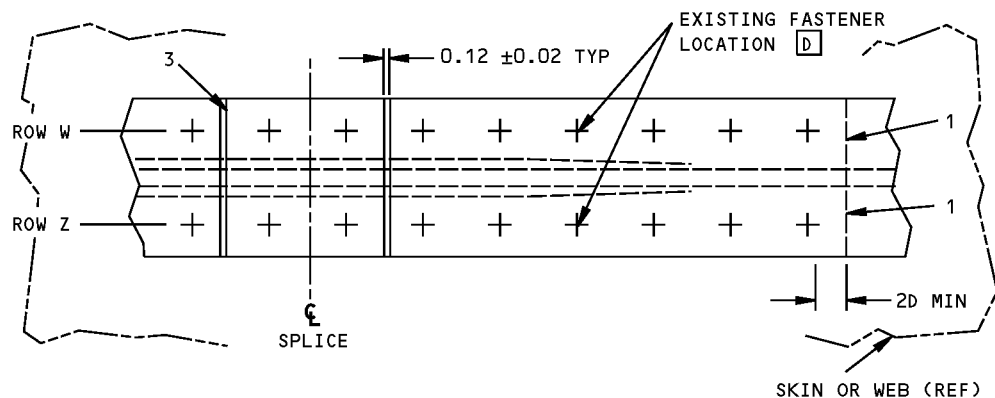
TABLE I

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 2 of 11)

757-200 STRUCTURAL REPAIR MANUAL



SIDE VIEW OF REPAIR

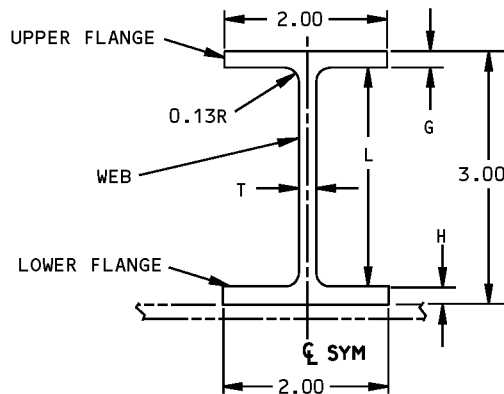


Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 3 of 11)

757-200 STRUCTURAL REPAIR MANUAL

SAMPLE CALCULATION FOR AREA AND GAGE

THE FOLLOWING EXAMPLE SHOWS THE CALCULATION REQUIRED TO REPAIR AN EXTRUSION OF THE FOLLOWING DIMENSIONS USING 2 REPAIR MEMBERS:



G = 0.15
H = 0.20
T = 0.20
L = 2.65

MATERIAL: 2024-T4 EXTRUSION

THICKNESS OF REPAIR PART (AT CONSTANT SECTION) FLANGES SHALL BE AT LEAST 1.25 x THICKNESS OF ORIGINAL EXTRUSION AND AREA SHALL BE AT LEAST 1.25 x AREA OF ORIGINAL (SEE SYMBOLS IN NOTES).

1. UPPER FLANGE THICKNESS (G_1)

$$1.25 \times G = (1.25)(0.15) \\ = 0.188$$

2. LOWER FLANGE THICKNESS (H_1)

$$1.25 \times H = (1.25)(0.20) \\ = 0.250$$

3. WEB AREA (AW)

REQUIRED AREA = REPAIR WEB AREA

$$2AW = 1.25 \times T \times L \text{ (FOR BOTH REPAIR WEBS)}$$

$$2AW = 1.25(0.20)(2.65) \text{ (FOR BOTH REPAIR WEBS)}$$

$$2AW = 0.6625 \text{ (FOR BOTH REPAIR WEBS)}$$

$$AW = 1/2(0.6625) \text{ (FOR ONE REPAIR WEB)}$$

$$AW = 0.331$$

4. WEB THICKNESS (T_2)

FROM STEP 3, AW = 0.331

$$\text{FIND LW; } LW = 3.00 - G - G_1 - H - H_1$$

$$LW = 3.00 - 0.15 - 0.188 - 0.25 - 0.20$$

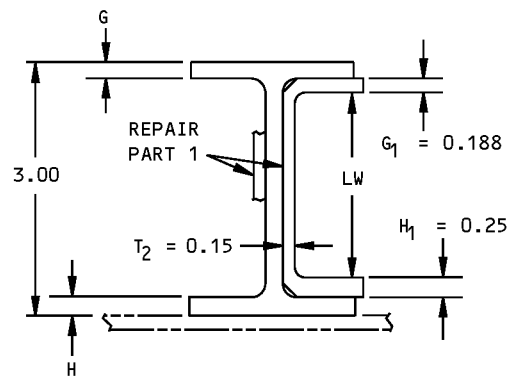
$$LW = 2.212$$

$$AW = T_2 \times LW \text{ AND,}$$

$$T_2 = AW/LW$$

$$T_2 = 0.331/2.212$$

$$T_2 = 0.150$$



Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 4 of 11)

757-200 STRUCTURAL REPAIR MANUAL

5. UPPER FLANGE AREA (AG_1)

$$\begin{aligned}\text{REQUIRED AREA} &= 1.25 \times AG \\ &= (1.25)(0.15)(1.00) \\ &= 0.188 \text{ SQ IN.}\end{aligned}$$

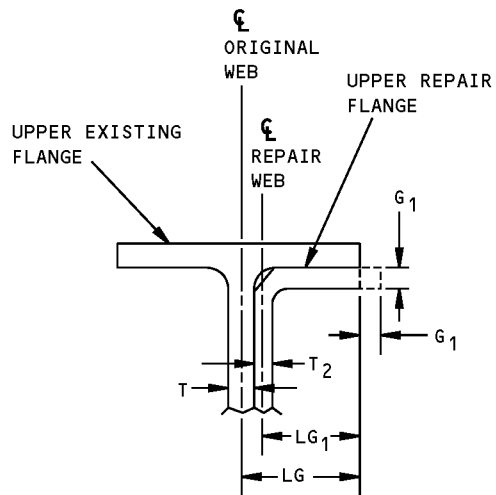
FOR A FLANGE THAT DOES NOT EXTEND PAST EXISTING FLANGE:

$$\begin{aligned}AG_1 &= LG_1 \times G_1, \text{ WHERE} \\ LG_1 &= LG - T/2 - T_2/2 \\ &= 1.00 - 0.10 - 0.075 \\ LG_1 &= 0.825 \text{ AND } G_1 = 0.188 \text{ FROM STEP 1} \\ AG_1 &= (0.825)(0.188) \\ AG_1 &= 0.155 \text{ SQ IN.; THIS DOES NOT MEET} \\ &\text{AREA REQUIREMENT OF 0.188 SQ IN.} \\ &\text{THEREFORE FLANGE MUST BE EXTENDED} \\ &\text{BY DISTANCE } G_1.\end{aligned}$$

$$\begin{aligned}\text{NOW, } LG_1 &= 0.825 + 0.188 \\ LG_1 &= 1.01\end{aligned}$$

RECHECK AREA:

$$\begin{aligned}AG_1 &= LG_1 \times G_1 \\ &= (1.01)(0.188) \\ AG_1 &= 0.190. \text{ THIS SATISFIES THE AREA} \\ &\text{REQUIREMENTS OF 0.188 SQ IN.}\end{aligned}$$



NOTE: MEASURE FLANGE LENGTH FROM CENTERLINE OF WEB.

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 5 of 11)

757-200 STRUCTURAL REPAIR MANUAL

6. LOWER FLANGE AREA (AH_1)

$$\begin{aligned}\text{REQUIRED AREA} &= 1.25 \times AH \\ &= 1.25(0.20)(1.00) \\ &= 0.250 \text{ SQ IN.}\end{aligned}$$

FOR FLANGE THAT DOES NOT EXTEND BEYOND EXISTING FLANGE:

$$\begin{aligned}AH_1 &= LH_1 \times H_1, \text{ WHERE} \\ LH_1 &= LH - T/2 - T_2/2 \\ LH_1 &= 1.00 - 0.10 - 0.075 \\ LH_1 &= 0.825\end{aligned}$$

AND, FROM STEP 2, $H_1 = 0.250$

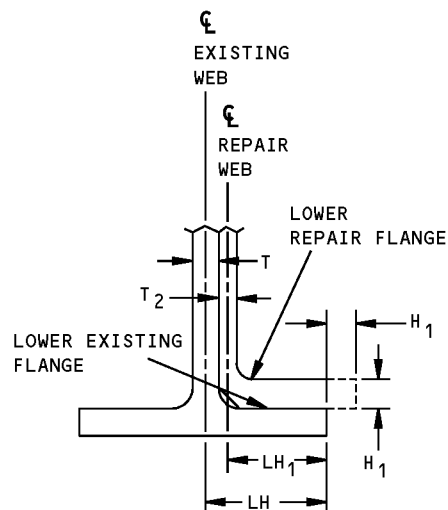
$$\begin{aligned}AH_1 &= LH_1 \times H_1 \\ &= (0.825)(0.250) \\ &= 0.206 \text{ SQ IN. THIS DOES NOT MEET} \\ &\text{THE AREA REQUIREMENTS OF 0.250 SQ} \\ &\text{IN. SO, THE FLANGE MUST BE EXTENDED} \\ &\text{BY DISTANCE } H_1.\end{aligned}$$

$$\text{NOW, } LH_1 = 0.825 + 0.250$$

$$LH_1 = 1.075$$

RECHECK AREA:

$$\begin{aligned}AH_1 &= LH_1 \times H_1 \\ AH_1 &= (1.075)(0.250) \\ AH_1 &= 0.269 \text{ SQ IN. THIS SATISFIES AREA} \\ &\text{REQUIREMENTS}\end{aligned}$$



NOTE: MEASURE FLANGE LENGTH FROM CENTERLINE OF WEB.

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 6 of 11)

757-200 STRUCTURAL REPAIR MANUAL

SAMPLE CALCULATION – FASTENER REQUIREMENTS

NOTE: FASTENER REQUIREMENTS ARE CALCULATED TO DEVELOP THE STRENGTH OF REPAIR PARTS. THIS SAMPLE CALCULATION IS TO DETERMINE THE NUMBER OF FASTENERS REQUIRED FOR THE REPAIR SECTION IDENTIFIED IN THE PREVIOUS CALCULATION. STRENGTHS OF FASTENERS ARE OBTAINED FROM SRM 51-40-07.

THE FOLLOWING CONDITIONS SHALL BE USED TO DETERMINE THE MINIMUM FASTENER REQUIREMENTS:

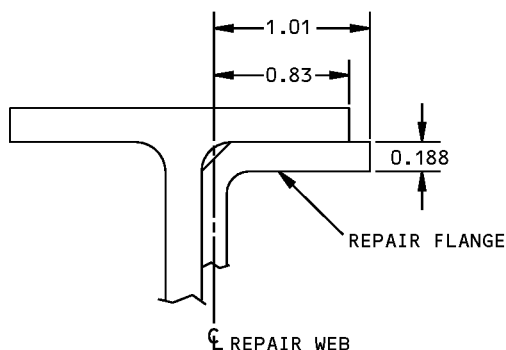
1. CONSERVATIVELY INSTALL SUFFICIENT FASTENERS IN THE CONSTANT SECTION TO DEVELOP THE REPAIR, USING A MINIMUM OF TWO FASTENERS.
2. FASTENER REQUIREMENTS IN TAPERED SECTION SHALL BE BASED ON LENGTH OF TAPERED SECTION, WITH 2D EDGE MARGIN AT END OF PART AND ABOUT 4D SPACING (3.5D TO 5D VARIATION).

NOTE: THE THICKNESS OF TAPERED SECTION IS TO BE PER NOTE [B].

3. LENGTH OF REPAIR PART IS TO BE DETERMINED BY LENGTH OF LONGEST SECTION (FLANGE OR WEB) OF REPAIR PART.

UPPER FLANGE

REQUIRED CAPABILITY (USING 3/16 DIAMETER HI-LOKS) = NET AREA $\times F_{TU}$



$$= [AG_1 - (n \times D \times G_1)] F_{TU}$$

WHERE n IS NUMBER OF FASTENER ROWS

$$= [0.190 - 0.19(0.188)] 61,000$$

$$= 9,411 \text{ LBS.}$$

REQUIRED CAPABILITY = 9,411 LBS.

CONSTANT SECTION:

FOR 3/16 DIAMETER HI-LOKS, THE FASTENERS ARE BEARING CRITICAL FOR THE 0.150 ORIGINAL FLANGE. THE BEARING ALLOWABLE IS 2,150 POUNDS PER FASTENER. THE NUMBER OF FASTENERS REQUIRED IN CONSTANT SECTION IS $9,411/2,150 = 4.37$. USE 5 FASTENERS AND SPACE AT ABOUT 4D.

TAPERED SECTION:

THICKNESS AT END OF PART = $1/3(0.15) = 0.05$ PER NOTE [B]. THEN LENGTH OF TAPERED SECTION FOR 20 TO 1 TAPER RATIO = $(0.188 - 0.05)20 = 2.76$ INCHES. USING 2D EDGE MARGIN FOR END FASTENER AND 2D FROM START OF TAPER TO FIRST FASTENER IN TAPERED SECTION, DISTANCE REMAINING IS $2.76 - 4D = 2.76 - 4 \times (0.188) = 2.01$ INCHES. INSTALL ADDITIONAL FASTENERS IN TAPERED SECTION AT 3.5 TO 5 DIAMETER SPACING. TWO ADDITIONAL WOULD GIVE $\frac{2.01}{3(0.188)} = 3.6D$ SPACING.

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 7 of 11)



757-200 STRUCTURAL REPAIR MANUAL

WEB

REQUIRED CAPABILITY (USING 2 ROWS 3/16 DIA HI-LOKS) = NET AREA x ULTIMATE TENSILE STRENGTH
= $[AW - (n \times D \times T_2)]F_{TU}$, WHERE n IS NUMBER OF FASTENER ROWS
= $[0.331 - 2(0.19)(0.15)]61,000$
= 16,714 LBS

REQUIRED CAPABILITY = 16,714 LBS. FOR EACH REPAIR WEB
= 2(16,714)
= 33,428 LBS. FOR BOTH REPAIR WEBS.

CONSTANT SECTION:

FROM PREVIOUS CALCULATIONS, 3/16 DIAMETER HI-LOKS ARE BEARING CRITICAL IN 0.150 THICK MATERIAL. SO 2,150 POUNDS OF LOAD PER FASTENER COULD BE TRANSFERRED INTO EACH REPAIR WEB IF THE REPAIR WEB WERE MORE CRITICAL THAN THE ORIGINAL WEB. THE FASTENERS REACT IN DOUBLE SHEAR WITH RESPECT TO THE ORIGINAL WEB. SO $2 \times 2,150 = 4,300$ POUNDS PER FASTENER COULD BE TRANSFERRED FROM THE ORIGINAL WEB IF THE ORIGINAL WEB WERE NOT BEARING CRITICAL. BEARING ALLOWABLE FOR 0.20 THICK ORIGINAL WEB IS 2,330 POUNDS, WHICH IS LESS THAN 4,300 POUNDS. THUS, FASTENERS ARE BEARING CRITICAL IN ORIGINAL WEB (0.20 THICK). THE NUMBER OF FASTENERS REQUIRED IN CONSTANT SECTION IS $33,428/2,330 = 14.35$. SINCE THE REPAIR CONSERVATIVELY TRANSFERS THE ENTIRE LOAD IN THE CONSTANT SECTION, USE 14 FASTENERS AND SPACE AT ABOUT 4D.

TAPERED SECTION:

THICKNESS AT END OF PART = $1/3(0.20) = 0.067$ PER NOTE [B]. THEN LENGTH OF TAPERED SECTION FOR 20 TO 1 TAPER RATIO = $(0.15 - 0.067)20 = 1.66$ INCHES. USING 2D EDGE MARGIN FOR END FASTENER AND 2D FROM START OF TAPER TO FIRST FASTENER IN TAPERED SECTION, DISTANCE REMAINING IS $1.66 - 4D = 1.66 - 4(0.188) = 0.91$ INCH. ONE ADDITIONAL FASTENER WOULD GIVE $\frac{0.91}{2(0.188)} = 2.43D$ SPACING (TOO CLOSE). SO DO NOT INSTALL THE ADDITIONAL FASTENER. THEN SPACING = $\frac{0.91}{(0.188)} = 4.85D$, WHICH MEETS THE 3.5 TO 5 DIAMETER SPACING REQUIREMENT.

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 8 of 11)

757-200 STRUCTURAL REPAIR MANUAL

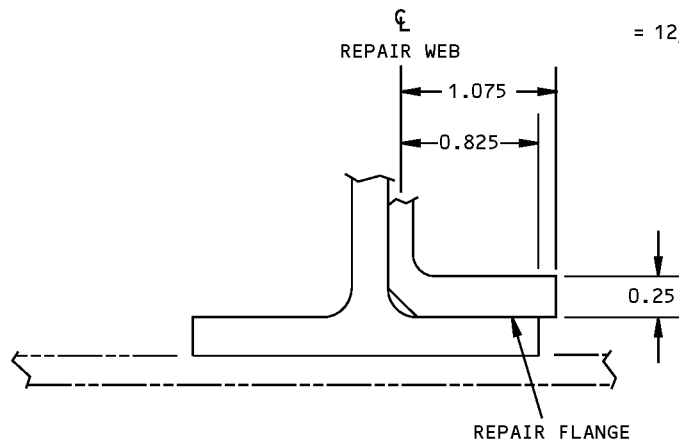
LOWER FLANGE

REQUIRED CAPABILITY (USING 1/4 DIAMETER HI-LOKS) = NET AREA x ULTIMATE TENSILE STRENGTH

$$= [AH_1 - (n \times D \times H_1)] F_{TU}$$

$$= [0.269 - 0.25(0.25)]61,000$$

$$= 12,597 \text{ LBS}$$



REQUIRED CAPABILITY = 12,597 LBS.

CONSTANT SECTION:

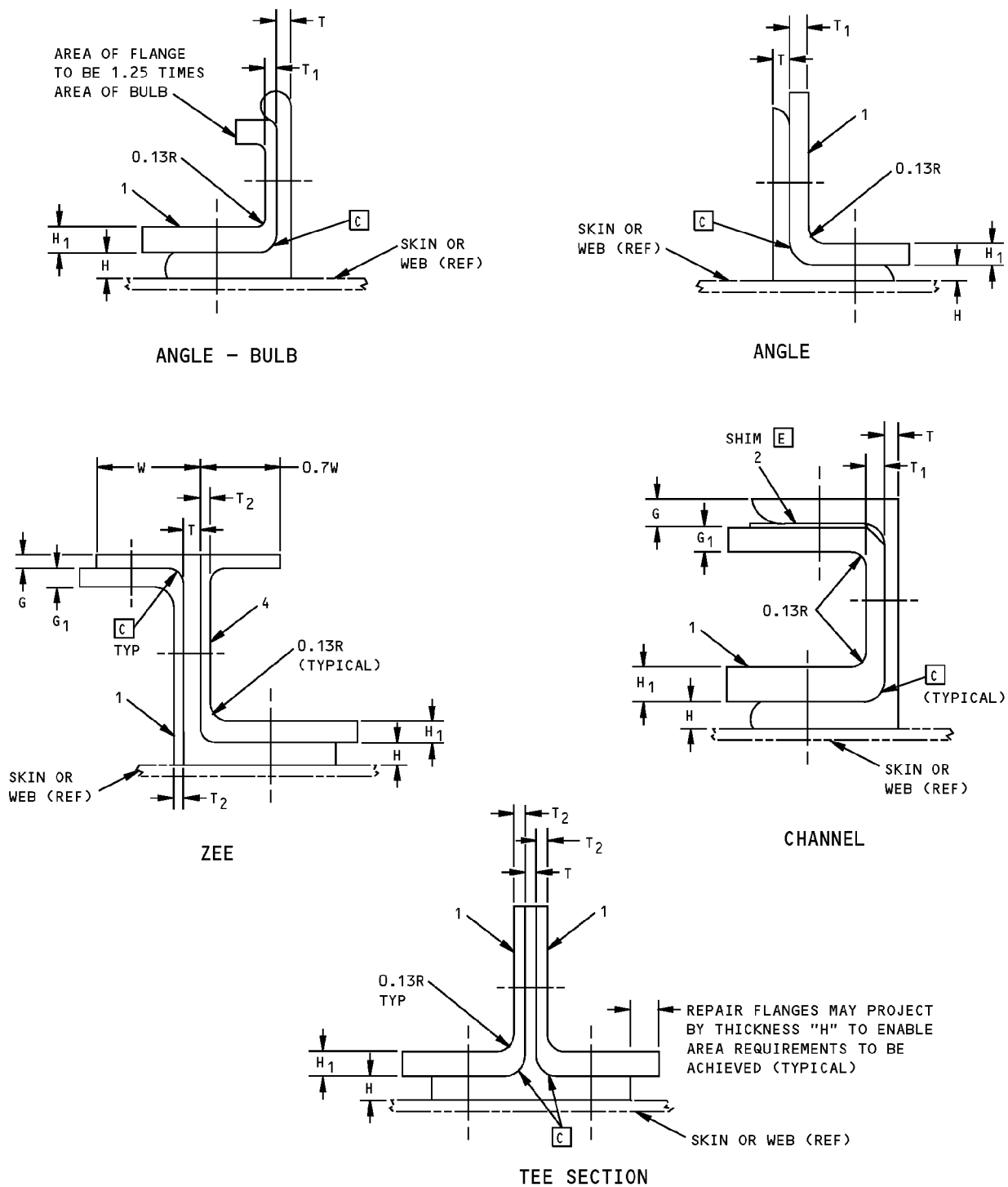
FOR 1/4 DIAMETER HI-LOKS, THE FASTENERS ARE BEARING CRITICAL IN THE 0.20 ORIGINAL FLANGE. THE BEARING ALLOWABLE IS 3,790 POUNDS PER FASTENER. THE NUMBER OF FASTENERS REQUIRED IN CONSTANT SECTION IS $12,597/3,790 = 3.32$. USE 4 FASTENERS AND SPACE AT ABOUT 4D. IF THERE ARE EXISTING 1/4 DIAMETER FASTENERS, PICK UP 4. IF FASTENER DIAMETER DIFFERS, RECALCULATE REQUIREMENT.

TAPERED SECTION:

THICKNESS AT END OF PART = $1/3(0.20) = 0.067$ PER NOTE [B]. THEN LENGTH OF TAPERED SECTION FOR 20 TO 1 TAPER RATIO = $(0.25 - 0.067)20 = 3.66$ INCHES. USING 2D EDGE MARGIN FOR END FASTENER AND 2D FROM START OF TAPER TO FIRST FASTENER IN TAPERED SECTION, DISTANCE REMAINING IS $3.66 - 4D = 3.66 - 4(0.25) = 2.66$ INCHES. INSTALL ADDITIONAL FASTENERS IN TAPERED SECTION AT 3.5 TO 5 DIAMETER SPACING. TWO ADDITIONAL WOULD GIVE $\frac{2.66}{3(0.25)} = 3.55D$ SPACING. IF THERE ARE EXISTING FASTENERS, MAKE ADJUSTMENTS TO END UP WITH APPROXIMATELY SAME END THICKNESS AND TAPER RATIO.

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 9 of 11)

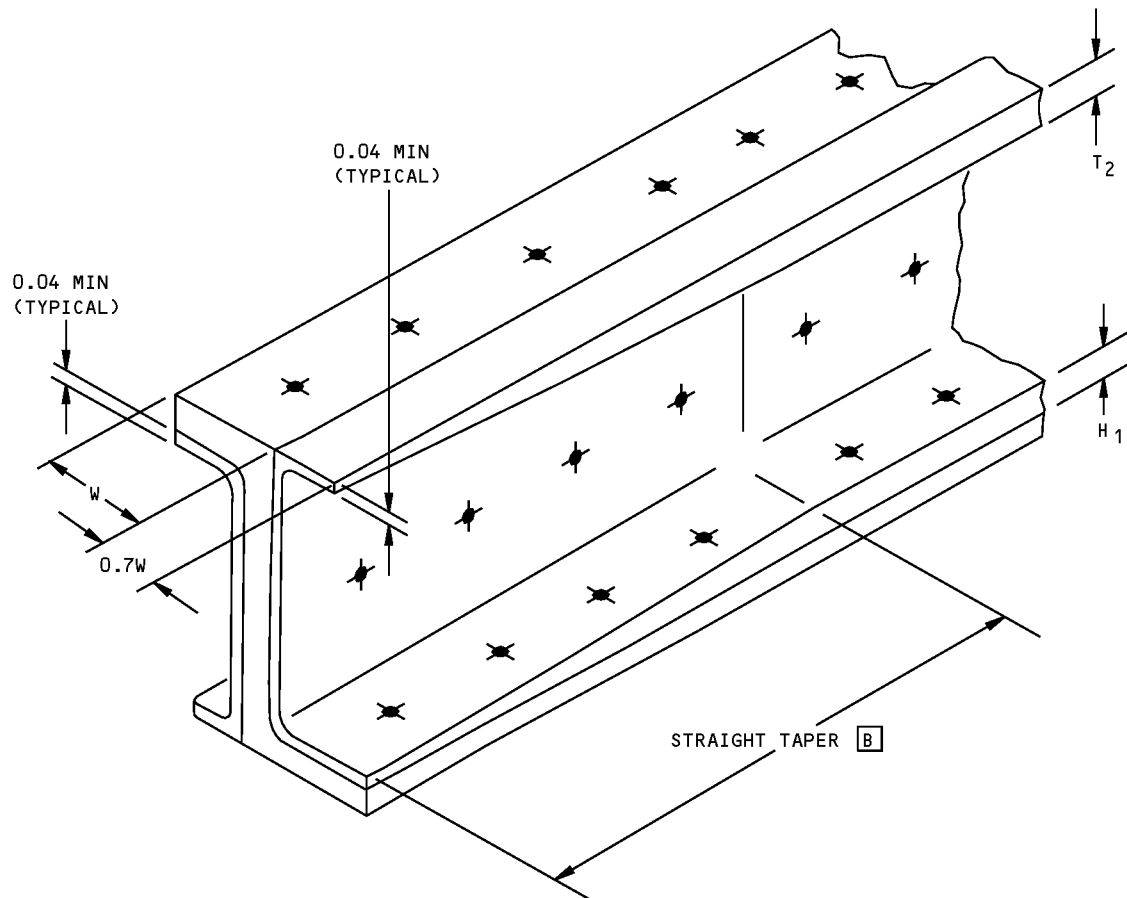
757-200 STRUCTURAL REPAIR MANUAL



TYPICAL EXTRUDED SECTIONS

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 10 of 11)

757-200
STRUCTURAL REPAIR MANUAL



ISOMETRIC VIEW OF REPAIR ANGLES
(TYPICAL FOR ALL SECTIONS)

Typical Extruded Section Repair - Machine Tapered
Figure 2 (Sheet 11 of 11)

757-200 STRUCTURAL REPAIR MANUAL

GENERAL - TYPICAL WEB REPAIRS

APPLICABILITY
THIS REPAIR DOES NOT APPLY TO DAMAGE IN THE MAIN AND NOSE WHEEL WELL PRESSURE DECK WEBS, FLOOR BEAM WEBS, KEEL BEAM WEBS, HORIZONTAL STABILIZER JACKSCREW SUPPORT STRUCTURE, FUSELAGE FRAMES, CHEM-MILLED WEBS WHERE REPAIR OVERLAPS POCKETS OF DIFFERENT THICKNESSES, HORIZONTAL AND VERTICAL STABILIZERS, SECTION 48 LONGERONS AT STRINGERS 9 AND 17, BULKHEADS AT STA 1180,1720,1743,1768, 1862,1885,1896

REPAIR INSTRUCTIONS

1. Cut and remove damaged portion of web. Do not cut into any surrounding structure.
2. Fabricate repair parts as shown in Detail I.
3. Assemble the repair parts and drill the fastener holes. See Table I for rows of rivets required and rivet spacing.
4. Remove repair parts.
5. Break sharp edges of original and repair parts 0.015 to 0.030 Inch (0.38 TO 0.76 mm)
6. Remove all nicks, scratches, burrs, sharp edges and corners from original and repair parts.
7. Apply a chemical conversion coating to the repair parts and the raw edges of the original parts as given in SRM 51-20-01.
8. Apply one coat of BMS 10-11, Type I primer to all repair parts as given in SOPM 20-41-02
9. Install the repair parts with a faying surface seal using BMS 5-95. Install fasteners wet with BMS 5-95. Refer to SRM 51-20-05
10. Restore original finish as given in AMM 51-21

NOTES

- WHEN USING THIS REPAIR REFER TO:
 - AMM 51-21 FOR INTERIOR AND EXTERIOR FINISHES
 - AMM 51-31 FOR SEALS AND SEALING
 - SRM 51-40 FOR FASTENER CODE, REMOVAL, INSTALLATION, HOLE SIZES AND EDGE MARGINS
 - SRM 51-10-02 FOR INSPECTION AND REMOVAL OF DAMAGE
 - SRM 51-20-01 FOR PROTECTIVE TREATMENT OF METALS
 - SRM 51-20-05 FOR SEALING OF REPAIRS
 - SOPM 20-41-02 FOR APPLICATION OF CHEMICAL AND SOLVENT RESISTANT FINISHES

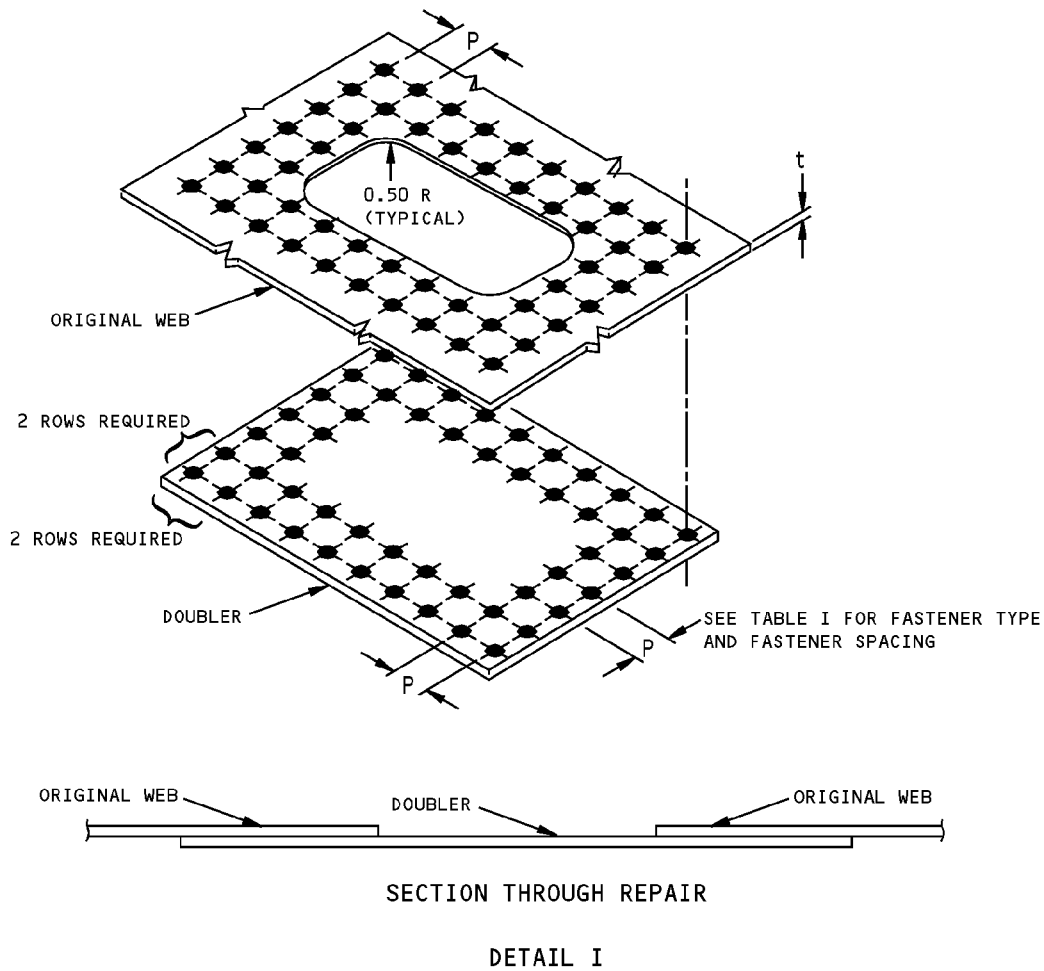
- A** WHEN ORIGINAL WEB IS 7075-T6, USE CLAD 7075-T6
- WHEN ORIGINAL WEB IS 2024-T3, USE CLAD 2024-T3

FASTENER SYMBOLS

-  REPAIR FASTENER

Typical Web Repair
Figure 1 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



THICKNESS (t)	DOUBLER	FASTENER		ROW SPACING (P)
		TYPE	DIA	
0.025 TO 0.050	USE SAME MATERIAL AND ONE GAGE THICKER THAN ORIGINAL A	BACR15FT()AD()	5/32	0.60 TO 0.68
0.025 TO 0.056			3/16	0.71 TO 0.81
0.040 TO 0.080			1/4	0.94 TO 1.06
0.025 TO 0.125		BACB30MY()K()	3/16	0.60 TO 0.68
0.040 TO 0.180			1/4	0.71 TO 0.81
0.060 TO 0.190			5/16	0.94 TO 1.06

TABLE I

Typical Web Repair
Figure 1 (Sheet 2 of 2)



757-200

STRUCTURAL REPAIR MANUAL

GENERAL - ALLOWABLE DAMAGE AND REPAIR OF FLAME-SPRAYED ALUMINUM COATINGS, ALUMINUM-COATED GLASS FABRIC (BMS 8-278), ALUMINUM FOIL (BMS 8-289), AND EXPANDED ALUMINUM FOIL MESH (BMS 8-336)

1. General

- A. This subject contains allowable damage and repair data for flame-sprayed aluminum coatings, aluminum coated glass fabric (BMS 8-278 Thorstrand), and aluminum foil (BMS 8-289).
- B. Refer to Figure 1/GENERAL for location of flame-sprayed aluminum coatings, aluminum coated glass fabric, and aluminum foil on the airplane. Figure 1/GENERAL, Table I lists the Boeing drawings for the callouts in the locator diagram.
- C. The allowable damage and repairs contained in this subject apply only to the flame-sprayed aluminum coating, aluminum coated glass fabric ply, or aluminum foil ply on glass fabric and composite panels. For allowable damage or repairs to underlying plies, see the specific component allowable damage or repair subject.
- D. Repairs by flame-spraying glass fabric reinforced epoxy resin components may be carried out by any approved facilities. Where a metal-spraying capability exists, damaged flame-sprayed aluminum coatings may be repaired as outlined in Paragraph 10.A./GENERAL. Alternate repairs for replacing entire aluminum flame sprayed areas are in Paragraph 10.B./GENERAL and Paragraph 10.C./GENERAL.
- E. Store resins at 40°F (5°C) to 80°F (27°C) in sealed containers. Store BMS 10-21 Conductive Coating at 40°F (5°C) to 90°F (32°C) in sealed containers. An identification label must accompany the material inside the bag with the following information: BMS number, type, class, grade, supplier name and product designation, batch number, and date of manufacture.
- F. Refer to 51-30-03, GENERAL for sources of materials.
- G. A composite panel is "electrically critical" if its aluminum layer is used to prevent lightning strike damage to wires, electrical components, fuel vapor zones, or antennae. Electrically critical panels that have been damaged must be repaired by the applicable time limited or permanent repair. Refer to Table 1/GENERAL for an index of repair procedures. Failure to repair an electrically critical panel could cause the loss of necessary airplane systems if that panel has subsequent lightning strike damage.
- H. A composite panel is "electrically non-critical" if its aluminum layer prevents lightning strike damage to the panel structure only. A subsequent lightning strike could cause total damage to the panel structure but the airplane will continue to fly. Thus, it is recommended to make time limited repairs to these panels before subsequent flight.
- I. Refer to Figure 1/GENERAL, Table I to find which composite panels are "electrically critical" and which are "electrically non-critical". For information on panels not listed in Figure 1/GENERAL, Table I, go to The Boeing Company with the applicable panel part number and location.
- J. Refer to Table 1/GENERAL for an index of allowable damage and repair procedures.

Table 1: Index of Allowable Damage and Repair Procedures

PARAGRAPH	SUBJECT
Paragraph 3./GENERAL	Allowable Damage for Flame-Sprayed Aluminum Coatings
Paragraph 4./GENERAL	Allowable Damage for Aluminum Coated Glass Fabric (BMS 8-278 Thorstrand)
Paragraph 5./GENERAL	Allowable Damage for Aluminum Foil (BMS 8-289)

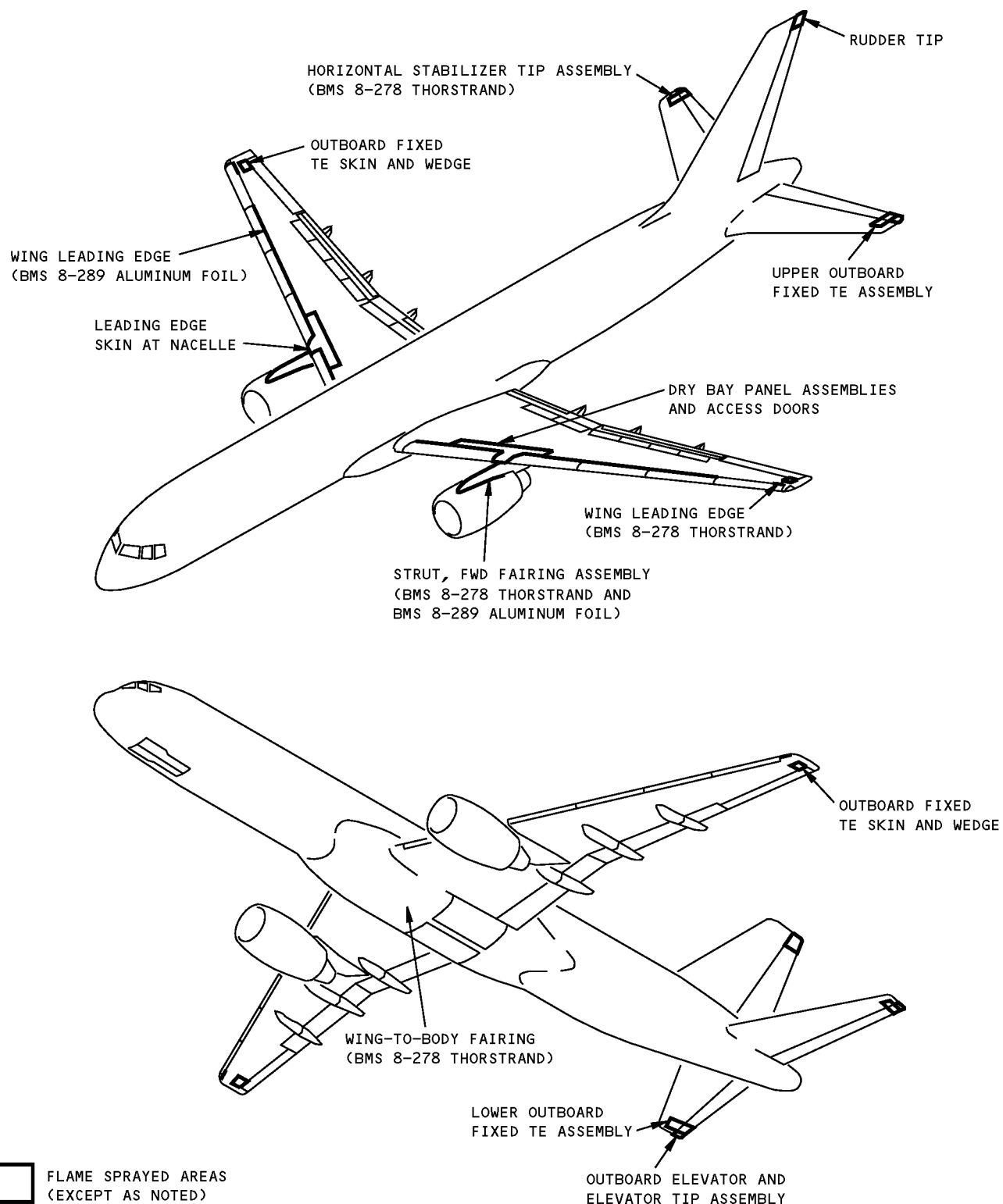


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Table 1: Index of Allowable Damage and Repair Procedures (Continued)

PARAGRAPH	SUBJECT
Paragraph 6./GENERAL	Sealing of Allowable Damage to Flame-Sprayed Aluminum Coatings and Aluminum Coated Glass Fabric with Resin
Paragraph 7./GENERAL	Time Limited Repair for Flame-Sprayed Aluminum Coatings
Paragraph 8./GENERAL	Time Limited Repair for Aluminum Coated Glass Fabric (BMS 8-278 Thorstrand)
Paragraph 9./GENERAL	Time Limited Repair for Aluminum Foil (BMS 8-289)
Paragraph 10./GENERAL	Repair of Flame-Sprayed Aluminum Coating - Full Conductivity
Paragraph 11./GENERAL	Repair of Flame-Sprayed Coatings by Potting
Paragraph 12./GENERAL	Restoration of Conductivity for Fasteners in Aluminum Flame-Sprayed Panels
Paragraph 13./GENERAL	Repair of Fastener Holes in Aluminum Flame-Sprayed Panels
Paragraph 14./GENERAL	Permanent Repair for Aluminum Coated Glass Fabric (BMS 8-278 Thorstrand)
Paragraph 15./GENERAL	Permanent Repair for Aluminum Foil (BMS 8-289)
Paragraph 16./GENERAL	Permanent Repair for Aluminum Foil Joint Splice (BMS 8-289)
Paragraph 17./GENERAL	Repair of Surface Coatings or Finishes after Repair

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Location of Flame-Sprayed Aluminum Coatings, Aluminum Coated Glass Fabric (BMS 8-278), and Aluminum Foil (BMS 8-289)
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DRAWING NUMBER	DESCRIPTION
112N8002	BARRIER - DRY BAY, WING STA 204.5 TO WING STA 231.5 C
112N8003	BARRIER - DRY BAY, WING STA 231.5 TO WING STA 258.5 C
112N8004	BARRIER - DRY BAY, WING STA 258.5 TO WING STA 285.7 C
112N8005	DOOR - 12 x 18 ACCESS HOLE, DRY BAY BARRIER C
112N8006	DOOR - 8.6 x 18 ACCESS HOLE, DRY BAY BARRIER C
113N1645	PANEL - UPR, OUTBD TE, WING STA 735 TO WBL 740 D
113N1646	TE WEDGE WBL 730.5 TO WBL 740 D
113N1657	SKIN PANEL - LWR, OUTBD D
113N1855	PANEL - BOND ASSEMBLY, WS648 TO WS736, OUTBD WING TE, UPPER D
113N1976	PANEL - UPR, OUTBD TE, WING STA 735 TO WBL 740 D
113N7101	BONDED ASSEMBLY - AILERON. D
114N1502	LOWER SKIN PANEL ASSEMBLY, INBD SLAT STA 104.22 - 106.0 INBD WING L.E. C
114N1503	LOWER SKIN PANEL ASSEMBLY, INBD SLAT STA 106.0 - 119.0 INBD WING L.E. C
114N1504	LOWER SKIN PANEL ASSEMBLY, INBD SLAT STA 119.0 - 150.52 INBD WING L.E. C
114N1505	LOWER SKIN PANEL ASSEMBLY, INBD SLAT STA 150.52 - 169.0 INBD WING L.E. C
114N1506	LOWER SKIN PANEL ASSEMBLY, INBD SLAT STA 169.0 - 213.3 INBD WING L.E. C
114N1513	ASSEMBLY - BLOWOUT PANEL, ISS 150.52-169.08, INBD WING LE. B C
114N1517	LWR SKIN PANEL ASSEMBLY - ISS 264.00 TO 284.89 INBD WING LE B C
114N1518	LWR SKIN PANEL ASSEMBLY - ISS 213.30 TO 230.48 INBD WING LE B C
114N1519	LWR SKIN PANEL ASSEMBLY - ISS 230.48 TO ISS 264.00 INBD WING L.E. B C
114N1521	LWR SKIN PANEL ASSEMBLY - ISS 104.22-106.00 INBD WING FIXED LE B C
114N1522	LWR SKIN PANEL ASSEMBLY - ISS 106.00-119.00 INBD WING FIXED LE B C
114N1523	LWR SKIN PANEL ASSEMBLY - ISS 119.00-150.52 INBD WING FIXED LE B C
114N1524	LWR SKIN PANEL ASSEMBLY - ISS 150.52-169.00 INBD WING FIXED LE B C
114N1525	LWR SKIN PANEL ASSEMBLY - ISS 169.00-213.30 INBD WING FIXED LE B C
114N1526	LWR SKIN PANEL ASSEMBLY - ISS 150.52-169.00 INBD WING FIXED LE B C
114N1527	LWR SKIN PANEL ASSEMBLY - ISS 169.00-213.30 INBD WING FIXED LE B C
114N1602	UPR SKIN PANEL ASSEMBLY, ISS 106.00-INBD CLOSURE RIB, WING FIXED LE. A OR B C
114N1603	UPR SKIN PANEL ASSEMBLY - ISS 106.0 TO ISS 169.0 WING LE C
114N1604	UPR SKIN PANEL ASSEMBLY - ISS 169.0 TO ISS 213.3 WING LE C
114N1605	UPR SKIN PANEL ASSEMBLY - ISS 213.3 TO ISS 279.89 WING LE C
114N1712	ACCESS PANEL ASSEMBLY - LANDING LIGHT, STRAKELET B C
114N1807	UPR SKIN PANEL - GAP COVER, WING LE C
114N2101	LWR SKIN PANEL ASSEMBLY - WBL 740.0 TO OSS 838.37 A C
114N2103	UPR SKIN PANEL ASSEMBLY - WBL 740.0 TO OSS 838.37 A C
114N2107	UPR SKIN PANEL ASSEMBLY - OUTBD FIXED LE - WING B C
114N2108	UPR SKIN PANEL ASSEMBLY - OUTBD FIXED LE - WING B C
114N2201	LWR PANEL ASSEMBLY OSS 365.0 - OSS 421.90 OUTBD WING FIXED LE A OR B C
114N2202	LWR PANEL ASSEMBLY OSS 333.00 - OSS 365.00 OUTBD WING FIXED LE A OR B C
149N7110	FAIRING PANEL INSTL A D
149N7111	FAIRING PANEL INSTL - FRONT SPAR THRU BS 820 A C
149N7511	FLAP TRACK FAIRING PANEL INSTL C
149N7527	BULLNOSE FAIRING PANEL INSTL C
149N7540	FAIRING PANEL INSTL. KEEL BEAM. C
149N7541	FAIRING PANEL INSTL - R/S TO B. STA 1063. D

TABLE I

NOTES

- REFER TO AMM 51-24-02 FOR LOCATION AND REPAIR OF BMS 10-21 CONDUCTIVE COATING (ELECTRICALLY NON-CRITICAL AREAS)

- A BMS 8-278 ALUMINUM COATED GLASS FABRIC
- B BMS 8-289 ALUMINUM FOIL
- C ELECTRICALLY CRITICAL
- D ELECTRICALLY NON-CRITICAL

Location of Flame-Sprayed Aluminum Coatings, Aluminum Coated Glass Fabric (BMS 8-278), and Aluminum Foil (BMS 8-289)
Figure 1 (Sheet 2 of 3)



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DRAWING NUMBER	DESCRIPTION
149N7310	FORWARD KEEL BEAM FAIRING PANEL INSTL [C]
149N7314	AIR CONDITIONING ACCESS DOOR INSTL [C]
149N7410	OUTBOARD UNDERWING FAIRING PANEL INSTL [C]
149N7610	HYDRAULIC ACCESS DOOR INSTL [C]
149N7211	FRONT SPAR THROUGH BS 1020 FAIRING PANEL ASSEMBLY [D]
149N7640	CENTERLINE PANEL INSTL [A] [C]
149N7650	SIDE PANEL INSTL - BS 1180 TO BS 1240 [A] [C]
149N7660	AFT FAIRING PANEL INSTL - BS 1240 TO BS 1352 [A] [C]
149N7720	DOOR INSTL - RAM AIR TURBINE [A] [C]
173N2603	TIP - RUDDER [D]
183N1102	PANEL - UPR, OUTBD, FIXED TE [D]
183N1206	LWR PANEL - NO. 6, ELEV STA 267.2 TO 312.7, FIXED TE [D]
183N2302	UPR SKIN PANEL - ELEVATOR [D]
183N2402	LWR SKIN PANEL - ELEVATOR [D]
183N2903	FAIRING - ELEVATOR TIP [D]
184N1006	STRAKELET - HORIZONTAL STABILIZER [D]
189N0001	TIP - HORIZONTAL STABILIZER [D]
313N3101	STRUT - FWD FAIRING PANEL INSTL - PW2037 [A] [C]
313N3102	STRUT - FWD FAIRING - AFT SEGMENT - PW2037 [A] [C]
313N3210	PANEL ASSEMBLY - UNDERWING, STRUT, PW2037 ENGINE [B] [C]
313N5003	UPPER FAIRING INSTL - STRUT [A] OR [B] [C]
313N5034	UNDERWING FAIRING - FWD SEGMENT - STRUT [A] OR [B] [C]
313N5037	FWD FAIRING ASSEMBLY - AFT SEGMENT - STRUT [A] [C]
314N3110	FAN COWL ASSEMBLY - PW2000 SERIES ENGINES [B] [C]
314N3111	BONDED PANEL ASSEMBLY - FAN COWL [C]
416N2621	DOOR ASSEMBLY - OFF WING ESCAPE SLIDE SYSTEM [C]

TABLE I (CONT)

Location of Flame-Sprayed Aluminum Coatings, Aluminum Coated Glass Fabric (BMS 8-278), and Aluminum Foil (BMS 8-289)
Figure 1 (Sheet 3 of 3)



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2. References

Reference	Title
51-20-01, GENERAL	Protective Treatment of Metallic and Nonmetallic Materials
51-30-03, GENERAL	Nonmetallic Materials
51-70-00, GENERAL	Typical Repairs
51-70-04, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 350°F (177°C) Cure
51-70-05, GENERAL	Graphite/Aramid/Hybrid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 250°F (121°C) Cure
51-70-07, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 250°F (121°C) Cure
51-70-08, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - 350°F (177°C) Cure
51-70-09, GENERAL	Metal-to-Metal Structural Repair Adhesive Bond Procedures
51-70-17, GENERAL	Repairs to 250°F (121°C) and 350°F (177°C) Cured Graphite/Aramid/Fiberglass Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Structure - 200°F (93°C) to 230°F (110°C) Wet Layup Repair Method
AMM 51-20-00	Structures Finishes - Description and Operation
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
SOPM 20-30-97	Solvents For Final Cleaning Before Structural Bonding (Series 97)

3. Allowable Damage for Flame-Sprayed Aluminum Coatings

- A. Cracks up to 6.0 in. (15.2 cm) maximum length are allowed providing that cracks do not extend from one edge to another edge (including corners).
- B. Nicks, gouges, and scratches are allowed provided the underlying plies are not damaged.
- C. Total damage to the flame-sprayed aluminum surface must not exceed 4.0 in² (25.8 cm²).
- D. Seal damage with resin as given in Paragraph 6./GENERAL, or protect damage with aluminum foil tape (speed tape) 3M-Y436 or equivalent.
- E. If aluminum foil tape is used, record location of damage and inspect at every airplane "A" check. Replace aluminum foil tape if any peeling or deterioration of tape is evident.
- F. Damage that exceeds the allowable limits must be repaired.

4. Allowable Damage for Aluminum Coated Glass Fabric (BMS 8-278 Thorstrand)

- A. Cracks up to 6.0 in. (15.2 cm) maximum length are allowed providing that cracks do not extend from one edge to another edge (including corners).
- B. Holes and punctures up to 2.0 in. (5.1 cm) maximum diameter are allowed.
- C. Delamination is allowed provided there are no cracks or holes.
- D. Nicks, gouges, scratches, and dents are allowed provided the underlying plies are not damaged.
- E. Total damage to the aluminum coated glass fabric ply must not exceed 4 in² (25.8 cm²).
- F. Seal damage with resin as given in Paragraph 6./GENERAL or protect damage with aluminum foil tape (speed tape) 3M-Y436 or equivalent.
- G. If aluminum foil tape is used, record location of damage and inspect at every airplane "A" check. Replace aluminum foil tape if any peeling or deterioration of tape is evident.
- H. Damage that exceeds the allowable limits must be repaired.



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5. Allowable Damage for Aluminum Foil (BMS 8-289)

- A. Cracks and slits up to 4.0 in. (10.2 cm) maximum length are allowed provided they are not over 50 percent of the panel dimension.
- B. Holes and punctures up to 3.0 in. (7.6 cm) maximum diameter are allowed provided they are 6.0 in. (15.2 cm) from any other damage. The maximum cumulative allowable damage per 4 ft² (0.37 m²) is 29 in² (187 cm²).
- C. Dents and delamination are allowed provided there are not cracks, slits, or holes.
- D. Protect damage that penetrates the aluminum foil with aluminum foil tape (speed tape) 3M-Y436 or equivalent and inspect as given in Paragraph 5.E./GENERAL or do a permanent repair as given in Paragraph 15./GENERAL.
- E. Record location of damage and inspect at every airplane "A" check. Replace aluminum foil tape if any peeling or deterioration is evident.
- F. Damage that exceeds the allowable limits must be repaired.

6. Sealing of Allowable Damage to Flame-Sprayed Aluminum Coatings and Aluminum Coated Glass Fabric with Resin

- A. Lightly sand the damaged area with 240-grit or finer abrasive paper.

WARNING: KEEP SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION.

AVOID CONTACT OF SOLVENT WITH SKIN, EYES, AND CLOTHING. WEAR EYE PROTECTION AND USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS.

CAUTION: DO NOT ALLOW STANDING SOLVENTS ON PART. DAMAGE TO PART WILL OCCUR.

- B. Wipe damaged area with a clean cloth moistened with BMS 11-7, MPK high purity, MEK, MIBK, trichloroethane, or acetone to remove any sanding dust or other contamination.
- C. Mix Resin Mix 1 as given in Figure 2/GENERAL.
- D. Apply Resin Mix 1 to the damaged area. Apply an excess to allow for shrinkage during cure.

WARNING: FOR ACCELERATED CURE, USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- E. Cure as given in Figure 2/GENERAL. If a heat lamp is used as a heat source, refer to Figure 3/GENERAL for heat lamp temperature curve.
- F. Sand repair area with 240-grit or finer abrasive paper to a smooth surface that is flush with the surrounding area.
- G. Apply a chemical conversion coating to any exposed flame-sprayed aluminum surface as given in 51-20-01, GENERAL.
- H. Refinish repair area as given in AMM 51-21-00/701.

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7. Time Limited Repair for Flame-Sprayed Aluminum Coatings

- A. This repair is allowed on damaged flame-sprayed aluminum coatings, provided cracks are less than 0.25 in. (6.35 mm) wide and damage in one area is less than 4.0 in² (25.8 cm²). The total damage per panel that is allowed by this procedure must not exceed 10 percent of the flame-sprayed aluminum surface. Damage that exceeds these limits must be repaired as given in Paragraph 10./GENERAL.

CAUTION: DO NOT SAND INTO FIBERS OF UNDERLYING PLIES. DAMAGE TO STRUCTURE WILL OCCUR.

- B. Lightly sand the damaged area with 180-grit or finer abrasive paper to remove any loose flame-sprayed aluminum.
- C. Remove finish 0.50 in. (13 mm) minimum around the edge of the damage using 240-grit or finer abrasive paper. Do not sand through the flame-sprayed aluminum coating.

WARNING: KEEP SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION.

AVOID CONTACT OF SOLVENT WITH SKIN, EYES, AND CLOTHING. WEAR EYE PROTECTION AND USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS.

CAUTION: DO NOT ALLOW STANDING SOLVENTS ON PART. DAMAGE TO PART WILL OCCUR.

- D. Wipe the damaged area with a clean cloth moistened with BMS 11-7, MPK high purity, MEK, MIBK, trichloroethane, or acetone to remove any contamination.
- E. Apply aluminum foil tape (speed tape) 3M-Y436 to the damaged area. Make sure to cut the speed tape to a dimension that will extend 1 in. (25 mm) over the flame-sprayed area that is not damaged.
- F. This time limited repair has FAA approval if you examine the speed tape at each subsequent "A" check. The speed tape must be replaced if any of it has peeled off. Remove the speed tape and do a permanent repair at the subsequent "C" check. Refer to Paragraph 10./GENERAL.

8. Time Limited Repair for Aluminum Coated Glass Fabric (BMS 8-278 Thorstrand)

WARNING: KEEP SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION.

AVOID CONTACT OF SOLVENT WITH SKIN, EYES, AND CLOTHING. WEAR EYE PROTECTION AND USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS.

CAUTION: DO NOT ALLOW STANDING SOLVENTS ON PART. DAMAGE TO PART WILL OCCUR.

- A. Wipe damaged area with a clean cloth moistened with BMS 11-7, MPK high purity, MEK, MIBK, trichloroethane, or acetone to remove any contamination.
- B. Apply aluminum foil tape (speed tape) 3M-Y436 to damaged area.
- C. Apply conductive coating as given in AMM 51-24-02 and Figure 6/GENERAL to aluminum foil tape and out to fasteners with dimpled washers. Conductive coating must extend from aluminum foil tape to fasteners with dimpled washers to ensure proper grounding to airplane structure.
- D. Refinish repair area as given in AMM 51-21-00/701.



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- E. Time limited repair has FAA approval providing it is replaced with a permanent repair as given in Paragraph 14./GENERAL no later than the next airplane "C" check.

9. Time Limited Repair for Aluminum Foil (BMS 8-289)

WARNING: KEEP SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION.

AVOID CONTACT OF SOLVENT WITH SKIN, EYES, AND CLOTHING. WEAR EYE PROTECTION AND USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS.

CAUTION: DO NOT ALLOW STANDING SOLVENTS ON PART. DAMAGE TO PART WILL OCCUR.

- A. Wipe damaged area with a clean cloth moistened with solvent, Series 97 (Refer to AMM 20-30-97 or SOPM 20-30-97) to remove any contamination.
- B. Cut a sheet of bare aluminum foil such that it will overlap the edge of the damage by 1.0 in. (25 mm) minimum.
- C. Place aluminum foil sheet over the damaged area such that it overlaps the edge of the damage by 1.0 in. (25 mm) minimum.
- D. Apply aluminum foil tape (speed tape) 3M-Y436 or equivalent around the edges of the aluminum foil sheet.
- E. Time limited repair has FAA approval providing it is replaced with a permanent repair as given in 51-70-04, GENERAL or 51-70-05, GENERAL no later than the next airplane "C" check.

10. Repair of Flame-Sprayed Aluminum Coating - Full Conductivity

CAUTION: DO NOT USE PAINT STRIPPERS ON COMPOSITE STRUCTURES. CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS:

- A. Repair of Damaged Flame-Sprayed Area
 - (1) Mask off the area surrounding the damage.

CAUTION: DO NOT SAND INTO FIBERS OF UNDERLYING PLIES. DAMAGE TO STRUCTURE WILL OCCUR.

- (2) Lightly sand the damaged area with 180 grit or finer abrasive paper to remove any loose flame-sprayed aluminum.
 - (3) Sand the undamaged aluminum flame-sprayed coating a minimum of 1.0 in. (25 mm) around the edge of the damage.

WARNING: KEEP SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION.



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(WARNING PRECEDES)

AVOID CONTACT OF SOLVENT WITH SKIN, EYES, AND CLOTHING. WEAR EYE PROTECTION AND USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS.

CAUTION: DO NOT ALLOW STANDING SOLVENTS ON PART. DAMAGE TO PART WILL OCCUR.

- (4) Wipe damaged area with a clean cloth moistened with BMS 11-7, MPK high purity, MEK, MIBK, trichloroethane, or acetone to remove any sanding dust or other contamination.
- (5) Coat the damaged area with with flame-sprayed aluminum to a thickness of 0.010 in. (0.254 mm) to 0.012 in. (0.305 mm).
 - (a) Flame-sprayed coatings are applied using 1/8 inch diameter pure aluminum wire per AMS 4180, and a Metco 8E or 11E gun (Metco, Inc., 1105 Prospect Ave., Westbury, NY 11590) or equivalent. Refer to the manufacturer's operating instructions for use of this equipment.
 - (b) Spray at a gun-to-work distance of 4.0 in. (10 cm) minimum to 8.0 in. (20 cm) maximum. When spraying with MAPP gas, a gun-to-work distance of 10.0 in. (25 cm) maximum is allowed.

CAUTION: DO NOT ALLOW THE PART SURFACE TEMPERATURE TO EXCEED 120°F (49°C). BUCKLING, CRACKING, OR LIFTING OF THE FLAME-SPRAYED ALUMINUM COATING MAY OCCUR.

- (c) Use a surface pyrometer to monitor the part surface temperature.
- (d) Apply flame-sprayed aluminum coating evenly with a progressive build-up over the repair area using a traverse rate of 10 in. (25 cm) to 22 in. (56 cm) per second. Overlap each previous pass by one-third of the spray width.
- (e) Determine the thickness of the flame-sprayed aluminum coating by one or both of the following methods:
 - 1) Peel oversprayed material from masking tape (outside the designated area). Measure one sample for every 6 in. (15 cm) of flame spray edge or a minimum of two samples.
 - 2) Measure and record (on the side opposite the surface to be flame-sprayed) the thickness of the laminate. After flame spray, re-measure the previous locations and calculate the flame-sprayed coating thickness. Sample the thickness every 6 in. (15 cm) or a minimum of two measurements per part.
- (6) Remove masking tape.
- (7) Thoroughly mix together equal quantities of EC 1838 Parts A and B. Refer to Figure 2/GENERAL for BMS 8-207, Type I, Class 1 resin type. BMS 8-201, Type IV may be used as an alternate system.

NOTE: EC 1838 may be thinned with up to 10 parts lacquer thinner (TT-T-266) per 100 parts catalyzed resin to facilitate coat application.

- (8) Carefully apply the resin mix evenly over the the entire oversprayed area.

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WARNING: FOR ACCELERATED CURE, USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- (9) Cure the resin sealed surface as given in Figure 2/GENERAL. If a heat lamp is used as a heat source, refer to Figure 3/GENERAL for heat lamp temperature curve.
 - (10) Sand the oversprayed area to produce a smooth surface that is flush with the surrounding area. Use 240-grit wet or dry abrasive paper.
 - (11) Wipe area clean with a clean cheesecloth moistened with BMS 11-7, MPK high purity, MIBK, MEK, trichlorethane, or acetone.
 - (12) Apply a chemical conversion coating to all exposed flame sprayed surface in the repaired area as given in 51-20-01, GENERAL.
 - (13) Refinish the repaired area as given in AMM 51-21-00/701.
- B. Replacement of Entire Flame-Sprayed Area on a Flat or Single Contour Surface (Alternate Repair)

CAUTION: THE FOLLOWING REPAIR IS ONLY TO BE USED WHEN REPLACING THE ENTIRE FLAME-SPRAYED AREA. NO PATCHING IS ALLOWED USING THIS REPAIR. FAILURE TO COMPLY WILL RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

- (1) Remove all removable fasteners, electrical bonding (dimpled) washers, and static discharger bases, as applicable. Remove static discharger bases as given in AMM 23-61-01. On some panels electrical bonding washers may not be used. In this case, permanent fasteners that provide the electrical bond to the airplane structure (Refer to engineering drawing) must be removed.

NOTE: Removal of all other permanent fasteners is optional. However, subsequent removal of these fasteners will require removal and possible repair of flame-sprayed aluminum coating on fastener head if they are not removed prior to this repair.

CAUTION: DO NOT SAND INTO FIBERS OF UNDERLYING PLIES. DAMAGE TO STRUCTURE WILL OCCUR.

- (2) Remove all of the existing flame-sprayed aluminum (both damaged and undamaged) from the panel by sanding with 180-grit or finer abrasive paper.

WARNING: KEEP SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION.

AVOID CONTACT OF SOLVENT WITH SKIN, EYES, AND CLOTHING. WEAR EYE PROTECTION AND USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS.

CAUTION: DO NOT ALLOW STANDING SOLVENTS ON PART. DAMAGE TO PART WILL OCCUR.

- (3) Wipe panel surface with a clean cloth moistened with BMS 11-7, MPK high purity, MEK, MIBK, trichloroethane, or acetone to remove any sanding dust or other contamination.
- (4) Cut a piece of PVA film larger than the repair area and secure to a smooth, flat surface.

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- (5) Apply flame-sprayed aluminum coating to PVA film and apply sealer resin (Refer to Paragraph 10.A.(5)/GENERAL through Paragraph 10.A.(9)/GENERAL).
- (6) Cut the flame-sprayed PVA film to match the flame-sprayed area on the panel.
- (7) Cut a 0.020 in. (0.5 mm) thick aluminum caul plate the same size and shape as the flame-sprayed PVA film.
- (8) Apply a coat of BMS 5-92 adhesive to the repair area on the panel.
- (9) On graphite panels, apply a glass fabric ply to the repair area as follows:
 - (a) Cut a piece of BMS 9-3, Type H-2 or Type H-3 glass fabric larger than the original glass fabric isolation ply.
 - (b) Cut two pieces of parting film 3.0 in. (7.6 cm) larger all around than the glass fabric.
 - (c) Tape down one piece of parting film to a smooth surface.
 - (d) Lay glass fabric onto parting film.
 - (e) Prepare BMS 5-92, Type I adhesive.
 - (f) Spread adhesive evenly over glass fabric.
 - (g) Lay second piece of parting film over glass fabric.
 - (h) Work adhesive thoroughly and evenly into fabric with a squeegee or roller to impregnate the fabric and to remove entrapped air.
 - (i) Work excess adhesive to edges of fabric.
 - (j) Cut the impregnated glass fabric to the same size as the original glass fabric isolation ply. The parting film on both sides of the fabric decreases fraying of the edges while cutting the fabric.
- CAUTION:** ENSURE THAT PARTING FILM IS REMOVED FROM GLASS FABRIC PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.
- (k) Remove parting film from one side of glass fabric and place exposed face against the repair area.
- (l) Remove wrinkles and entrapped air with a squeegee. Do not apply excessive pressure or repair will be deficient in adhesive.
- (m) Remove second piece of parting film from glass fabric.
- (10) Apply a coat of BMS 5-92, Type I adhesive to the exposed aluminum surface of the flame-sprayed PVA film.
- (11) Place flame-sprayed PVA film (with PVA film facing out) against the repair area (or on top of glass fabric, as applicable).
- (12) Remove wrinkles and entrapped air with a squeegee.
- (13) Refer to Figure 4 (Sheet 1), Detail I for the following layup procedure.
 - (a) Place a layer of perforated FEP parting film (1 mil thick) over the repair. Cut the FEP so that the edges extend 3.0 in. (7.6 cm) beyond the edge of the repair.
 - (b) If using an accelerated cure, secure three thermocouples (spaced evenly around repair) to the panel at the edge of the repair and connect them to the appropriate recorders.
 - (c) Place a layer of glass fabric over the perforated FEP as a surface breather. Cut the surface breather so that the edges extend 2.0 in. (5.1 cm) beyond the edge of the perforated FEP.
 - (d) Secure a vacuum line on the edge of the surface breather .

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- (e) Place a layer of solid FEP parting film (2 mil thick) over the surface breather. Cut the solid FEP so that the edges are even with the perforated FEP.
- (f) Place the aluminum caul plate over the solid FEP (where contour of part permits).

WARNING: FOR ACCELERATED CURE, USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- (g) If a heat blanket is used as a heat source, perform the following steps:

NOTE: A heat blanket, infrared heat lamp, or equivalent heat source may be used to accelerate the cure.

If the repair is made on structure too small to allow the heat blanket to be vacuum bagged, proceed to Paragraph 10.B.(13)(h)/GENERAL and place heat blanket over the vacuum bag.

- 1) Place a heat blanket over the caul plate. The heat blanket must extend 2.0 in. (5 cm) minimum beyond the edge of the repair.
 - 2) Place controlling thermocouple over the center of the heat blanket.
 - 3) Place four to six layers of glass fabric over the heat blanket. The glass fabric will insulate the heat blanket and prevent damage to the bagging film.
- (h) Apply extruded sealing compound around the entire repair area, approximately 6.0 in. (15.2 cm) outside the edge of the heat blanket.
 - (i) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent breakage. Pad all sharp objects and corners to prevent bag breakage. It is optional to vacuum bag the entire part.

NOTE: The entire part must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts where sagging and distortion could occur due to the weight of the part.

- (j) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum.
 - (k) Check the vacuum bag for leaks.
- (14) Cure repair as given in Figure 2/GENERAL and Figure 5/GENERAL. A heat blanket, infrared heat lamp, or equivalent heat source may be used to accelerate the cure. If a heat lamp is used as a heat source, refer to Figure 3/GENERAL for heat lamp temperature curve. Heat at a maximum of 8°F (5°C) per minute. Determination of the temperature must be made using the thermocouple placed at the edge of the repair. Use the thermocouple with the lowest reading to determine the cure temperature.

NOTE: Cure time does not include the time required for the part to heat up to temperature. Cure time is the period after the part has reached that temperature.

- (15) Maintain vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
- (16) Remove bagging material.
- (17) Remove PVA film from flame-sprayed area.

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- (18) Reinstall fasteners, electrical bonding (dimpled) washers, and static discharger bases, as applicable. Reinstall static discharger bases as given in AMM 23-61-01.
 - (19) Check conductivity from base of static discharger to the adjacent surface of the aluminum flame spray. Resistance shall not exceed 0.10 ohms.
 - (20) Ensure conductivity between washer and adjacent surface. Resistance shall not exceed 0.10 ohms.
 - (21) Apply a chemical conversion coating to the flame-sprayed aluminum surface as given in 51-20-01, GENERAL.
 - (22) Refinish the repair area as given in AMM 51-21-00/701.
- C. Replacement of Entire Flame-Sprayed Area (Second Alternate Repair)

CAUTION: THE FOLLOWING REPAIR IS ONLY TO BE USED WHEN REPLACING THE ENTIRE FLAME-SPRAYED AREA. NO PATCHING IS ALLOWED USING THIS REPAIR. FAILURE TO COMPLY WILL RESULT IN A UNACCEPTABLE AND UNAUTHORIZED REPAIR.

- (1) Perform Paragraph 10.B.(1)/GENERAL through Paragraph 10.B.(3)/GENERAL.
- (2) Cut a piece of 0.010-0.012 inch (0.254-0.305 mm) thick aluminum foil sheet the size of the original flame-sprayed area.
- (3) Clean, anodize, and prime all surfaces of aluminum foil sheet as given in 51-70-09, GENERAL.
- (4) Apply a coat of BMS 5-92, Type I adhesive to the repair area on the panel.
- (5) On graphite panels, apply a glass fabric ply to the repair area as given in Paragraph 10.B.(9)/GENERAL.
- (6) Apply a coat of BMS 5-92, Type I adhesive to the faying surface of the aluminum repair sheet.
- (7) Place the aluminum foil sheet with adhesive coating against the repair area (or on top of glass fabric, as applicable).
- (8) Remove wrinkles and entrapped air with a squeegee.
- (9) Refer to Figure 4 (Sheet 2), Detail II and Paragraph 10.B.(13)(a)/GENERAL through Paragraph 10.B.(13)(e)/GENERAL and Paragraph 10.B.(13)(g)/GENERAL through Paragraph 10.B.(13)(k)/GENERAL for layup procedure.
- (10) Cure, reinstall fasteners, and finish the repaired aluminum surface by performing Paragraph 10.B.(14)/GENERAL through Paragraph 10.B.(16)/GENERAL, Paragraph 10.B.(18)/GENERAL through Paragraph 10.B.(20)/GENERAL and Paragraph 10.B.(22)/GENERAL.

11. Repair of Flame-Sprayed Coatings by Potting

NOTE: Repairs made using the potting process will not restore conductivity and therefore are restricted by the limitations of Paragraph 3./GENERAL.

- A. Refer to repair limits in Paragraph 3./GENERAL prior to undertaking potting repair.
- B. Lightly sand the repair area with 240-grit or finer abrasive paper.

NOTE: The area to be repaired by this procedure shall not extend into the glass fabric of the laminate or sandwich structure.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- C. Wipe area with clean cloth or gauze moistened with BMS 11-7, MPK high purity, MIBK, MEK, trichlorethane, or acetone to remove any sanding dust or other contamination.

STRUCTURAL REPAIR MANUAL

- D. Thoroughly mix BMS 5-28, Type 3 potting resin as given in Figure 2/GENERAL.
- E. Apply the potting resin with a spatula to the areas to be repaired. Apply an excess to allow for shrinkage during cure.
- F. Cure the potting resin as given in Figure 2/GENERAL.
- G. Sand the potted area with 240-grit or finer abrasive to produce a smooth surface that is flush with the surrounding area.
- H. Apply a chemical conversion coating to all exposed flame-sprayed surface in repaired area as given in 51-20-01, GENERAL.
- I. Refinish the repaired area as given in AMM 51-21-00/701.

12. Restoration of Conductivity for Fasteners in Aluminum Flame-Sprayed Panels

NOTE: Repairs made using this method are restricted by the limitations of Paragraph 3./GENERAL.

- A. Lightly sand the area with 320-grit abrasive paper.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- B. Wipe with clean cloth or gauze moistened with BMS 11-7, MPK high purity, MIBK, MEK, trichloroethane, or acetone to remove sanding dust and any other contamination.
- C. Attach an aluminum foil strap (0.004-0.006 inch thick) connecting the fastener to the cleaned area. Use speed tape to hold the aluminum foil in place. The speed tape should overlap the flame-sprayed coating.
- D. With resistance meter, ensure that the conductivity has been restored. Resistance should not exceed 1.0 ohm.

13. Repair of Fastener Holes in Aluminum Flame-Sprayed Panels

NOTE: Repairs made using this method restore full electrical conductivity and continuity to damaged fastener holes.

- A. Repair fastener hole as given in 51-70-00, GENERAL.
- B. Apply flame-sprayed coating as given in Paragraph 10.A./GENERAL.
- C. Drill and countersink fastener locations from mating airplane structure or from hole transfer template.
- D. Apply a chemical conversion coating to the exposed flame-sprayed coating as given in 51-20-01, GENERAL.
- E. Install dimpled washer and fastener.

NOTE: Captive washers should be installed according to BACW10CC.

- F. Apply BMS 10-79, Type II or III primer over flame-sprayed coating and fastener.
- G. Refinish the repaired area as given in AMM 51-21-00/701.

14. Permanent Repair for Aluminum Coated Glass Fabric (BMS 8-278)

- A. Mask off the area surrounding the damage with masking tape.

CAUTION: DO NOT SAND INTO FIBERS OF UNDERLYING PLIES. DAMAGE TO STRUCTURE WILL OCCUR.

- B. Remove exterior finish from damaged area and 1.0 in. (25 mm) beyond damage by sanding with 240-grit or finer abrasive paper. Remove damage by sanding with 150-grit or finer abrasive paper.



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WARNING: KEEP SOLVENTS AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS. HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION.

AVOID CONTACT OF SOLVENT WITH EYES, SKIN, AND CLOTHING. WEAR EYE PROTECTION AND USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS.

CAUTION: DO NOT ALLOW STANDING SOLVENTS ON PART. DAMAGE TO PART WILL OCCUR.

- C. Wipe repair area with a clean cloth moistened with BMS 11-7, MPK high purity, MEK, MIBK, trichloroethane, or acetone to remove any sanding dust or other contamination.
- D. Apply flame-sprayed aluminum coating as given in Paragraph 10.A./GENERAL to a thickness of 0.010 in. (0.254 mm) to 0.012 in. (0.305 mm).
- E. Remove masking tape.
- F. Mix Resin Mix 1 as given in Figure 2/GENERAL.
- G. Apply Resin Mix 1 to repair area.

WARNING: FOR ACCELERATED CURE, USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- H. Cure as given in Figure 2/GENERAL. If a heat lamp is used as a heat source, refer to Figure 3/GENERAL for heat lamp temperature curve.
- I. Sand repair area with 240-grit or finer abrasive paper to a smooth surface that is flush with the surrounding area.
- J. Apply conductive coating as given in AMM 51-24-02 and Figure 6/GENERAL to repair area and out to fasteners with dimpled washers. Conductive coating must extend from repair area to fasteners with dimpled washers to ensure proper grounding to airplane structure.
- K. Refinish repair area as given in AMM 51-21-00/701.

15. **Permanent Repair for Aluminum Foil (BMS 8-289)**

- A. Determine Extent of Damage
 - (1) Use this repair only for damage exclusively to the aluminum foil.
 - (2) For structural damage extending into underlying plies, repair as given in 51-70-04, GENERAL, 51-70-05, GENERAL, 51-70-07, GENERAL, 51-70-08, GENERAL, or 51-70-17, GENERAL as applicable.
 - (3) Refer to Figure 7/GENERAL for the following repair procedure.
- B. Preparation for Repair
 - (1) Mask off the area surrounding the damage with masking tape.
 - (2) Remove damaged foil by peeling or abrading. Do not damage underlying glass fibers.
 - (3) Abrade and solvent wipe the primer on the aluminum foil on a 3.0 in. (7.6 cm) minimum border around the damaged area.
 - (4) Remove primer on a 1.0 in. (25 mm) minimum border; abrade and solvent wipe foil surface to water-break-free condition. Spotty traces of primer covering up to 10 percent of border area are acceptable.
 - (5) Abrade and solvent wipe exposed composite surface. Do not damage underlying glass fibers.

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C. Aluminum Foil Replacement

- (1) Cut a BMS 8-289 aluminum foil patch the size and shape of the area to be repaired (BMS 8-289, Type 0/250/x/x/x, Form I or II, where x = optional thickness, alloy, and adhesive thickness).
- (2) Apply Resin Mix 3 as given in Figure 2/GENERAL or EA956 (BMS 5-128) or EA9396 to the exposed fiberglass area.
- (3) Butt-splice the BMS 8-289 patch, adhesive side down, to the existing foil (no overlap, 0.25 in. (6 mm) maximum gap). Press down and remove excess resin (squeeze-out) with cheesecloth wetted with BMS 11-7, MIBK, acetone, MPK high purity, MEK or equivalent.
- (4) Cut splice strip of BMS 8-289, Type 0/250/x/x/x, Form II preferred, Form I optional. Form II splice strip may be pieced and trimmed to fit the repair area. If Form I splice strip is used, chemical conversion coat treat non-adhesive side of splice strip and perforate splice strip centerline with 0.5 in. (12.7 mm) diameter (nominal) holes 2.0 in. (5.1 cm) (nominal) on center.
- (5) Apply a chemical conversion coating to all aluminum surfaces that will contact splice strip and cover ply. Refer to 51-20-01, GENERAL.
- (6) Place the splice strip, adhesive side up, over the aluminum surface so that it has a minimum 1.0 in. (25 mm) overlap on each side of the splice line. The outer edge of the splice strip is to be at least 1.0 in. (25 mm) from the edge of part.

NOTE: Local spots of Resin Mix 3, EA956 or EA9396, approximately 0.25 in. (6.4 mm) diameter and 4.0 in. (10.2 cm) spacing may be used, if necessary, on the non-adhesive side of the splice strip to hold it in place. Do not use large amounts of resin for this purpose

Splicing is not allowed on the laminate edge-band faying surface.

- (7) Place a cover ply of BMS 9-3 Type D fiberglass impregnated with Resin Mix 3, EA956 or EA9396, over the repair so that it overlays the repair, including the splice strip, by 1.0 in. (25 mm) minimum on all sides.
- (8) Apply the parting film, breather, heat blanket and vacuum bag as given in Paragraph 10.B.(13)/GENERAL. Cure Resin Mix 3 as given in Figure 5/GENERAL. EA956 and EA9396 will cure to handling strength in 24 hours minimum at 70°F (21°C)-100°F (38°C). Full cure occurs in 5 days at 70°F (21°C)-100°F (38°C) or can be accelerated to 1 hour at 180°F (82°C) ± 10°F (6°C). The adhesive on the aluminum foil will sufficiently bond with any of the above cure cycles.
- (9) Refinish the repaired area as given in AMM 51-21-00/701.

16. Permanent Repair for Aluminum Foil Joint Splice (BMS 8-289)

NOTE: This repair is applicable to electrical splice failures on fan cowls and to electrical splices which did not use perforated foil in the original design.

A. Determine Extent of Damage

- (1) Use this repair for splice damage that includes no more than the cover ply and the aluminum foil.
- (2) For structural damage extending into the underlying plies, repair as given in 51-70-04, GENERAL, 51-70-05, GENERAL, 51-70-07, GENERAL, 51-70-08, GENERAL, or 51-70-17, GENERAL as applicable.
- (3) Refer to Figure 7/GENERAL for the following repair procedure.

B. Preparation for Repair

NOTE: Do not extend the splice into the edgeband area of the panel.

STRUCTURAL REPAIR MANUAL

- (1) Mask off the area surrounding the damage with masking tape.
- (2) Sand off the damaged cover ply.
- (3) Peel off the remaining splice foil. The splice is 2.0 in. (5.1 cm) wide and will peel easily (Refer to Figure 7 (Sheet 3), Detail III).
- (4) Solvent wipe the 2.0 in. (5.1 cm) wide splice and an additional 2.0 in. (5.1 cm) on each side for a total width of 6.0 in. (15.2 cm).
- (5) Abrade the 6.0 in. (15.2 cm) width cleaned area with Scotch-Brite.
 - (a) The 2.0 in. (5.1 cm) wide bare aluminum splice must be cleaned and abraded until a water-break-free surface is obtained. A water-break-free surface will hold a film of water without beading up.
 - (b) Do not abrade through the paint primer.
- (6) Apply a chemical conversion coating to the bare aluminum.

C. Splice Strip Replacement

- (1) Apply BMS 8-289 0/250/x/x/x adhesive backed foil splice strip (Refer to Figure 7 (Sheet 3), Detail IV). The x's stand for the optional foil thickness, alloy, and adhesive thickness.
 - (a) Use Form II foil applied adhesive side up. Overlap the bare aluminum on each side of the splice line by 1.0 in. (25 mm) minimum.
 - (b) Form I foil with 0.5 in. (12.7 mm) diameter holes on 2.0 in. (5.1 cm) centers is optional to Form II. Apply a chemical conversion coating to the nonadhesive side of the Form I foil and apply adhesive side up.
- (2) Apply a cover ply, 4.5 in. (11.4 cm) width minimum, so it overlaps each side of the foil splice strip by at least 1.0 in. (25 mm). Use BMS 9-3, Type D fiberglass impregnated with Resin Mix 3, EA956, or EA9396 as given in Paragraph 10.B.(9)(a)/GENERAL.
- (3) Apply the parting film, breather, heat blanket and vacuum bag as given in Paragraph 10.B.(13)/GENERAL. Cure Resin Mix 3 as given in Figure 5/GENERAL. EA956 and EA9396 will cure to handling strength in 24 hours minimum at 70°F (21°C)-100°F (38°C). Full cure occurs in 5 days at 70°F (21°C)-100°F (38°C) or can be accelerated to 1 hour at 180°F (82°C) ± 10°F (6°C). The adhesive on the aluminum foil will sufficiently bond with any of the above cure cycles.
- (4) Refinish the repaired area as given in AMM 51-21-00/701.

17. Repair of Surface Coatings or Finishes After Repair

- A. Lightly sand, with 180-grit or finer abrasive paper, the surface and edge of topmost ply to produce a feather edge.
- B. Apply finish to the repaired surface using the following applicable methods.
 - (1) Where clear Tedlar film surfaces have been removed, seal with Resin Mix 1 (Figure 2/GENERAL). Scrape excess resin off before it gels. Cure for 6 to 8 hours at room temperature.

NOTE: For underwing fairing panels with high operating temperatures, seal with Resin Mix 2 (Figure 2/GENERAL). Refer to Figure 1 (Sheet 1) for location of these panels.

- (2) Where gray or white Tedlar film surfaces have been removed, seal with Resin Mix 1 (Figure 2/GENERAL). Scrape excess resin off before it gels. Cure 6 to 8 hours at room temperature and apply one coat of BMS 10-79, Type II or III primer and one coat of BMS 10-60 enamel as given in AMM 51-20-00.



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NOTE: For underwing fairing panels with high operating temperatures, seal with Resin Mix 2 (Figure 2/GENERAL). Refer to Figure 1 (Sheet 1) for location of these panels.

- (3) Where BMS 10-21 conductive coating has been removed, apply coating as given in AMM 51-24-02.
- (4) Where the abrasion resistant Teflon finish has been removed from the internal surface of the panel edgeband, apply finish as given in AMM 51-24-13.
- (5) Where the original painted surfaces have been removed, apply finish as given in AMM 51-21-00/701.



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RESIN TYPE	COMPONENTS	PARTS BY WEIGHT	POT LIFE OF MIXTURE	CURING TIME
RESIN MIX 1	EPOCAST 156A EPOCAST 156B HARDENER	100 \pm 2 5 \pm 0.3	45 TO 60 MINUTES AT 70°F (21°C)	6 TO 8 HOURS AT 70°F (21°C)
RESIN MIX 1 (ALTERNATE)	FIBER-RESIN 5318S FIBER-RESIN 5318C	100 \pm 2 50 \pm 1	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 3
RESIN MIX 1 EPOX-O WELD (ALTERNATE)	TWO COMPONENT KIT	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT		
			45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 3
RESIN MIX 1 (ALTERNATE)	EPOCAST 156 EPOCAST 941 HARDENER	100 \pm 2 10 \pm 0.5	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 3
RESIN MIX 2 BMS 8-214	EPOCAST 35A FURANE 927 HARDENER	100 25 \pm 0.5	4 HOURS AT 70°F (21°C)	90 MINUTES AT 340°F (171°C) TO 360°F (182°C)
RESIN MIX 2 BMS 8-207 TYPE I, CLASS II (ALTERNATE)	FIBER RESIN 40 HARDENER 5413C	100 \pm 1 15 \pm 0.5	30 MINUTES AT 70°F (21°C)	1 HOUR AT 150°F TO 170°F (66°C TO 77°C)
BMS 8-207 TYPE I CLASS I	EC1838A RESIN EC1838B HARDENER	50 50	20 MINUTES AT 77 \pm 2°F (25 \pm 1°C)	2 HOURS MIN AT 115 \pm 10°F (46 \pm 5°C)
RESIN MIX 3 BMS 8-301	EA9390 A RESIN EA9390 B HARDENER	100 \pm 0.5 56 \pm 0.5	2 HOURS AT 77°F (25°C)	220 MINUTES AT 200 \pm 10°F (93 \pm 6°C) 180 MINUTES AT 230 \pm 10°F (110 \pm 6°C)
BMS 5-28 TYPE 3	EPOCAST 1511A EPOCAST 1511B	100 15	20 MINUTES AT 75° TO 79°F (24° TO 26°C)	5 HOURS AT 120°F TO 130°F (49° TO 54°C)
BMS 5-92, TYPE I ADHESIVE	EC2216A (GRAY) EC2216B (WHITE)	140 100	2 HRS BELOW 100°F (38°C)	24 HRS MIN AT 65°F (19°C) TO 100°F (38°C). 180 \pm 10 MINUTES AT 110°F (43°C) TO 130°F (54°C). 130 \pm 10 MINUTES AT 150°F (66°C) TO 170°F (76°C)

NOTES

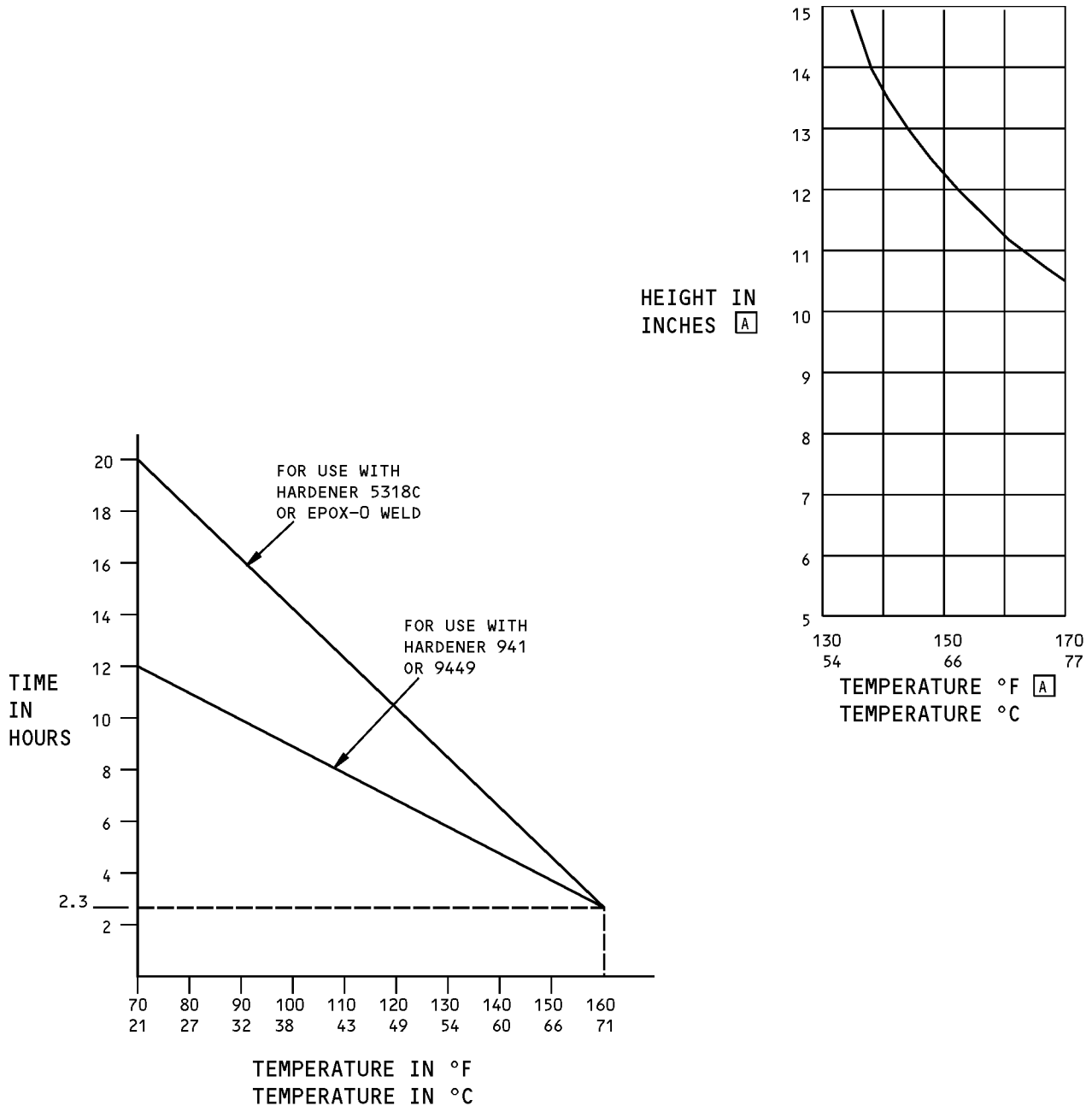
- REFER TO FIG. 5 FOR CURE CYCLE IF USING
CURE TEMPERATURES ABOVE 125° (52°C)

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

Resin Specifications and Mixing Procedures Figure 2

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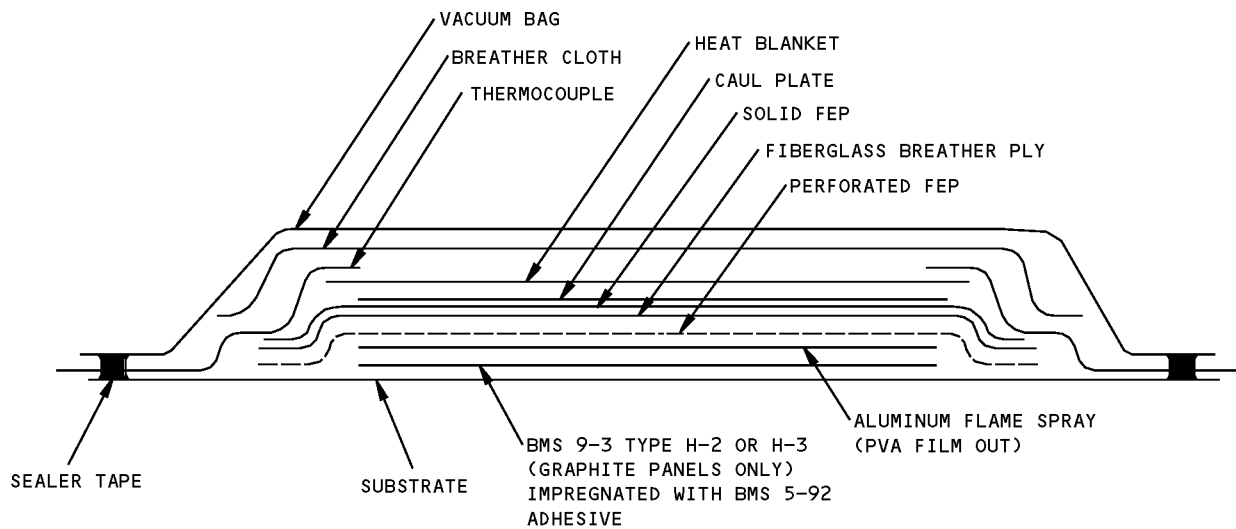
NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE

[A] THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACE OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

**Potting and Laminating Resin Cure Temperature
Figure 3**

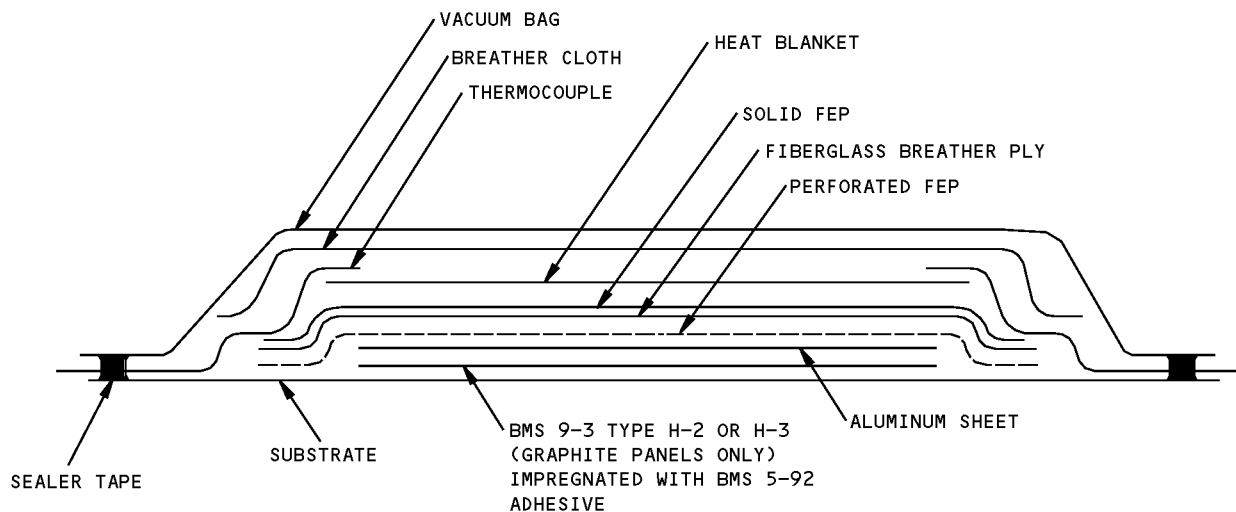
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**ALTERNATE REPAIR
DETAIL I**

**Repair Layup
Figure 4 (Sheet 1 of 2)**

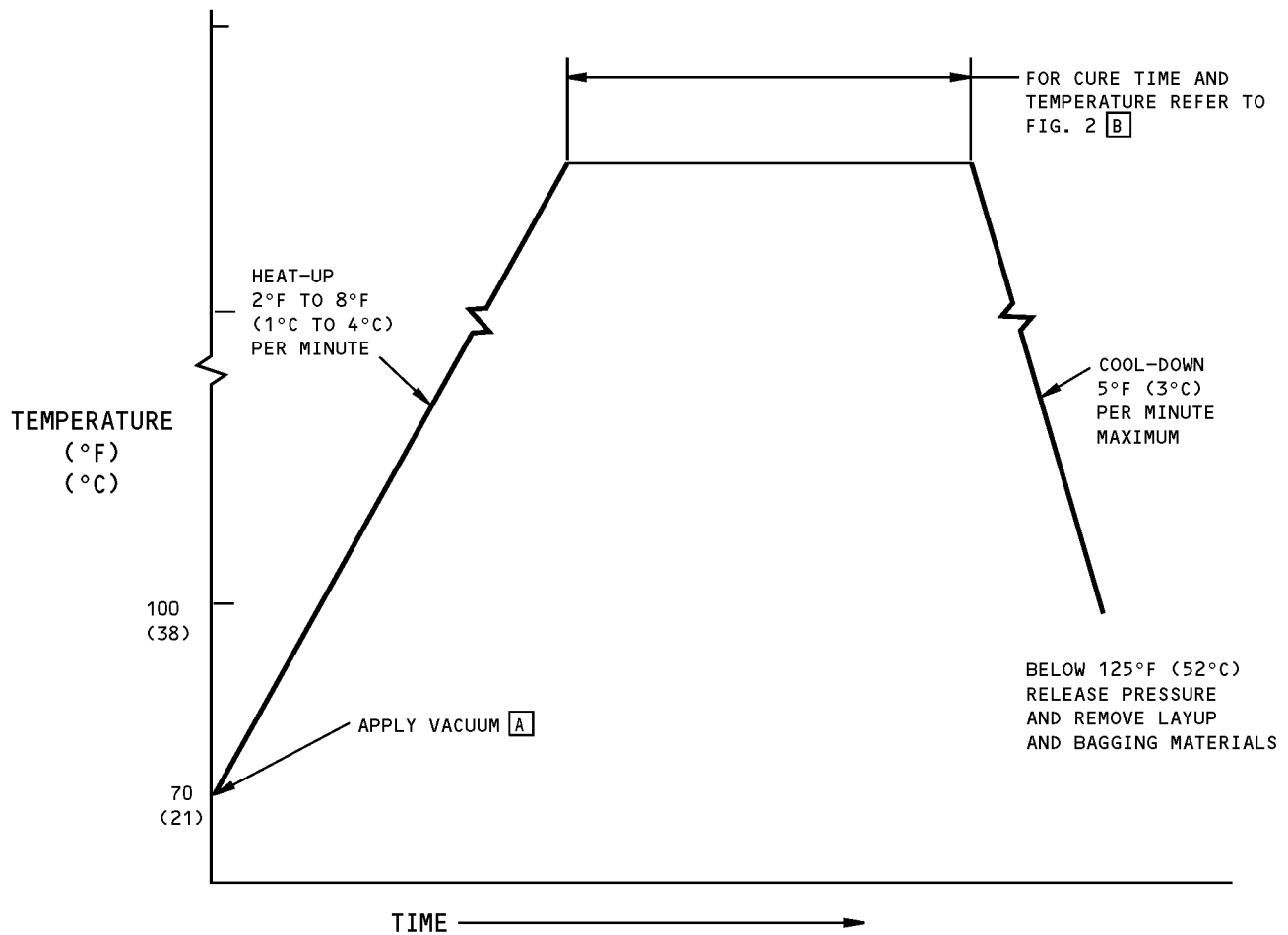
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SECOND ALTERNATE REPAIR
DETAIL II

Repair Layup
Figure 4 (Sheet 2 of 2)

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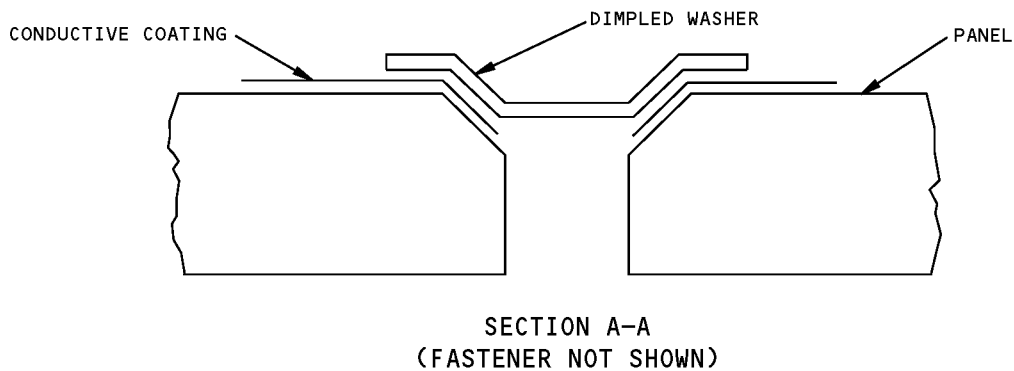
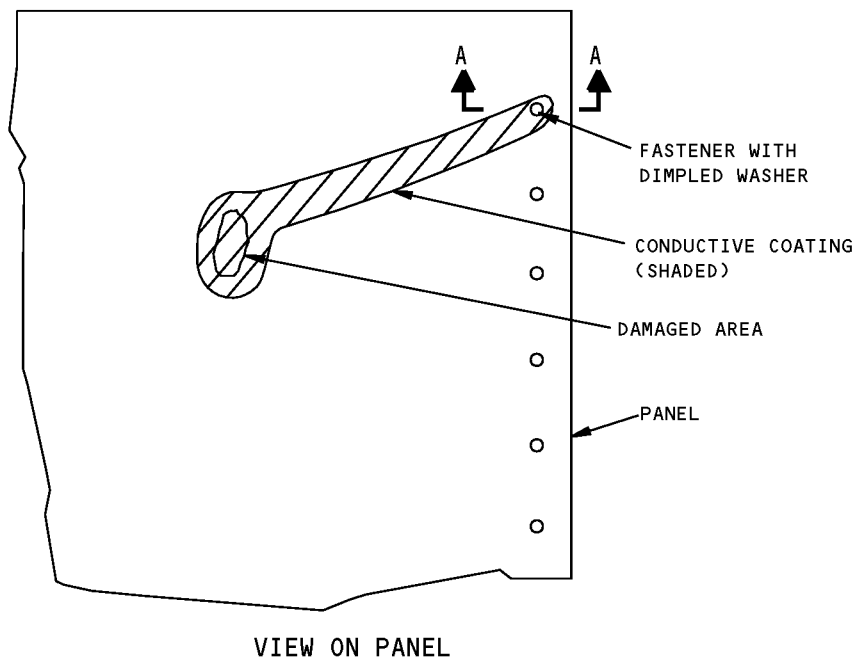


NOTES

- A** MAINTAIN 22 INCHES MERCURY (75 kPa)
VACUUM MINIMUM DURING ENTIRE CURE CYCLE
- B** CAUTION: DO NOT CURE REPAIRS TO
250°F (121°C) ORIGINAL CURE
COMPONENTS AT 300°F (149°C)

**Cure Cycle
Figure 5**

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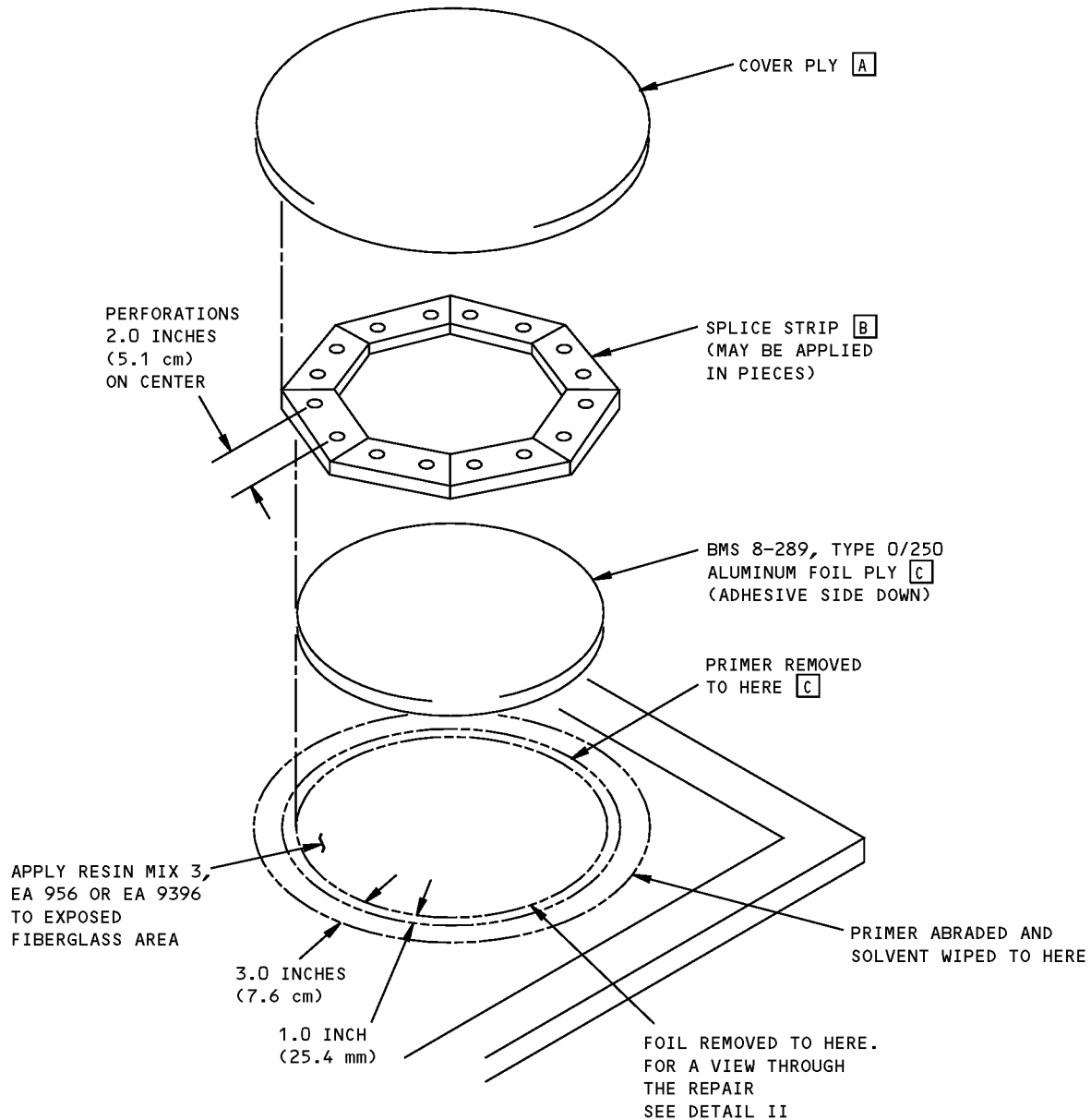


NOTE

- CONDUCTIVE COATING MUST RUN UNDER DIMPLED WASHER

**Application of Conductive Coating to Repairs of Aluminum Coated Glass Fabric (BMS 8-278 Thorstrand)
Figure 6**

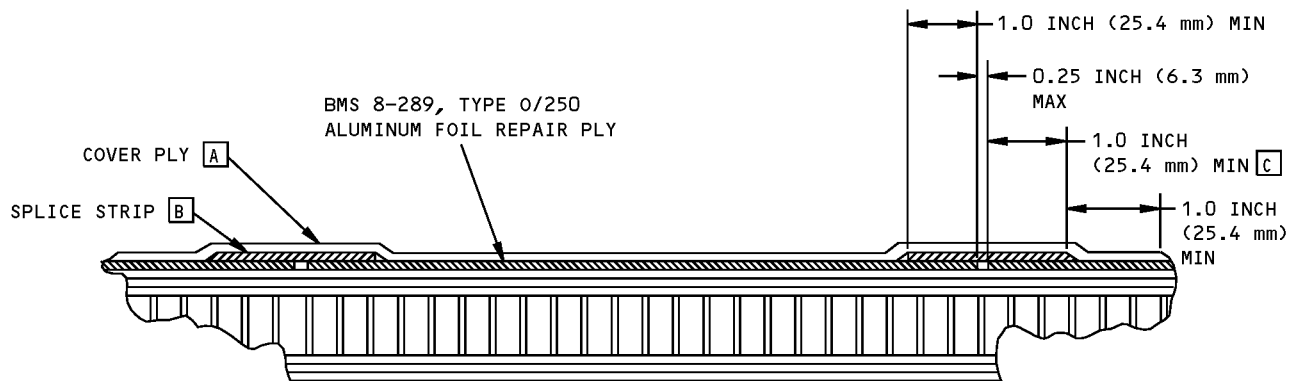
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**REPAIR PLY LAYUP
DETAIL I**

**Aluminum Foil Repair
Figure 7 (Sheet 1 of 3)**

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VIEW THRU REPAIR
DETAIL II

MATERIAL	SHIPPING AND STORAGE LIFE		SHELF LIFE [D]	
	MAXIMUM TEMPERATURE [E]	DURATION (DAYS)	MAXIMUM TEMPERATURE	DURATION (HOURS)
BMS 8-289 TYPE O/250	10°F (-12°C)	180	95°F (35°C)	240

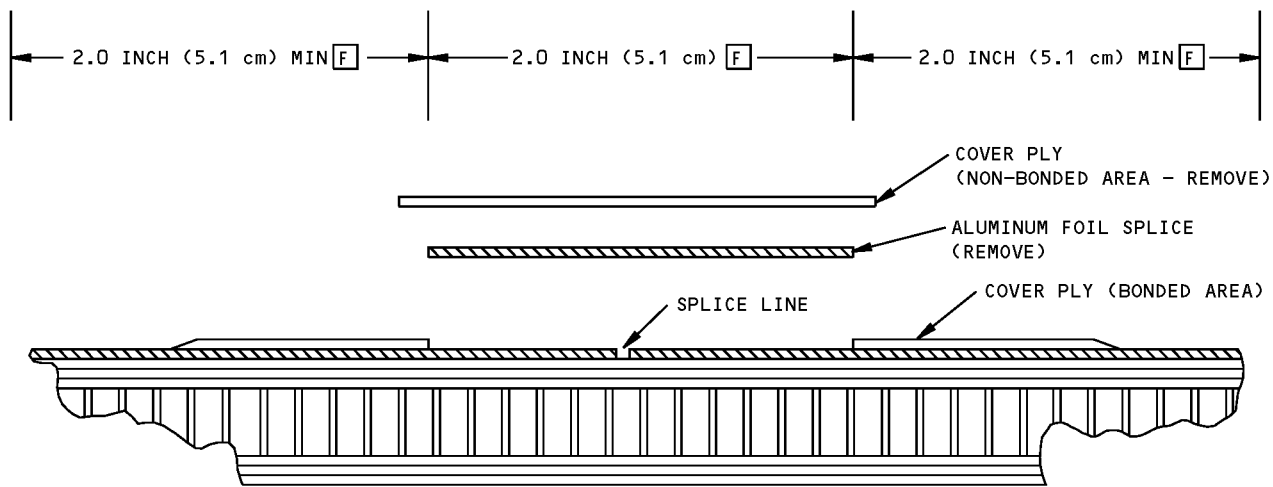
STORAGE AND SHELF LIFE OF BMS 8-289

NOTES

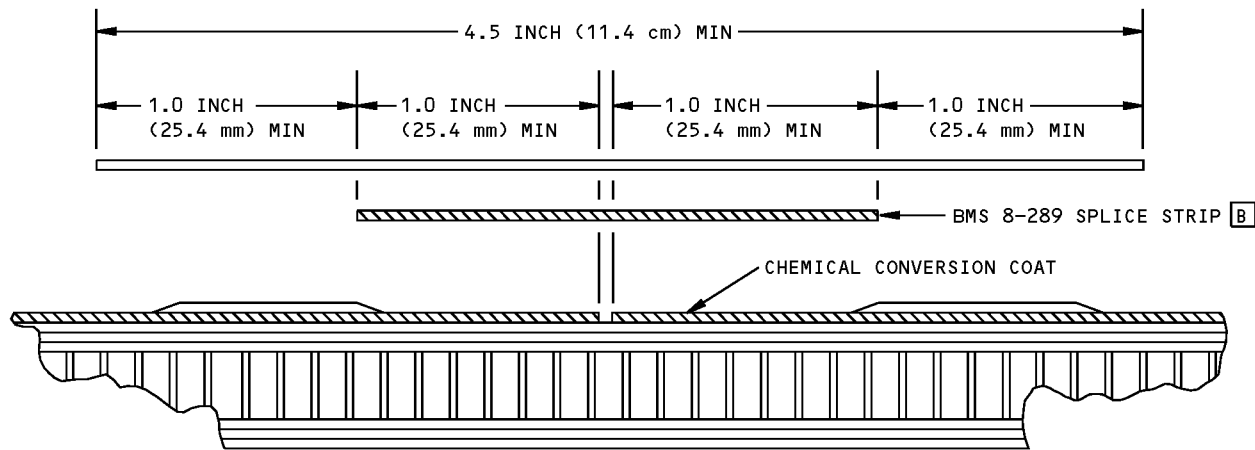
- [A] BMS 9-3, TYPE D FIBERGLASS IMPREGNATED WITH RESIN MIX 3, EA 956 OR EA 9396.
- [B] BMS 8-289, TYPE O/250 WITH THE ADHESIVE SIDE UP. FORM II PREFERRED; FORM I OPTIONAL. IF FORM I IS USED, CHEMICAL CONVERSION COAT THE NONADHESIVE SIDE AND PERFORATE THE CENTERLINE WITH 0.5 INCH (12.7 mm) DIAMETER HOLES, 2.0 INCHES (5.1 cm) ON CENTER.
- [C] CHEMICAL CONVERSION COAT THE INITIAL ALUMINUM FOIL.
- [D] SHELF LIFE HOURS ACCUMULATE FROM THE DATE OF REMOVAL FROM STORAGE UNTIL START OF THE REPAIR CURE CYCLE.
- [E] QUALIFIED PRODUCTS, GUARANTEED BY THE SUPPLIER TO MEET SPECIFICATION REQUIREMENTS AFTER 360 DAYS AT 95°F (35°C), MAY BE STORED AT 95°F (35°C) MAX.
- [F] SOLVENT WIPE THEN ABRABE WITH SCOTCH-BRITE.

Aluminum Foil Repair
Figure 7 (Sheet 2 of 3)

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ALUMINUM FOIL SPLICE REMOVAL
DETAIL III



ALUMINUM FOIL SPLICE REPAIR
DETAIL IV

Aluminum Foil Repair
Figure 7 (Sheet 3 of 3)



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GENERAL - COMPOSITE MATERIALS SUBSTITUTION

1. Fiberglass/Aramid/Graphite Materials

- A. The following Figure 1/GENERAL, Table shows substitute materials for repairing fiberglass/ aramid/graphite materials when the "as manufactured" material is not available or not in stock.

2. Nonmetallic Honeycomb Core (BMS 8-124)

- A. Substitute with equivalent or higher density nonmetallic core only.
- B. When replacing damaged honeycomb core it is acceptable to substitute higher density core provided the following conditions are met.
- (1) The density of the replacement core must be equal to or greater than the original core but no more than 3 lb (1.36 kg) per 1 ft³ (0.03 m³) denser.
 - (2) The strength and stiffness of the replacement core must be equal to or greater than that of the original core.
 - (3) Replacement core that is not the same type, class, and grade of the original core must not be used for repairs where the maximum dimension of the damage is more than 50 percent of the panel width at the damage location.
- C. When replacing damaged honeycomb core with higher density core these additional cautions must be considered.
- (1) The use of stiffer core may cause hard spots and may affect the flexibility of the part.
 - (2) The use of heavier core in repairs to the aileron may require that it be rebalanced.
 - (3) The use of core with larger cells may increase skin surface mark-off.
 - (4) The use of core with larger cells may decrease the peel strength of the face skin.

STRUCTURAL REPAIR MANUAL

MATERIAL USED AT THE INITIAL MANUFACTURE	ALTERNATIVE REPAIR MATERIAL C
250°F FIBERGLASS FABRIC - BMS 8-79: STYLE 1581 STYLE 7781	3 PLYS OF STYLE 120 FABRIC OR STYLE 220 FABRIC 3 PLYS OF STYLE 120 FABRIC OR STYLE 220 FABRIC
350°F FIBERGLASS FABRIC - BMS 8-139: STYLE 1581	3 PLYS OF STYLE 120 FABRIC OR STYLE 220 FABRIC
250°F GRAPHITE FABRIC - BMS 8-168 TYPE II, CLASS 2: STYLE 3K-135-8H	2 PLYS OF STYLE 3K-70-PW FABRIC
250°F GRAPHITE UNIDIRECTIONAL TAPE - BMS 8-168, TYPE II, CLASS 1: GRADE 145 GRADE 190	2 PLYS OF GRADE 95 TAPE OR 2 PLYS OF TYPE II, CLASS 2, STYLE 3K-70-PW FABRIC
350°F GRAPHITE UNIDIRECTIONAL TAPE - BMS 8-212, TYPE III, CLASS 1: GRADE 145 AND GRADE 190	1 PLY OF THE SAME GRADE OF BMS 8-256, CLASS 1 TAPE, 1 PLY OF THE SAME GRADE OF BMS 8-297, CLASS 1 TAPE, 2 PLYS OF BMS 8-212 GRADE 95 TAPE, 2 PLYS OF BMS 8-297 GRADE 95 TAPE, 2 PLYS OF BMS 8-212, STYLE 3K-70-PW FABRIC, 2 PLYS OF BMS 8-256, STYLE 3K-70-PW FABRIC, OR, 2 PLYS OF BMS 8-297, STYLE 3K-70-PW FABRIC
350°F GRAPHITE FABRIC - BMS 8-212, TYPE IV, CLASS 2: STYLE 3K-135-8H	1 PLY OF BMS 8-297, STYLE 3K-135-8H FABRIC, 2 PLYS OF BMS 8-212, STYLE 3K-70-PW FABRIC, OR 2 PLYS OF BMS 8-256, STYLE 3K-70-PW FABRIC
350°F GRAPHITE FABRIC - BMS 8-212, TYPE IV, CLASS 2: STYLE 3K-70-PW	1 PLY OF BMS 8-256, STYLE 3K-70-PW FABRIC, OR 1 PLY OF BMS 8-297, STYLE 3K-70-PW FABRIC
350°F GRAPHITE FABRIC - BMS 8-256, TYPE I AND IV, CLASS 2: STYLE 3K-70-PW	1 PLY OF BMS 8-212, STYLE 3K-70-PW FABRIC, OR 1 PLY OF BMS 8-297, STYLE 3K-70-PW FABRIC
250°F ARAMID FABRIC - BMS 8-219 A : STYLE 120 STYLE 285	1 PLY OF BMS 8-79, STYLE 120 FABRIC OR STYLE 220 FABRIC 1 PLY OF BMS 8-79, STYLE 1581 OR 7781 FABRIC, OR 3 PLYS OF BMS 8-79, STYLE 120 FABRIC
350°F ARAMID FABRIC - BMS 8-218 A : STYLE 120 STYLE 285	1 PLY OF BMS 8-139, STYLE 120 FABRIC 1 PLY OF BMS 8-139, STYLE 1581 OR 7781 FABRIC, OR 3 PLYS OF BMS 8-139, STYLE 120 FABRIC
250°F FIBERGLASS FABRIC - BMS 8-169 B : STYLE 120	1 PLY OF BMS 8-79, STYLE 120 FABRIC OR STYLE 220 FABRIC
250°F GRAPHITE FABRIC - BMS 8-258 B , CLASS 2: STYLE 3K-70-PW	1 PLY OF BMS 8-168, TYPE II, CLASS 2, STYLE 3K-70-PW FABRIC

Composite Materials - Alternatives
Figure 1 (Sheet 1 of 2)



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STRUCTURAL REPAIR MANUAL

NOTES

- [A] ONE PLY OF BMS 9-3, TYPE D GLASS FABRIC CAN BE USED FOR EACH PLY OF STYLE 120 ARAMID FABRIC. ONE PLY OF BMS 9-3 TYPE H-2 OR H-3 GLASS FABRIC CAN BE USED FOR EACH PLY OF STYLE 285 ARAMID FABRIC
- [B] THESE MATERIALS ARE USED ONLY ON THE NOSE LANDING GEAR DOORS
- [C] CAUTION: USE 350°F (177°C) CURE PREIMPREGNATED CARBON FIBER MATERIALS FROM ONE SPECIFIED BOEING MATERIAL SPECIFICATION (BMS) AND ONE SUPPLIER FOR EACH CURE OF THE REPAIR. IF YOU DO NOT OBEY, THE REPAIR WILL BE UNSATISFACTORY.

Composite Materials - Alternatives
Figure 1 (Sheet 2 of 2)



757-200 STRUCTURAL REPAIR MANUAL

GENERAL - HOLE DRILLING AND MACHINING OF COMPOSITE STRUCTURE

1. General

- A. This section contains machining information for advanced composite structures. Advanced composites, graphite and especially aramid structures, require special drilling, trimming and countersinking techniques to prevent excessive fiber breakout and/or delamination. Machining information in graphite/aramid-to-aluminum/titanium structures, countersinking in graphite/aramid structures, deburring, and hole quality is also included.
- B. Refer to FASTENERS, SECTION/51-40 for general fastener information.
 - (1) Refer to Figure 10/GENERAL for fastener hole sizes.
 - (2) Refer to 51-40-08, GENERAL for fastener countersink hole dimensions.
- C. The equipment required for drilling and trimming operations are listed in Figure 1/GENERAL.

WARNING: WEAR APPROVED DUST MASK AND SAFETY GLASSES WHEN DRILLING, REAMING OR COUNTERSINKING COMPOSITE STRUCTURES. USE OF VACUUM PICKUP WHEN DRILLING IS RECOMMENDED. MACHINING OF COMPOSITE STRUCTURES PRODUCES DUST AND PARTICLES. BREATHING DUST OR ALLOWING DUST OR PARTICLES TO CONTACT EYES IS HAZARDOUS.

- D. Health and safety precautions should be observed when conducting hole preparation operations contained herein.
- E. Composite materials cause several problems that are not found in metallic materials. Refer to Figure 1 (Sheet 5), Table V for a list of comparative hole preparation properties.

CAUTION: PROTECT ELECTRIC MOTORS, SWITCHES, RELAYS, CONTACTS AND ELECTRONIC CIRCUITS FROM GRAPHITE DUST. USE DUST PROOF VACUUM ATTACHMENTS TO POWER TOOLS. GRAPHITE DUST IS ABRASIVE AND AN ELECTRICAL CONDUCTOR. PERMANENT DAMAGE TO ELECTRICAL EQUIPMENT MAY OCCUR.

- F. Graphite/epoxy dust control is best accomplished by a high-velocity, low volume vacuum system at the cutter. Vacuum nozzle airflow should be at least three times higher than dust velocity.

2. References

Reference	Title
51-40	FASTENERS
51-40-02, GENERAL	Fastener Installation and Removal
51-40-08, GENERAL	Countersinking
SOPM 20-41-02	Application of Chemical and Solvent Resistant Finishes
SOPM 20-44-04	Application of Urethane Compatible Primers

3. Hole Drilling in Graphite or Graphite/Fiberglass Structures

- A. Refer to Figure 1 (Sheet 6), Table VI for drill selection, speed, feed and lubrication requirements.
- B. Place the drill against the structure. Without letting the drill rotate, apply a steady, medium force, and then operate the drill motor.

NOTE: Some trial drilling on scrap material is recommended. Slow, cautious feeding will result in chatter of the drill and oversized holes. Excessive feed force may cause ramming of drill into the structure.

- C. Ensure that the drill is normal to the work surface.

STRUCTURAL REPAIR MANUAL

- D. Refer to Figure 1 (Sheet 13), Table XIII for maximum recommended reaming speeds.

NOTE: Drill dry for thicknesses up to 1.5 times the drill diameter. For material over 1.5 times drill-diameter thick, also drill dry if possible.

4. Hole Drilling in Graphite-to-Aluminum Structures

- A. Refer to Figure 1 (Sheet 7), Table VII for drill selection, speed, feed and lubrication requirements.
- B. Drill from the graphite side producing either a No. 30 or a No. 40 pilot hole for location and the reduction of fiber breakout.
- C. Refer to Figure 1 (Sheet 13), Table XIII for maximum recommended reaming speeds and type of reamers being used.

5. Hole Drilling in Graphite-to-Titanium Structures

- A. Refer to Figure 1 (Sheet 8), Table VIII for drill selection, speed, feed and lubrication requirements.

CAUTION: MAINTAIN A CHIP CLEARANCE SPACE OF 3/16 TO 3/8 INCH (4.8 TO 9.5 MM) BETWEEN THE DRILL JIG AND THE PART BEING DRILLED.

- B. For close tolerance holes, drill 1/32 inch undersize for 5/16 inch and over, 1/64 inch under size for under 5/16 inch, and ream to full size.

NOTE: Use Freon TB-1, Microcut-26, or Boelube for coolant. Apply with mist system for material up to one drill diameter thick. For material over one drill diameter thick, use oil-hole drills.

- C. All holes should be piloted first, drilled and reamed to size. Refer to Figure 1 (Sheet 13), Table XIII for reaming speeds and type of reamers being used.

6. Countersinking in Graphite Structures

- A. Use a 3-flute carbide insert cutter (ST1221C-C) or a 2-flute polycrystalline cutter (ST1223C-D) for countersinking. (Figure 2/GENERAL, Details I and IV).
- B. Countersink at 500 RPM with carbide cutters and up to 1500 RPM with diamond cutters.

NOTE: Use of a vacuum adapted microstop as the modular suction casing as shown in Figure 3/GENERAL and Figure 4/GENERAL is recommended.

- C. For taped surfaces, bond a mask pad (ST1223-DA) onto the vacuum adapted microstop. This pad must be sized as the countersink depth is set (Figure 5/GENERAL).

NOTE: Each fastener size will require a separate microstop and adjustment.

- D. Because of wear rate (approximately 50 holes per grind) and fastener head radius, the following techniques must be used:

- (1) The countersink depth must be set with a sharp cutter.
- (2) The depth should always be set in some scrap material using a fully torqued fastener from the same lot for the definition of countersink depth.
- (3) For a large number of flush fasteners, have two sharp countersinks available to begin the work.
- (4) After the depth control is established with both cutters, one cutter is used to produce all of the countersinks, and the other is used to follow or clean up any problems caused by the wear of the first tool.

STRUCTURAL REPAIR MANUAL**7. Deburring of Graphite Structures**

- A. Use a conical abrasive tool (fine grit, closed structure, rubber bond) with a 500 RPM drill unit to remove frayed or delaminated fibers from the entrance and exit of a hole.

8. Hole Quality of Graphite Structures

- A. Refer to Figure 6/GENERAL for hole quality requirements.

9. Rough Trimming Graphite Panels

- A. Rough trimming can be accomplished prior to final trimming by several methods, as discussed below. The choice of which operation is best fitted for a particular part is determined by part size, straight or curved trim, access to trim line, etc.
- (1) For band sawing, scribe contoured lines on the material to be trimmed with a 0.375 in. (9.5 mm) excess allowance for final trimming.
- (a) Use a coated diamond abrasive blade in the 60- to 80-mesh range or a medium grit carbide abrasive blade at 2000-4500 SFM. Feed rates of 20 in. (51 cm) per minute are typical on currently available bandsawing equipment.

NOTE: A backup on the exit side of graphite panel is required to prevent delamination with the unidirectional tape side facing upward.

Inclusion of dust collection provisions is recommended.

- (2) For circular sawing, use an 8 in. (20 cm)-10 in. (25 cm) diameter diamond abrasive, 40-60 grit cutter or a carbide abrasive, medium grit cutter at 3000-5000 RPM. Extend the blade height 0.25 in. (6.4 mm) above the workpiece to control out-of-plane forces from delaminating material plies.
- (3) For portable circular sawing, scribe contoured lines on the material to be trimmed with a 0.25 in. (6.4 mm) excess allowance for final trimming. Use a 2.0 in. (5.1 cm) diameter diamond abrasive, 40-60 grit cutter or a carbide abrasive medium grit cutter at 7500-10,000 SFM. Use of a vacuum is recommended (Figure 7/GENERAL).

10. Final Trimming Graphite Panels

- A. Limit the radial depth of cut by making a roughing cut to a quarter of the cutter diameter or 0.06 in. (1.52 mm), whichever is less, followed by a net finishing cut, to eliminate excessive delamination experienced in heavier cuts.
- B. Final trimming can be accomplished after rough trimming by several methods, as discussed below. The choice of process is determined by part size, configuration of trim and part, access to trim line, etc.
- (1) For spindle (Table) shaping, use a 1 inch diameter x 3/4 inch cut x 3/4 inch shank x 4 inch long diamond abrasive, 60-80 mesh cutter at 6000-10,000 RPM or a carbide rotary, single cut cutter at a speed of 500-1500 SFM set in a holding fixture. Feed rate depends on part thickness and range from 150 IPM for thin sections (0.040 inch) to 30 IPM for thick sections (0.750 inch). Use of a vacuum pickup is recommended.
- (2) For routing, use a 0.25 inch diameter x 3/4 inch cut x 2-1/2 inch long diamond abrasive, 60-80 mesh cutter in an 18,000-25,000 RPM air motor, Dotco 10L2500C-01 with front exhaust and at feed rates from 150 IPM for thin parts to 50 IPM for thick parts or TSI-DFR dualflex router with integral vacuum pick-up, at a speed of 1200-5000 SFM. Optional to use a carbide rotary burr, single cut cutter at a speed of 500-1300 SFM. Use a hand routing fixture with a 0.062 inch setback. Use of a vacuum pickup is recommended.

STRUCTURAL REPAIR MANUAL

- (3) For trimming graphite panels for fit up, use the air motors mentioned in Paragraph 10.B.(2)/GENERAL and a 1/4 inch x 1 inch cut x 2 inch long carbide rotary file, single cut cutter.

11. Deburring Trimmed Graphite Panels

A. Deburr trimmed graphite panels after final trimming by the following methods:

- (1) Deburr with 280/320 (wet or dry) medium grit abrasive cloth or with a Scotchbrite abrasive pad.

NOTE: Fine finishes may require a secondary stroke with a 200 grit garnet cloth.

- (2) Use a 2 in. (5 cm) disc sander, 180 grit abrasive in an air motor.

- (3) Belt sand with 80 grit bands and file with the direction of the strokes towards the centerline of the material. Use a Dotco 10L1280-32 with a No.14-1301 sanding attachment, or equivalent.

12. Hole Drilling in Aramid Structures

A. For full size holes, use a high spiral, 135° split point drill (refer to Figure 2 (Sheet 1), Detail II) at 5200 RPM in a drill motor mounted with a pressure foot to control fiber breakout.

B. The drill operation is best accomplished by placing the drill against the work without rotation, applying a steady, medium force, and then operating the drill motor.

NOTE: Some trial drilling on scrap material is recommended. Improper technique can cause rejectable delamination. Use slow, controlled feed, especially when breaking through the backside of the material.

Pilot holes are not recommended. If pilot holes must be used, drill them at 5000 RPM with No. 30 or No. 40 HSS twist drills. Ream according to information given in Figure 1 (Sheet 13), Table XIII.

CAUTION: IT IS REQUIRED TO USE LIMITED-TRAVEL DRILL GUIDE FOR MANUAL DRILLING TO PREVENT FIBER BREAKOUT.

C. Ensure that the drill is normal to the work surface.

NOTE: Holes in aramid structures should not normally require reaming unless they have fiberglass surfaces.

13. Hole Drilling in Aramid-to-Aluminum Structures

A. Refer to Figure 1 (Sheet 10), Table X for drill selection, speed, feed and lubrication requirements.

NOTE: Drill holes in one operation from the pyramid side. Use a HSS double-margin stepped drill with a 135° split point (ST10-907-A) which must be used with a limited-travel drill guide. The drill guide is also useful for locating the holes by means of a strip template.

Hole diameters in aramid laminates are 0.001 to 0.003 inch (0.025 to 0.076 mm) less than cutter diameter while the holes in aluminum are 0.001 to 0.003 inch (0.025 to 0.076 mm) larger than cutter diameter. Drill to produce the required hole size in aluminum and ream the stack-up, if required, to final size.

B. If required, ream hole according to information presented in Figure 1 (Sheet 13), Table XIII.

C. Use the following methods for drilling holes in aramid panels previously located by pilot holes in aluminum:

- (1) Press the aramid panel firmly against the aluminum substructure and drill hole in one operation from the aluminum side.
- (2) Press the aramid panels firmly together so that they remain in contact while drilling. Pilot the aramid panel, then drill to full size from the aramid side.

STRUCTURAL REPAIR MANUAL

(3) Ream to full size, if required, by referring to Figure 1 (Sheet 13), Table XIII.

14. Hole Drilling in Aramid-to-Titanium Structures

- A. Use drills and techniques mentioned for aramid-to-aluminum combinations in Paragraph 13.A./GENERAL except drill and/or ream according to information in Figure 1 (Sheet 11), Table XI and Figure 1 (Sheet 13), Table XIII, respectively.

15. Countersinking in Aramid Structures

- A. Use standard HSS countersink cutters or polycrystalline diamond cutters for countersinking in aramid structures.
- B. Countersink at 500 RPM with HSS cutters and up to 1500 RPM with diamond cutters.

NOTE: Use of a vacuum adapted microstop as shown in Figure 3/GENERAL is recommended.

- C. For surfaces without fiberglass plies, bond a mask pad onto the vacuum adapter microstop. This pad must be sized as the countersink depth is set (Figure 5/GENERAL).

NOTE: Each fastener size will require a separate microstop and adjustment.

16. Deburring of Aramid Structures

- A. Use either an 80-grit belt sander or hand sand with a 150-grit water resistant sandpaper to remove frayed fibers from the entrance and exit of the hole.

NOTE: If outer plies of structure are fiberglass, a conical abrasive tool with a medium grit is recommended to remove fibers and fuzz.

17. Hole Quality of Aramid Structures

- A. Refer to Figure 6/GENERAL for hole quality requirements.

18. Rough Trimming Aramid Panels

- A. Rough trimming aramid panels can be accomplished prior to final trimming by several methods, as discussed below. The choice of which operation is best fitted for a particular part is determined by part size, straight or curved trim, access to trim line, etc.

- (1) For band sawing, scribe contoured lines on the material to be trimmed with at least 0.10 in. (2.5 mm) access allowance for final trimming.

- (a) Use saw blades specified in Figure 1 (Sheet 12), Table XII depending on the type of the aramid material

- (2) For circular sawing, use a semi-HSS, alternate cutter with 10-14 teeth per inch (2.5 cm) at 12,000-15,000 RPM and with Boelube 100A lubricant. The following portable saws are recommended:

- (a) Dotco Model 10L1280-32

- (b) Aro Model 8825 with integral dust shroud

NOTE: Vacuum pick-up is recommended.

- (3) For saber sawing, scribe contoured lines on the material to be trimmed with 0.125 in. (3.2 mm) excess allowance for final trimming.

- (a) Use a HSS blade, with 14-17 teeth per inch (2.5 cm) at 800-6500 FPM and a Bosh saber saw No. 7598, or equivalent, with Boelube 100A lubricant.

19. Final Trimming Aramid Panels

- A. Limit the radial depth of cut to a quarter of the cutter diameter or 0.06 in. (1.52 mm), whichever is less, to eliminate excessive delamination experienced in heavier cuts.

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B. Final trimming can be accomplished after rough trimming by the following methods:

- (1) For hand (portable) routing, use Boeing Standard cutter (ST1435-E) or a carbide rotary burr, diamond cut cutter with Boelube 100A lubricant at 18,000-25,000 RPM. Use of vacuum pick-up is recommended.

NOTE: Placement of the cutter on the edge of the material being cut is very important. The centerline of the material edge must intersect the cutting tool where the two helical cutting edges intersect (Figure 8/GENERAL).

- (2) For track routing, use a 1/4 inch diameter, 1 inch by 2-1/2 inch long diamond cut cutter in a router, Dotco (rear exhaust) 10L2502C-01 or equivalent, at 18,000 RPM and at a feed rate of 16-18 IPM with Boelube 100A lubricant.
- (3) For hand routing with Boeing standard cutter ST1435-D (3/16 inch diameter) use a 15,000-18,000 RPM air motor, rear exhaust, DOTCO 10L2502C-01, or TS1-DFR dualflex router with integral vacuum system. Use Boelube 100A at a feed rate of 10-15 feet (3-4.6 m) per minute. For this cutter use a standard 1/4 inch router guide, provided the routing fixture is set back 3/32 inch (for 3/16 inch diameter cutter).
- (4) For hand routing with Boeing standard cutter ST1435-E (1/4 inch diameter) use router, DOTCO 10L4018A-01, with a standard 1/4 inch router guide (0.062 inch set back). Use Boelube 100A at a feed rate of 10-15 feet (3-4.6 m) per minute.

NOTE: Both of the above cutters leave a burr-free edge.

- (5) To final trim aramid panels for fit up, use a 15,000-18,000 RPM hand router with rear exhaust, DOTCO 10L2502C-01, or equivalent, with a 1/4 inch by 1 inch cut by 2 inch long double cut, medium rotary file, or disc sand using any air motor (rear exhaust preferred) use with 2 inch (5 cm) diameter 180 grit disc sander.

20. Deburring Trimmed Aramid Panels

A. Deburr trimmed aramid panels after final trimming by the following methods:

- (1) Block sand with 280/320 grit wetted with Boelube 100A lubricant.
- (2) Use a 2 inch (5 cm) diameter 180 grit disc sander with an air motor with rear exhaust.
- (3) Belt sand with a DOTCO 10L1280-32 sander and a DOTCO 14-1301 sanding attachment, or equivalent, with an 80 grit silicon carbide belt. File with the direction of each stroke towards the centerline of the material.

21. Trimming Hybrid Aramid/Graphite Panels

- A. For aramid/graphite panels with more than 3 plies of graphite in the panel, use trimming methods mentioned for trimming graphite, except use 20-40 grit and mist spray with Boelube 100A.
- B. For aramid/graphite panels with less than 3 plies of graphite in the panel, use trimming methods mentioned for trimming aramid.

22. Treatment of Fastener Holes in Composite Panels

- A. Prime countersinks and holes with BMS 10-11, Type I or BMS 10-79, Type III. BMS 10-79, Type II is optional for graphite panels. Refer to SOPM 20-41-02 and SOPM 20-44-04 respectively.
- B. For fastener installation procedures and restrictions concerning composite panels, refer to 51-40-02, GENERAL.



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DESCRIPTION	SPEED (RPM)	CHUCK SIZE IF APPLICABLE (INCH)	MODEL NUMBER	SUPPLIER
<u>DRILL MOTORS</u> <u>(IN LINE):</u>	330	1/2	41D-108	B
	400	1/2	15DP-4B	O
	500	3/8	6AR3	A
	650	1/4	21D-106	B
	900	1/4	21D-105	B
	900	1/4	15C1490A-38	C
	1000	1/4	3AN1	A
	1000	3/8	31DR-805	B
	2000	3/8	42DR-103	B
	2000	1/4	15C2991-38	C
	3000	1/2	15C2992-53	C
	5000	3/8	15C2993-51	C
	6000	1/4	42DR-101	B
	6000	1/4	7AH1	A
	12000	1/4	15C2982D-38	C
	18000	1/4	41D-100	B
	20000	1/4	7AD1	A
<u>DRILL MOTORS</u> <u>(ANGLE HEAD):</u>	600		15L1281B-32	C
	2100	1/4	21A-624	B
	5000	1/4	31AR-621	B

HOLE PREPARATION EQUIPMENT FOR GRAPHITE AND ARAMID STRUCTURES
TABLE I

Cutting Tools for Composite Panels
Figure 1 (Sheet 1 of 15)



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STRUCTURAL REPAIR MANUAL

DESCRIPTION	TYPE	SUPPLIER
<u>MISCELLANEOUS:</u>	<p>MICROSTOPS</p> <ul style="list-style-type: none"> MAGNAVON NO. 2193 <input type="checkbox"/> S OR NO. 2140 <input type="checkbox"/> T ZEPHYR NO. ZT330 <p>ADAPTER: NO. 2767 (FITS DOTCO AIR MOTORS), NO. 2852, OR NO. 2072</p> <p>JACOBS CHUCK</p> <p>QUICK CHANGE CHUCK: NO. 1365A</p> <p>DRILL GUIDE: NO. 2772 (QUICK CHANGE) OR NO. 2044</p> <p>EXTENSION: NO. 2817</p> <p>DRILL BUSHING: NO. 2043</p> <p>DRILL STOP: NO. 2776</p> <p>DRILL BITS</p> <p>QUICK CHANGE DRILL BITS</p>	<div><input type="checkbox"/> L</div> <div><input type="checkbox"/> N</div>
<u>CUTTERS:</u>	<p>DRILLS</p> <ul style="list-style-type: none"> ST1257B (SOLID CARBIDE) ST10-907-H (CARBIDE TIPPED HSS TWIST) NO. 30 OR NO. 40 HSS DRILLS FOR PILOTING <p>COUNTERSINKS</p> <ul style="list-style-type: none"> ST1221C-C ST10-1223 ST1223C-D <p>REAMERS (WITH 1/32 UNDERSIZE PILOT)</p> <ul style="list-style-type: none"> ST1864P (CARBIDE) FOR GRAPHITE OR GRAPHITE WITH ALUMINUM SINGLE-STEP OR DOUBLE-STEP DESIGN FOR GRAPHITE WITH TITANIUM <p>HOLE SAWS</p> <ul style="list-style-type: none"> DIAMOND GRIT HOLE SAWS 	<div><input type="checkbox"/> R <input type="checkbox"/> U <input type="checkbox"/> V <input type="checkbox"/> W</div> <div><input type="checkbox"/> U <input type="checkbox"/> V <input type="checkbox"/> W</div> <div><input type="checkbox"/> L <input type="checkbox"/> M</div> <div><input type="checkbox"/> X</div> <div><input type="checkbox"/> R <input type="checkbox"/> W</div> <div><input type="checkbox"/> K <input type="checkbox"/> M <input type="checkbox"/> X <input type="checkbox"/> Y</div>

HOLE PREPARATION EQUIPMENT FOR GRAPHITE STRUCTURES
TABLE II

Cutting Tools for Composite Panels
Figure 1 (Sheet 2 of 15)



757-200
STRUCTURAL REPAIR MANUAL

DESCRIPTION	TYPE	SUPPLIER
<u>MISCELLANEOUS:</u>	MICROSTOPS <ul style="list-style-type: none">• MAGNAVON NO. 2193 <input type="checkbox"/> S OR NO. 2140 <input type="checkbox"/> T• ZEPHYR NO. ZT330	<input type="checkbox"/> L <input type="checkbox"/> N
	ADAPTER: NO. 2767 (FITS DOTCO AIR MOTORS), NO. 2852, OR NO. 2072 JACOBS CHUCK QUICK CHANGE CHUCK: NO. 1365A DRILL GUIDE: NO. 2772 (QUICK CHANGE) OR NO. 2044 EXTENSION: NO. 2817 DRILL BUSHING: NO. 2043 DRILL STOP: NO. 2776 DRILL BITS QUICK CHANGE DRILL BITS	<input type="checkbox"/> G
<u>CUTTERS:</u>	DRILLS <ul style="list-style-type: none">• HSS TWIST DOUBLE-MARGIN STEP DRILL• BW 840 KLENK DRILL	<input type="checkbox"/> U <input type="checkbox"/> V <input type="checkbox"/> W
	COUNTERSINKS <ul style="list-style-type: none">•	<input type="checkbox"/> L <input type="checkbox"/> M
	ST10-1223 REAMERS <ul style="list-style-type: none">• B1-3079 (STRAIGHT, HSS)• B1-3085 (PILOT, HSS)• SINGLE-STEP OR DOUBLE-STEP DESIGN FOR ARAMID WITH TITANIUM	<input type="checkbox"/> Q <input type="checkbox"/> W
	HOLE SAWS <ul style="list-style-type: none">• HSS OR CARBIDE INSERT HOLE SAWS, WITH 30° POSITIVE FACE AND 30° POSITIVE CLEARANCE CUTTING ANGLES	<input type="checkbox"/> K <input type="checkbox"/> M <input type="checkbox"/> X <input type="checkbox"/> Y

HOLE PREPARATION EQUIPMENT FOR ARAMID STRUCTURES
TABLE III

Cutting Tools for Composite Panels
Figure 1 (Sheet 3 of 15)



757-200 STRUCTURAL REPAIR MANUAL

DESCRIPTION	TYPE	SUPPLIER
<u>DRILL MOTORS:</u>	6000-10,000 RPM DRILL UNIT	[K]
	15,000-18,000 RPM DRILL UNIT DOTCO NO. 10L2580C-01 18,000-23,000 RPM DRILL UNIT DOTCO NO. 10L2580C-01	[C]
<u>ROUTERS:</u>	15,000-25,000 RPM, DUALFLEX TSI-DFR WITH INTEGRAL VACUUM SYSTEM	[J]
	DOTCO 10L2502C-01 HAND ROUTER DOTCO 10L2500C-01	[C]
<u>SAWS:</u>	BAND SAW - 1000-3000 SFM 2500-3500 SFM	[K] [M] [Y]
	CIRCULAR SAW - 3000-5000 RPM	[K] [M] [Y]
	PORTABLE CIRCULAR SAW - 12,000 RPM, DOTCO 10L1280-32 [H] OR 18,000 RPM, DOTCO 10L1281-32 [I]	[C]
	SABER SAW - 2500-3500 SFM BOSCH MODEL NO. 7598	[D]
<u>CUTTERS:</u>	DIAMOND ABRASIVE CUTTER, 40-60 GRIT 8-10 INCH DIA 2 INCH DIA 1 INCH DIA X 3/4 INCH CUT X 3/4 SHANK X 4 INCHES LONG 1/4 INCH DIA X 3/4 INCH CUT X 2-1/2 INCH LONG DIAMOND CUT, ROTARY BURR CUTTER 1/4 INCH DIA X 1 INCH CUT X 2-1/2 INCH LONG ROTARY FILE, DOUBLE CUT, MEDIUM CUTTER 1/4 INCH DIA X 1 INCH CUT X 2-1/2 INCH LONG CARBIDE ABRASIVE, MEDIUM GRIT CARBIDE, ROTARY FILE, SINGLE CUT 1/4 INCH DIA X 1 INCH CUT X 2 INCH LONG HSS BLADE, WAVY SET 14-18 TPI HSS BLADE, 18-20 TPI, BOSCH T-218A ST1435-E TWO FLUTE CUTTER	[K] [M] [Y]
		[D]
		[E] [Y] [AU]
<u>ABRASIVES:</u>	60 GRIT, SANDING BLOCK 80 GRIT, SILICONE CARBIDE BLOCK 150 GRIT, WATER RESISTANT SANDPAPER 180 GRIT, BELT 180 GRIT, 2-INCH DISC SANDER 280/320 GRIT SANDING BLOCK	[K] [M] [Y] [Z]
<u>LUBRICANTS:</u>	BOELUBE 100A	[F]
<u>MISCELLANEOUS:</u>	SANDER WITH SANDER ATTACHMENT DOTCO NO. 10L1280-32 (SANDER) DOTCO NO. 14-1301 (1/2 INCH WIDE SANDER ATTACHMENT)	[C]

TRIMMING EQUIPMENT FOR COMPOSITE STRUCTURES
TABLE IV

Cutting Tools for Composite Panels
Figure 1 (Sheet 4 of 15)



757-200
STRUCTURAL REPAIR MANUAL

PROPERTIES	MATERIAL			
	FIBERGLASS	GRAPHITE-EPOXY	ARAMID	HYBRID
CUTTING CHARACTERISTICS	RESIDUE IN POWDER FORM	VERY SIMILAR TO FIBERGLASS	NOT SIMILAR TO FIBERGLASS	VERY DIFFICULT TO DRILL
HOLE GENERATION	NO PROBLEM EXCEPT THAT RESIDUE MAY CAUSE SKIN IRRITATION IN SOME PEOPLE	NO PROBLEM IN CLOTH LAMINATES BREAKOUT IS A SIGNIFICANT PROBLEM IN TAPE	SIGNIFICANT PROBLEM (FUZZING, SHREDDING, BREAKOUT, DELAMINATION ARE MAJOR PROBLEMS)	PROBLEMS OCCUR EXCEPT WITH A KLENK DRY BW840
CUTTER MATERIAL	HSS OR CARBIDE	CARBIDE	HSS OR CARBIDE	HSS OR CARBIDE
CUTTER SPEED	HIGH SPEEDS ARE DESIRABLE	HIGH SPEEDS ARE DESIRABLE	TENDENCY TO HEAT UP AND CHATTER AT HIGH SPEEDS	6200 OPTIMUM SPEED
SELF FEEDING	-----	-----	TENDENCY TO SELF-FEED WITH TWIST DRILLS	

COMPARATIVE HOLE PREPARATION PROPERTIES
TABLE V

Cutting Tools for Composite Panels
Figure 1 (Sheet 5 of 15)



757-200
STRUCTURAL REPAIR MANUAL

MATERIAL	FIBERGLASS LAMINATES			GRAPHITE-EPOXY AC		
DRILL TYPE AF	1. ST 10-907-H AD 2. ST 1257B AE			1. ST 10-907-H 2. ST 1257B		
CUTTER LIFE (HOLES)	50-100			50-100		
DRILL SIZE (INCH)	MAX RPM (DRY)	MAX RPM (WET)	FEED (IPR)	MAX RPM (DRY) AA	MAX RPM (WET) AA	FEED (IPR) AB
1/16 - NO. 40	6000	6000	0.005	6000	6000	0.002
0.09	6000	6000	0.005	6000	6000	0.002
0.12	6000	6000	0.005	6000	6000	0.002
5/32 - NO. 30	6000	6000	0.005	6000	6000	0.002
0.18	6000	6000	0.005	6000	6000	0.002
7/32	6000	6000	0.005	6000	6000	0.002
1/4	6000	6000	0.005	6000	6000	0.002
0.31	5000	6000	0.005	6000	6000	0.002
3/8	5000	6000	0.005	6000	5000	0.002
1/2	3000	5000	0.005	5000	3000	0.002
5/8	3000	3000	0.005	3000	3000	0.002
3/4	2000	3000	0.005	3000	2000	0.002
1	1000	3000	0.005	3000	1000	0.002

MATERIAL/RPM DRILLING FIBERGLASS AND GRAPHITE
TABLE VI

Cutting Tools for Composite Panels
Figure 1 (Sheet 6 of 15)



757-200
STRUCTURAL REPAIR MANUAL

MATERIAL	GRAPHITE-EPOXY AND ALUMINUM STACK AC		
DRILL TYPE	ST10-907-H AD		
CUTTER LIFE (HOLES)	50-100		
DRILL SIZE (INCH)	MAXIMUM RPM (DRY)	MAXIMUM RPM (WET) AG	FEED (IPR) AH
1/16 - NO. 40	6000		0.002
0.09	6000		0.002
0.12	5000		0.002
5/32 - NO. 30	5000		0.002
0.18	3000		0.002
7/32	3000		0.003
1/4	3000		0.004
0.31	3000		0.004
3/8	2000		0.004
1/2	1500		0.006
5/8	1250		0.006
3/4	1000		0.008
1	750		0.008

MATERIAL/RPM - DRILLING GRAPHITE AND ALUMINUM
TABLE VII

Cutting Tools for Composite Panels
Figure 1 (Sheet 7 of 15)



757-200
STRUCTURAL REPAIR MANUAL

MATERIAL	GRAPHITE-EPOXY AND TITANIUM STACK <input type="checkbox"/> AC		
DRILL TYPE	1. ST10-907-H <input type="checkbox"/> AK 2. ST7096-BG <input type="checkbox"/> AL <input type="checkbox"/> AN		
DRILL SIZE	MAXIMUM RPM (DRY)	MAXIMUM RPM (WET)	FEED (IPR) <input type="checkbox"/> AM
1/16 - NO. 40	850	1275	0.001
0.09		1200	0.001
0.12		800	0.001
5/32 - NO. 30	500	750	0.001
0.18		600	0.002
7/32	375	550	0.002
1/4	300	450	0.002
0.31		300	0.004
3/8	200	300	0.004
1/2	150	225	0.004
5/8	125	190	0.004
3/4	100	150	0.006
1	75	110	0.006

MATERIAL/RPM - DRILLING GRAPHITE AND TITANIUM
TABLE VIII

Cutting Tools for Composite Panels
Figure 1 (Sheet 8 of 15)



757-200
STRUCTURAL REPAIR MANUAL

APPROXIMATE DRILL DIAMETER (INCH)	MAXIMUM STACK THICKNESS (INCH)	DRILL TYPE AI	MAXIMUM SPEED (RPM)	FEED (IPR) AJ
1/16	0.25	HSS	2000	0.002
0.12 – NO. 31	0.25	HSS TWIST – DOUBLE-MARGIN OR BW 840 KLENK DRILL (PREFERRED)	6000	0.002
0.18 – NO. 15	0.375		6000	0.002
1/4	0.375		6000	0.002
5/16	0.375		6000	0.002
3/8	0.375		6000	0.002

MATERIAL/RPM – DRILLING ARAMID STRUCTURES
TABLE IX

Cutting Tools for Composite Panels
Figure 1 (Sheet 9 of 15)



757-200
STRUCTURAL REPAIR MANUAL

APPROXIMATE DRILL DIAMETER (INCH)	MAXIMUM STACK THICKNESS (INCH)	DRILL TYPE [AI]	MAXIMUM SPEED (RPM)	FEED (IPR) [AJ]
1/16	0.25	HSS - TWIST	4500	0.002
0.12 - NO. 31	0.25	HSS - TWIST - DOUBLE-MARGIN, STEP	3000	0.002
0.18 - NO. 15	0.375		2000	0.002
1/4	0.375		1500	0.003
5/16	0.375		1200	0.004
3/8	0.375		1000	0.004

MATERIAL/RPM - DRILLING ARAMID AND ALUMINUM
TABLE X

Cutting Tools for Composite Panels
Figure 1 (Sheet 10 of 15)



757-200
STRUCTURAL REPAIR MANUAL

APPROXIMATE DRILL DIAMETER (INCH)	MAXIMUM STACK THICKNESS (INCH)	DRILL TYPE [AI]	MAXIMUM SPEED (RPM)	FEED (IPR) [AJ]
1/16	0.25	HSS - TWIST	1200	0.002
0.12 - NO. 31	0.25	HSS - TWIST - DOUBLE-MARGIN, STEP	750	0.002
0.18 - NO. 15	0.375		500	0.002
1/4	0.375		375	0.003
5/16	0.375		300	0.004
3/8	0.375		250	0.004

MATERIAL/RPM - DRILLING ARAMID AND TITANIUM
TABLE XI

Cutting Tools for Composite Panels
Figure 1 (Sheet 11 of 15)



757-200
STRUCTURAL REPAIR MANUAL

ARAMID	SAW BLADE	
	TYPE	SPEED (SFM)
STRUCTURAL	1. HSS ALTERNATE SET 14-17 TEETH/INCH	4000 TO 7000
	2. HARD-BACK 14-17 TEETH/INCH	
NON-STRUCTURAL	SANDVIK FLEX-BACK 14-17 TEETH/INCH, 1/2 INCH WIDE	4000 TO 7000

SAW BLADES FOR USE IN ROUGH TRIMMING OF ARAMID STRUCTURES
TABLE XII

Cutting Tools for Composite Panels
Figure 1 (Sheet 12 of 15)



757-200
STRUCTURAL REPAIR MANUAL

REAMER SIZE (INCH) [AT]	GRAPHITE OR ARAMID			WITH ALUMINUM			WITH TITANIUM		
	SPEED (RPM) [AO]	FEED (IPR) [AP]	REAMER TYPE	SPEED (RPM) [AO]	FEED (IPR) [AP]	REAMER TYPE	SPEED (RPM) [AO]	FEED (IPR) [AP]	REAMER TYPE
1/8	2000	0.002	[AQ] [AR]	800	0.003	[AQ] [AR]	500	0.002	[AS]
3/16	2000	0.002		800	0.003		400	0.002	
1/4	1500	0.002		700	0.004		300	0.004	
3/8	1500	0.002		700	0.006		200	0.006	
1/2	1000	0.002		600	0.006		130	0.006	
5/8	1000	0.002		600	0.008		100	0.008	

REAMING COMPOSITES AND COMPOSITES WITH METAL
TABLE XIII

Cutting Tools for Composite Panels
Figure 1 (Sheet 13 of 15)



757-200 STRUCTURAL REPAIR MANUAL

NOTES

- [A] INGERSOLL-RAND COMPANY
POWER TOOL DIVISION
P.O. BOX 1776
LIBERTY CORNER, NJ 07938
- [B] DELTA INTERNATIONAL
POWER TOOL DIVISION
4290 RAINES ROAD
MEMPHIS, TENNESSEE 38118
OR
ROCKWELL INDUSTRIAL TOOLS
US HWY #1 NORTH
P.O. BOX 1765
COLUMBIA, SC 29202
OR
E.A. SELZER & ASSOCIATES
15086 N.E. 40TH ST.
REDMOND, WA 98052
- [C] DOTCO/COOPER AIR TOOLS
RT 18E
P.O. BOX 182
HICKSVILLE, OHIO 43526
OR
[L], [P]
- [D] ROBERT BOSCH CORP.
2800 - S. 25TH AVE.
BROADVIEW, IL 60153
- [E] ULTRA-TOOL INTERNATIONAL, INC.
5451 McFADDON AVENUE
HUNTINGTON BEACH, CALIFORNIA 92649
- [F] THE ORELUBE CORPORATION
201 EAST BETHPAGE ROAD
PLAINVIEW, NEW YORK 11803
- [G] MAGNAVON INDUSTRIES, INC.
4320 EAST LA PALMA AVENUE
ANAHEIM, CALIFORNIA 92807-1806
- [H] FOR TRIMMING ARAMID
- [I] FOR TRIMMING GRAPHITE
- [J] J.P. TOOLING SERVICES
1128 INDUSTRY DRIVE
#38 BUILDING
TUKWILA, WA 98188
- [K] ANY SOURCE
- [L] PACIFIC DISTRIBUTING, INC.
7118 BEACON AVE. SOUTH
SEATTLE, WA 98108
- [M] ARONSON INDUSTRIAL SUPPLY
P.O. BOX 80987
5300 DENVER AVE. SOUTH
SEATTLE, WA 98108
- [N] ZEPHYR
981 INDUSTRY ROAD
SUITE NO. 31
SEATTLE, WA 98118
- [O] DRESSER INDUSTRIES
INDUSTRIAL TOOL DIVISION
1136 INDUSTRY DR.
SEATTLE, WA 98188
- [P] COOPER INDUSTRIES
7500 212TH S.W., SUITE #205
EDMONDS, WA 98020
- [Q] ALVORD-POLK
P.O. BOX 97
MILLERSBURG, PA 17061
- [R] CLARK & CLARK
P.O. BOX 17449
TUCSON, AZ 85731
- [S] FOR COUNTERSINKING ON STRUCTURE ONLY
- [T] FOR COUNTERSINKING ON EXTERIOR SKINS
- [U] PRECISION TWIST DRILL
C/O A. J. HANSON CO.
203 SO. ORCAS
SEATTLE, WA 98108
- [V] MOHAWK TOOLS CO.
C/O A. J. HANSON CO.
203 SO. ORCAS
SEATTLE, WA 98108

Cutting Tools for Composite Panels
Figure 1 (Sheet 14 of 15)



757-200 STRUCTURAL REPAIR MANUAL

NOTES (CONT)

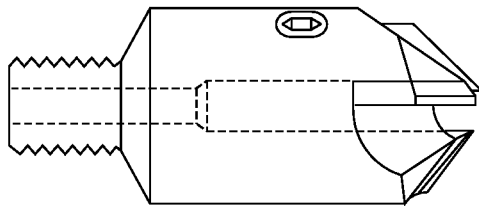
- [W] CLEVELAND TWIST DRILL CO.
1242 E. 49TH ST.
P.O. BOX 91839
CLEVELAND, OH 44101
- [X] ATI INDUSTRIES
220 N. TULIP
ESCONDITO, CA 92025
- OR
- [L]
- [Y] GENERAL TOOL AND SUPPLY CO.
P.O. BOX 80904
SEATTLE, WA 98108
- [Z] SANDING ABRASIVE
19015 PARTHENIA ST.
NORTHRIDGE, CA 91324
- [AA] FOR DRILL SIZES BETWEEN 0.09 AND 1/4 INCH
USED ON A GRAPHITE EPOXY STRUCTURE AND FOR
MATERIAL STACKUPS 0.06 INCH AND THICKER,
DRILLING CAN BE PERFORMED AT 18,000 RPM IF
AND ONLY IF THE DRILLS BEING USED ARE
JOBBER LENGTH DRILLS MEASURING 3 INCHES
LONG OR LESS
- [AB] FEED RATE SHOWN IS FOR DRILLING GR/EP UNI-
DIRECTIONAL TAPE. IT MAY BE INCREASED TO
0.004-0.005 IPR IF STURDY BACKUP IS USED,
OR THE GR/EP PART HAS FABRIC CO-CURED ON
DRILL EXIT SIDE
- [AC] VACUUM DUST COLLECTION MANDATORY
- [AD] CARBIDE-TIPPED HSS TWIST DRILL
- [AE] 4-FLUTE, STRAIGHT SHANK CARBIDE DRILL; SEE
FIG. 2, DETAIL III
- [AF] TO PREVENT DRILL BREAKAGE AND POSSIBLE
SERIOUS INJURY, DRILLS LONGER THAN THREE
INCHES MUST NOT BE USED AT SPEEDS ABOVE
6000 RPM
- [AG] NOT APPLICABLE
- [AH] FEED RATE SHOWN IS FOR DRILLING GR/EP WITH
CO-CURED FABRIC AND ALUMINUM ON DRILL EXIT
SIDE. WHEN DRILL EXISTS THROUGH GR/EP UNI-
DIRECTIONAL TAPE, REDUCE FEED RATE TO 0.002
IPR
- [AI] USE BOELUBE TO PREVENT RESIN BUILDUP ON
CUTTER
- [AJ] APPLICABLE TO POWER-FEED DRILLING ONLY
- [AK] MAXIMUM STACKUP OF 0.18 INCH OF WHICH 0.10
INCH MAXIMUM TITANIUM DEPTH IS ALLOWED.
THIS IS A CARBIDE-TIPPED HSS TWIST DRILL
- [AL] CARBIDE-TIPPED, OIL-HOLE DRILL WITH
THREADED SHANK FOR USE IN DEEP HOLES
- [AM] FEED RATE SHOWN IS FOR DRILLING GR/EP
WITH CO-CURED FABRIC OR TITANIUM ON DRILL
EXIT SIDE
- [AN] CAN BE OBTAINED FROM:

ARONSON INDUSTRIAL SUPPLY
P.O. BOX 80987
5300 DENVER AVE. SO.
SEATTLE, WA 98108

* RECOMMENDED: GUHRING BRAND
- [AO] MAXIMUM SPEED OF 700 RPM WHEN REAMING
ARAMID MATERIALS
- [AP] APPLICABLE TO POWER-FEED EQUIPMENT ONLY
- [AQ] ST1864P (CARBIDE) FOR GRAPHITE OR GRAPHITE
WITH ALUMINUM
- [AR] B1-3079 (STRAIGHT, HSS) OR B1-3085 (PILOT,
HSS); BOTH REAMERS ARE USED ON ARAMID OR
ARAMID WITH ALUMINUM STRUCTURES
- [AS] SINGLE-STEP OR DOUBLE-STEP DESIGN FOR
GRAPHITE OR ARAMID WITH TITANIUM
- [AT] A MINIMUM CUT OF 1/64 INCH ON THE DIAMETER
IS REQUIRED WHEN REAMING HOLES UP TO 5/16-
INCH DIAMETER, FOR LARGER HOLES, A MINIMUM
CUT OF 1/32-INCH ON THE DIAMETER IS
REQUIRED
- [AU] KIMBERLY INDUSTRIAL SUPPLY
1637 NW 14TH
PORTLAND, OREGON 97232

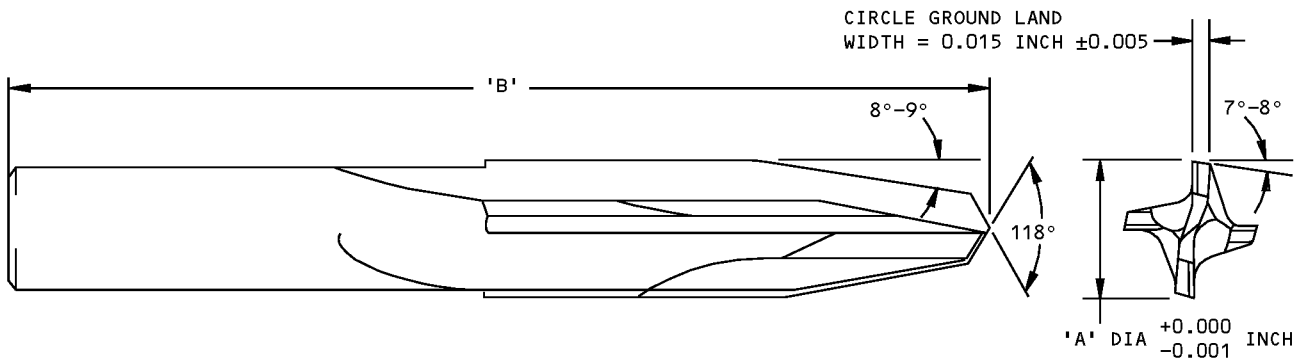
Cutting Tools for Composite Panels
Figure 1 (Sheet 15 of 15)

757-200 STRUCTURAL REPAIR MANUAL



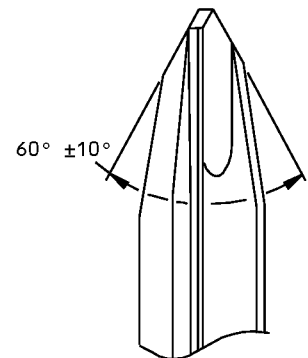
ST1221C-C-X-X
 ———— DIA IN 16THS
 ———— COUNTERSINK ANGLE (°)
 ———— VARIATION (CARBIDE)
 ———— SERIES
 ———— BASIC TOOL NO.

ST1221C-C [A] CUTTER - MICROSTOP, COUNTERSINK 3-FLUTE-CARBIDE
DETAIL I



DRILL MAY BE ORDERED BY THE FOLLOWING CODE
 ST1257B-XXX-XX-X
 BASIC TOOL NO. ————
 'A' DIA IN 1/1000THS ————
 'B' OVERALL LENGTH IN 1/100THS ————

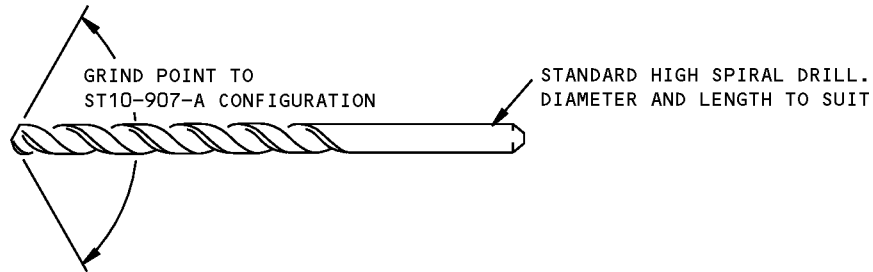
—1 = WITHOUT QUICK CHANGE ADAPTER
 —2 = WITH ST10-1365A QUICK CHANGE ADAPTER
 —3 = WITH ST10-1365B QUICK CHANGE ADAPTER



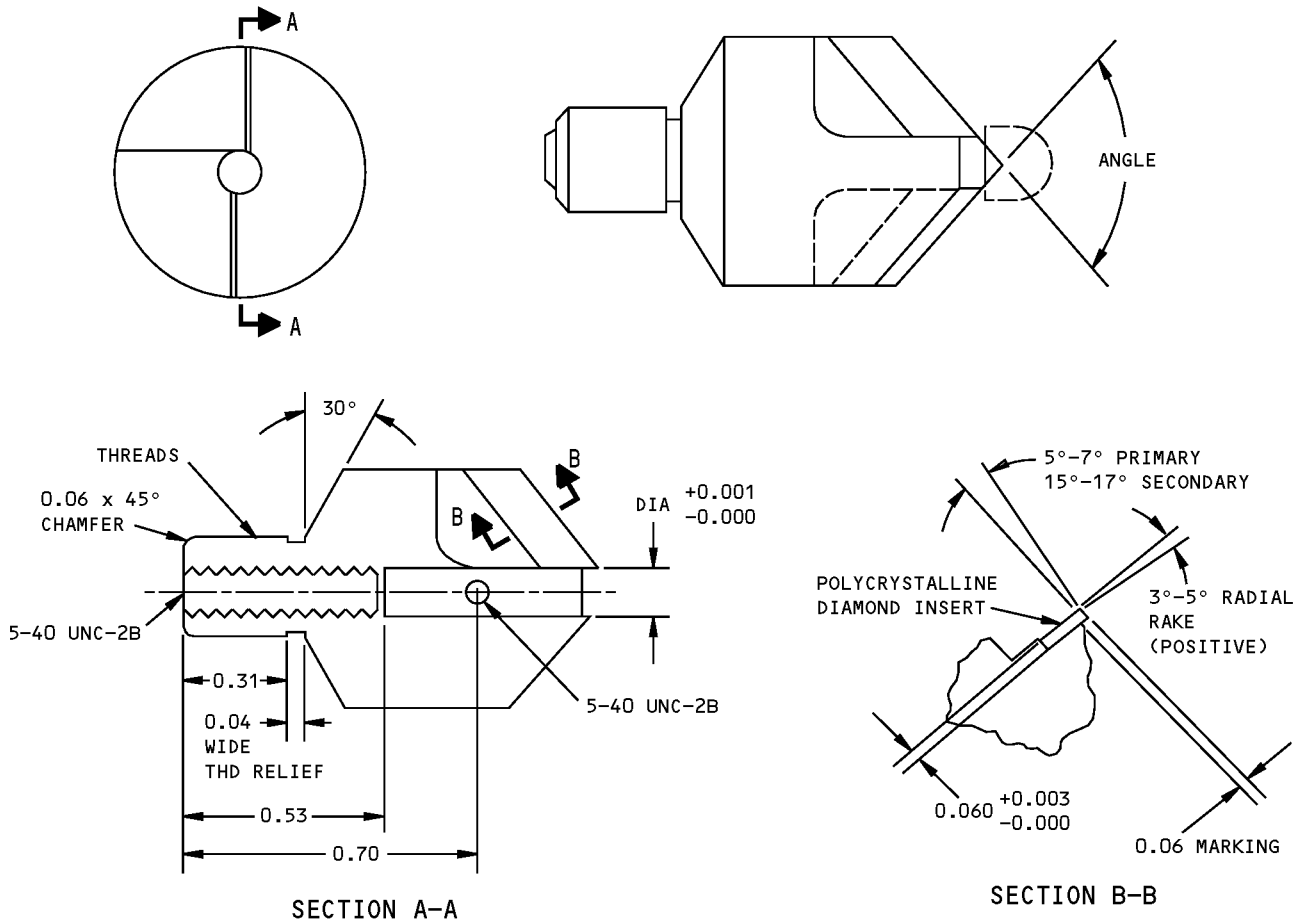
ST1257B [A] 4-FLUTE, STRAIGHT SHANK, RH DRILL
DETAIL II

Cutters for Hole Drilling in Graphite and Aramid Structures Figure 2 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



ST10-907-H [A] HIGH SPIRAL DRILL, 135° SPLIT POINT
DETAIL III



ST1223C-D [A] CUTTER - 2-FLUTE, POLYCRYSTALLINE DIAMOND
DETAIL IV

NOTES

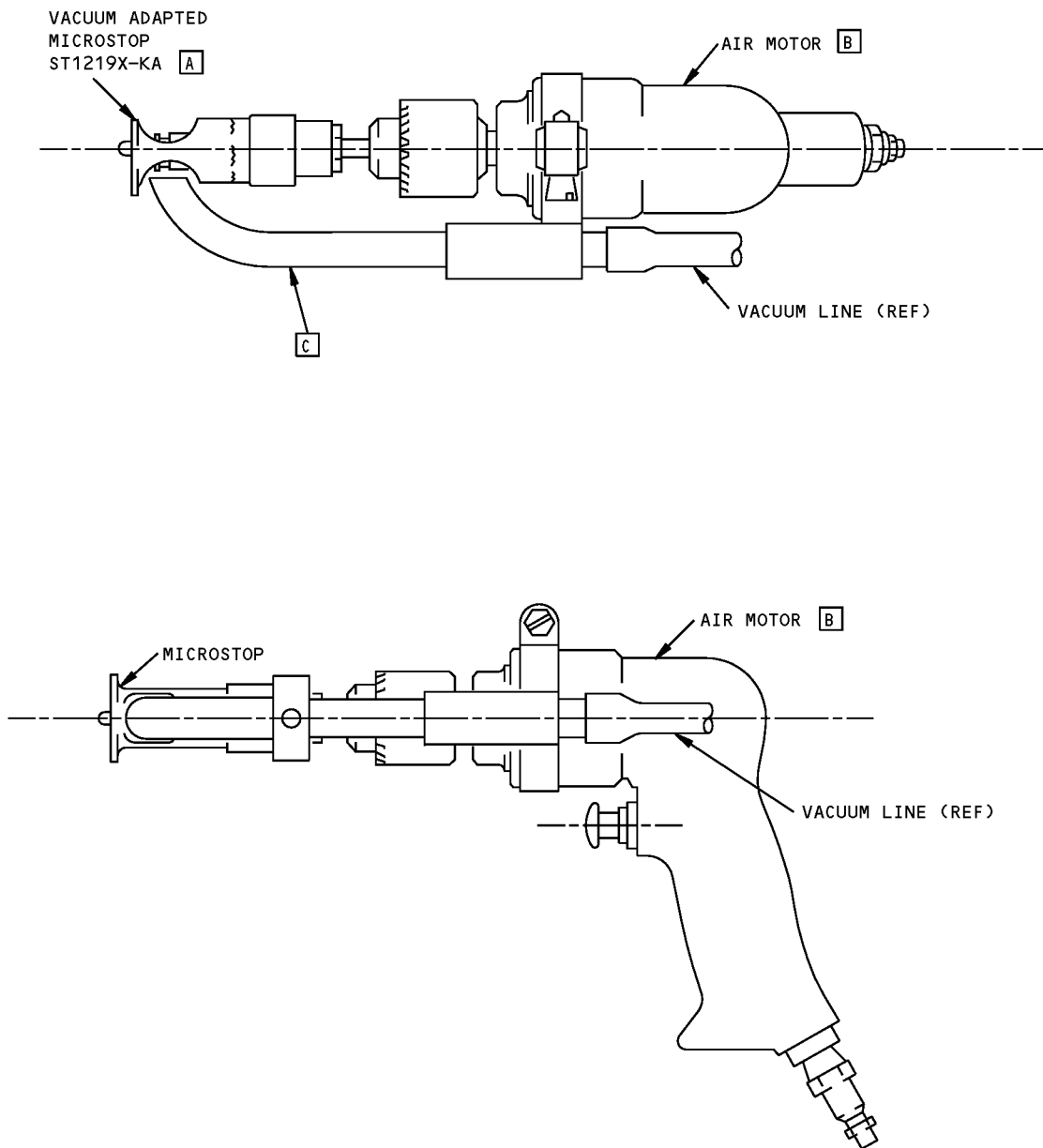
- ALL DIMENSIONS ARE IN INCHES.

[A] BOEING STANDARD TOOL NUMBER

Cutters for Hole Drilling in Graphite and Aramid Structures
Figure 2 (Sheet 2 of 2)

757-200

STRUCTURAL REPAIR MANUAL



NOTES

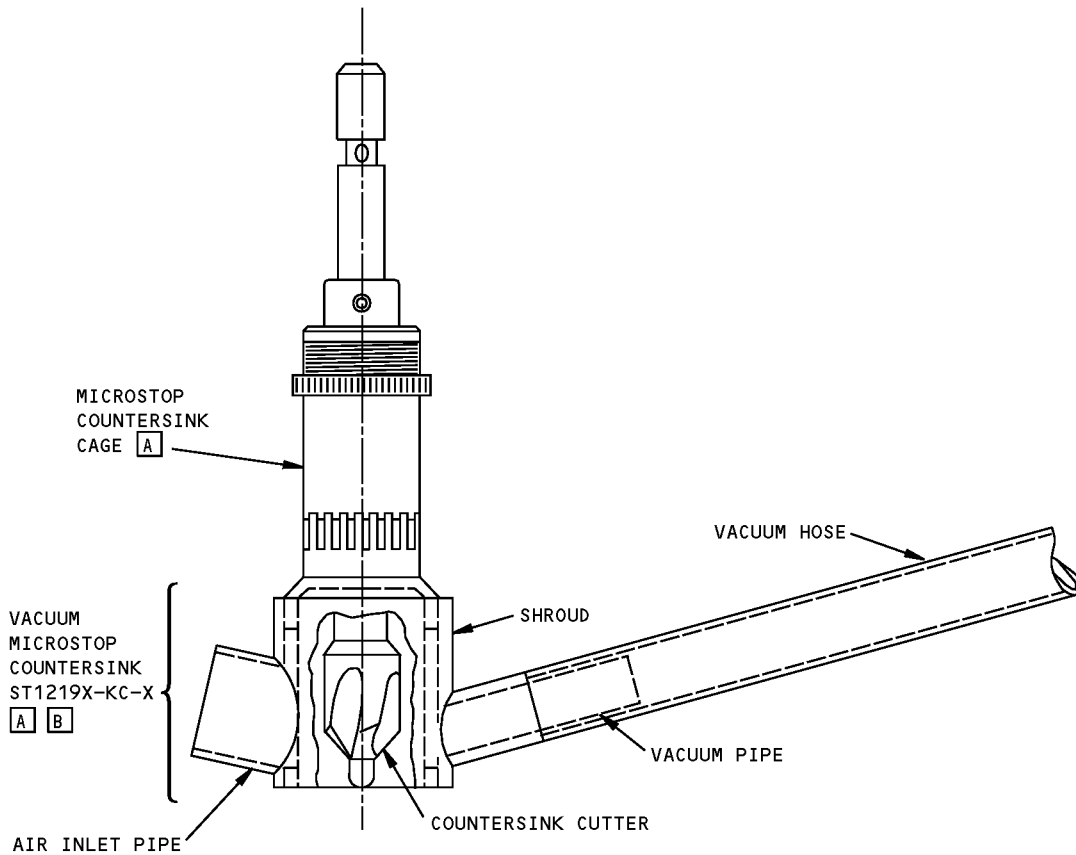
[A] BOEING STANDARD TOOL NUMBER

[B] 5000 RPM AIR MOTOR

[C] STAINLESS STEEL TUBING
1/2 INCH O.D. X 0.035 INCH WALL X 7 1/2 INCH
SOURCE: KILSBY ROBERTS CO.
22011 76TH AVE SO.
KENT, WA 98032
(800) 562-5311
(206) 872-0100

Air Motor - Vacuum Foot, Graphite Microstop, Countersink
Figure 3 (Sheet 1 of 2)

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STRUCTURAL REPAIR MANUAL

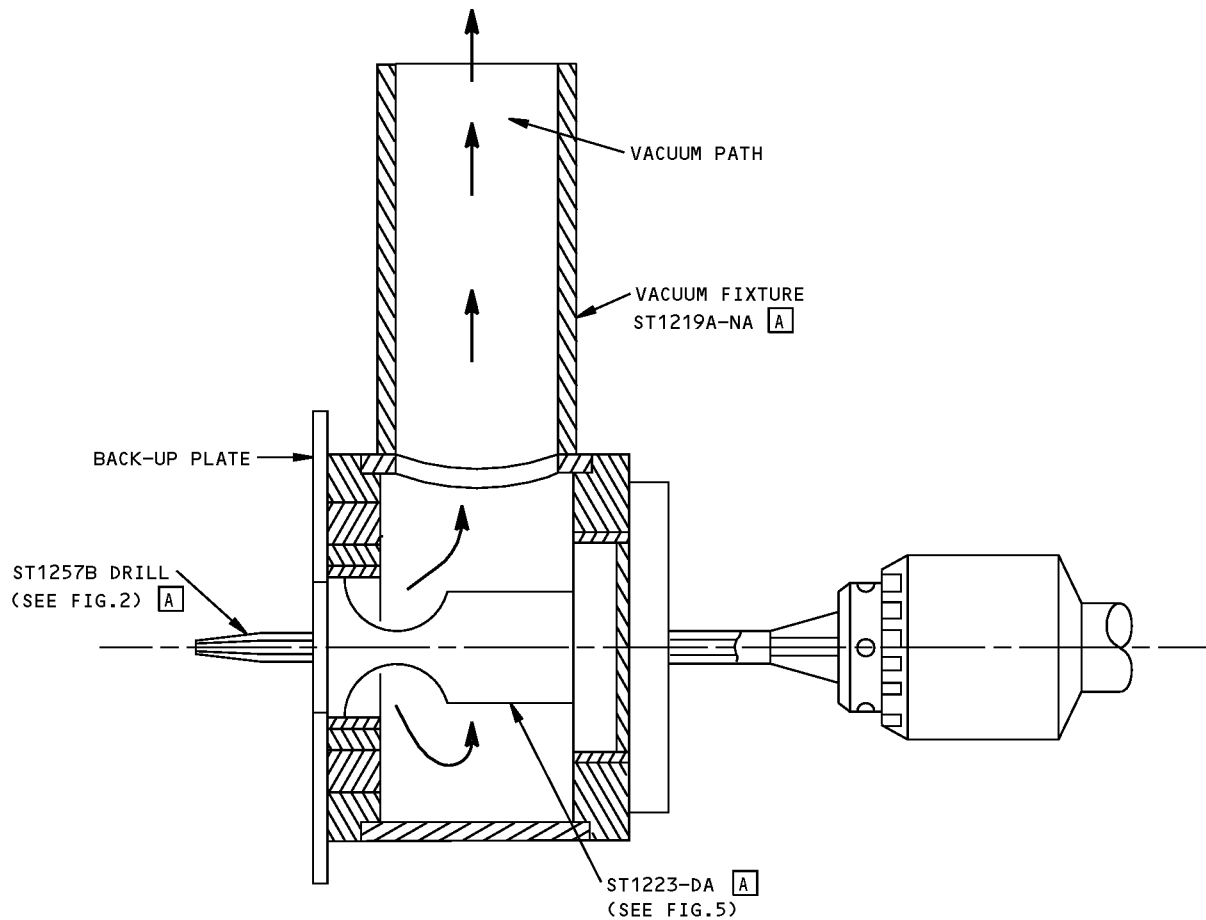


NOTES

- [A] BOEING STANDARD TOOL NUMBER
- [B] USE ST1219X-KC-13 WITH MAGNAVON
NO. 2140 MICROSTOP COUNTERSINK CAGE
OR ST1219X-KC-14 WITH MAGNAVON
NO. 2193 MICROSTOP COUNTERSINK CAGE

Air Motor - Vacuum Foot, Graphite Microstop, Countersink
Figure 3 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL

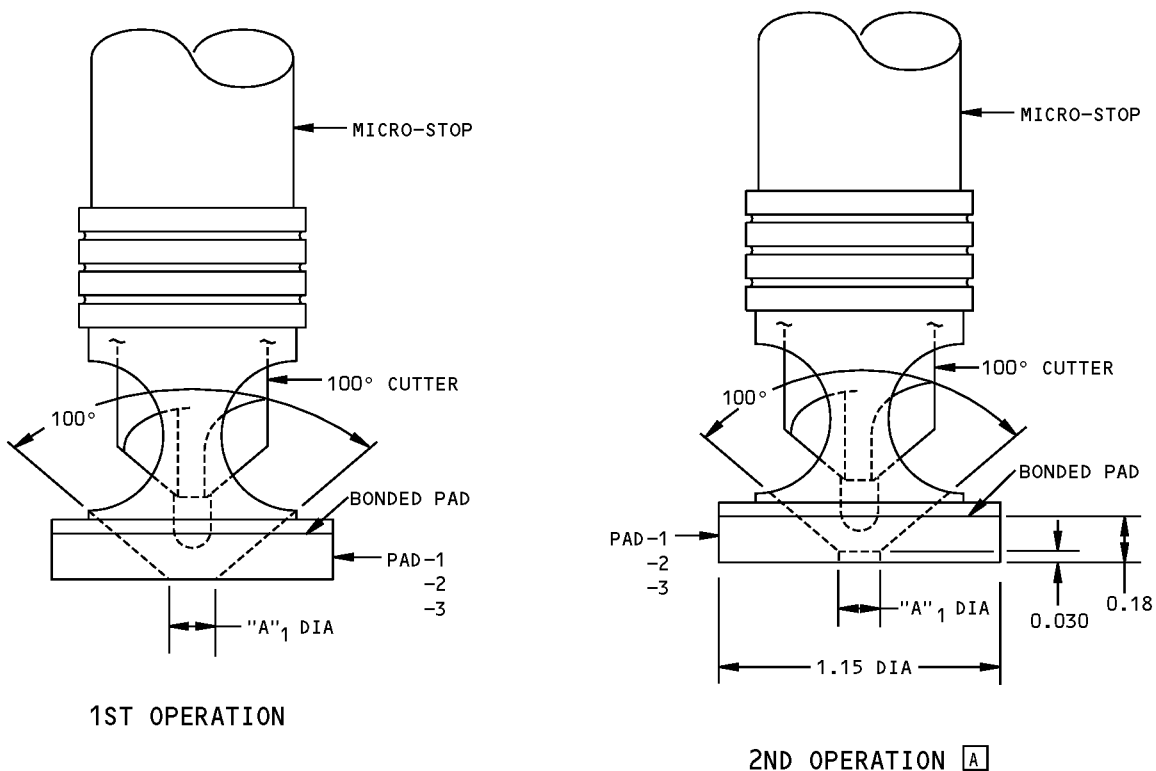


NOTES

[A] BOEING STANDARD TOOL NO.

Locator/Vacuum Shroud Set-up for Countersinking Graphite Structures
Figure 4

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ST1223DA [B]

TOOL NUMBER [B]	PAD ITEM NO.	A_1 +0.005 -0.000 DIA 1ST OPERATION	A_1 +0.010 -0.000 DIA ESTABLISHED SURFACE FLUSHNESS 2ND OPERATION
ST1223DA-156	-1	0.156	0.156
ST1223DA-187	-2	0.187	0.187
ST1223DA-250	-3	0.250	0.250

DIAMETERS FOR ST1223DA FOOT - PHENOLIC MICROSTOP COUNTERSINK
TABLE I

NOTES

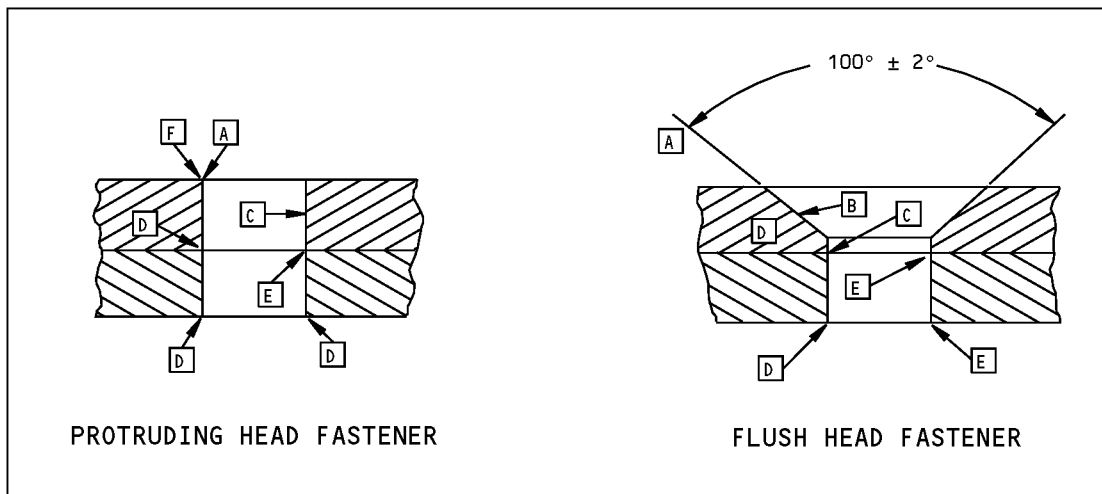
- ALL DIMENSIONS ARE IN INCHES.

[A] AFTER PHENOLIC PAD IS BONDED, ADJUST CUTTER TO OBTAIN A_1 DIA AS SHOWN

[B] BOEING STANDARD TOOL NUMBER

Foot - Phenolic Microstop Countersink
Figure 5

757-200 STRUCTURAL REPAIR MANUAL



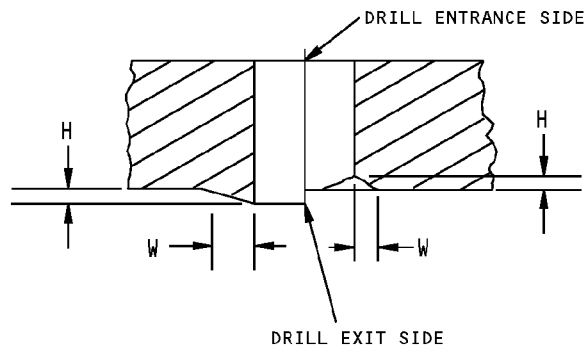
HOLE REQUIREMENTS
TABLE I

NOTES

- | | |
|---|--|
| <p>[A] THERE SHALL BE NO DELAMINATION TO THE EXTERNAL PLY</p> <p>[B] COUNTERSINKS SHALL BE CONCENTRIC TO THE HOLE WITHIN 0.003 INCH (0.076 mm). COUNTERSINK AXIS SHALL BE PARALLEL TO THE HOLE WITHIN 1°</p> <p>[C] THERE SHALL BE NO EVIDENCE OF DELAMINATION OR MATERIAL SCORCHING ON THE SURFACE OF THE HOLE OR COUNTERSINK EXCEPT AS INDICATED BY [F]. SURFACE FINISH SHALL BE 125 MICROINCHES MAXIMUM.</p> <p>[D] BURRS, DUST, OR FIBER PARTICLES WHICH PREVENT SEATING OF THE FASTENER OR INTIMATE CONTACT OF STRUCTURE MUST BE REMOVED</p> | <p>[E] BREAKOUT DAMAGE SHALL NOT EXCEED LIMITS SHOWN IN TABLE II. BREAKOUT DAMAGE IS DEFINED TO BE CHIPPING, SPLINTERING, OR DELAMINATION</p> <p>[F] BREAKOUT OR CHIPPING OF THE EXTERNAL PLY SHALL NOT EXCEED 0.030 INCH (0.76 mm) FROM THE EDGE OF THE DRILLED HOLES. WHERE THE EXTERNAL PLIES ARE UNIDIRECTIONAL GRAPHITE/EPOXY TAPE, THE BREAKOUT ALLOWANCE IS 0.100 INCH (2.54 mm) FROM THE EDGE OF THE DRILLED HOLES</p> |
|---|--|

Hole Requirements for Graphite and Aramid Structures
Figure 6 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL

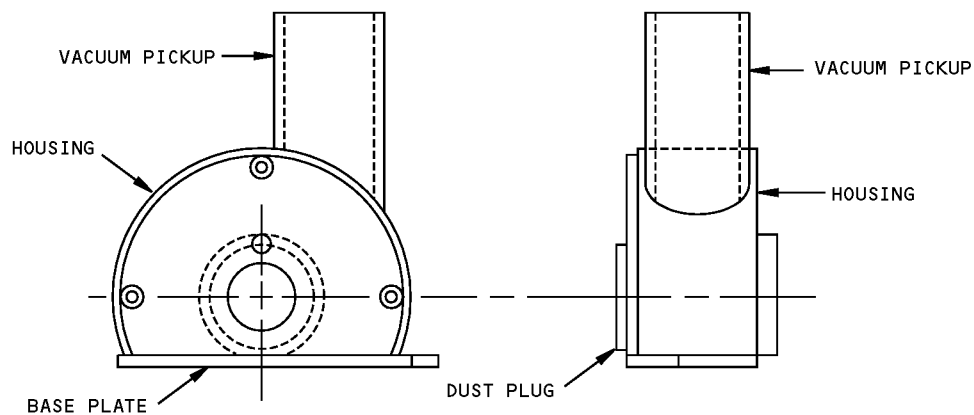


SIZE (inches)	GRAPHITE/EPOXY FABRIC BMS 8-168, BMS 8-212		GRAPHITE/EPOXY TAPE BMS 8-168, BMS 8-212		ARAMID 250°F (121°C) CURE AND FIBERGLASS BMS 8-79, BMS 8-139, BMS 8-219		ARAMID 350°F (177°C) CURE BMS 8-218	
	H MAX (inches)	W MAX (inches)	H MAX (inches)	W MAX (inches)	H MAX (inches)	W MAX (inches)	H MAX (inches)	W MAX (inches)
3/32	↓	0.015	↓	0.050	↓	0.015	↓	0.075
1/8		0.020		0.050		0.020		0.075
9/64		0.025		0.075		0.025		0.075
5/32		0.030		0.100		0.030		0.100
3/16		0.030		0.100		0.030		0.100
1/4		0.040		0.100		0.040		0.100
5/16		0.040		0.120		0.040		0.100
3/8		0.040		0.120		0.040		0.100
7/16		0.040		0.150		0.040		0.100
1/2		0.040		0.150		0.040		0.100

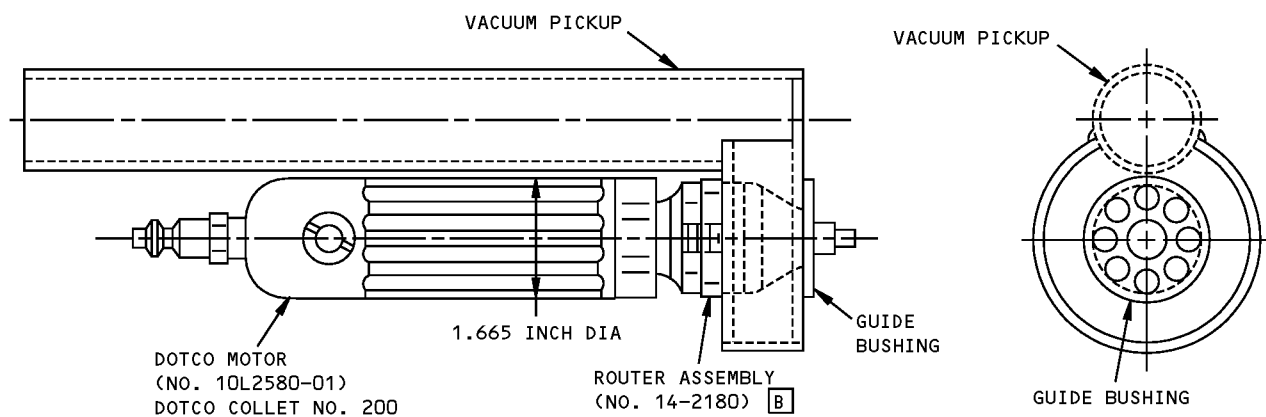
LIMITS FOR DRILL BREAKOUT DAMAGE TO FASTENER HOLES
TABLE II

Hole Requirements for Graphite and Aramid Structures Figure 6 (Sheet 2 of 2)

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ST1265H [A] VACUUM GUARD FOR DOTCO CIRCULAR SAW MODEL 10L1280-32
DETAIL I



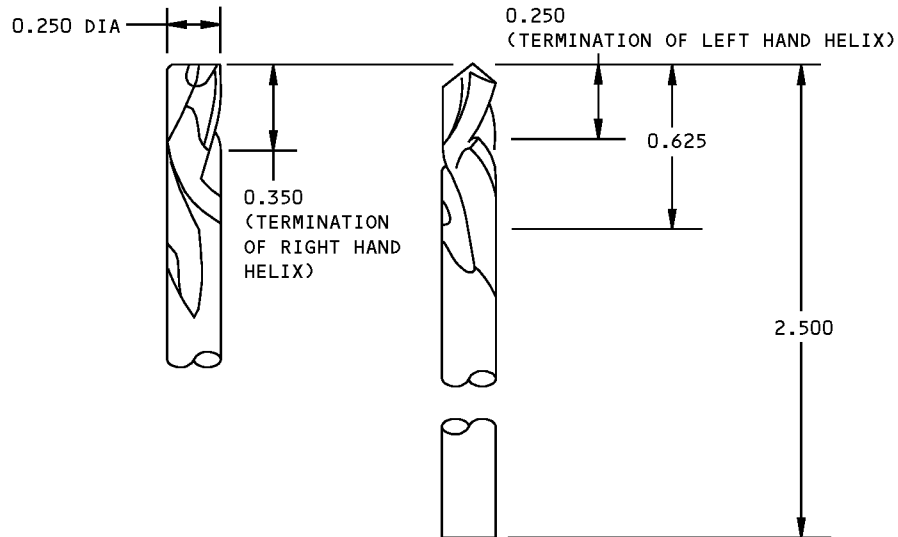
ST-301-J-15 [A] VACUUM PICKUP FOR DOTCO DRILL MOTOR
DETAIL II

NOTES

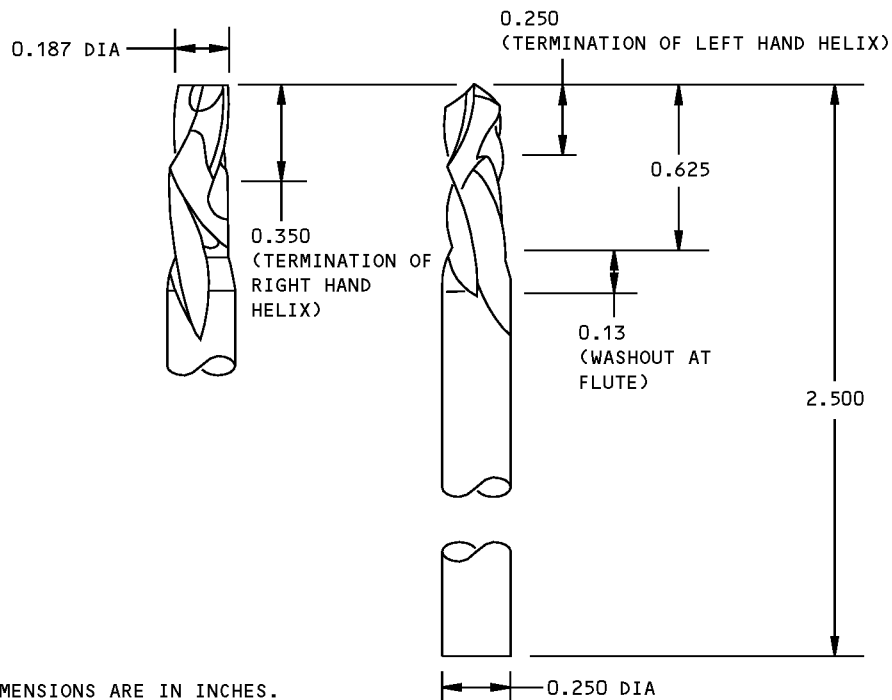
- [A] BOEING STANDARD TOOL NO.
- [B] PACIFIC DISTRIBUTING INC.
7118 BEACON AVE SO.
SEATTLE, WA 98108

Vacuum Pickup for Trimming Operations Figure 7

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STRUCTURAL REPAIR MANUAL



HERRING BONE TWO FLUTE CUTTER - 20° HELIX ANGLE
DETAIL I



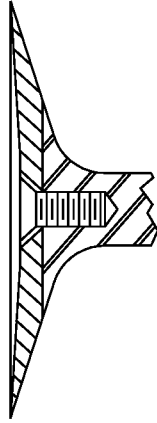
NOTE:

- ALL DIMENSIONS ARE IN INCHES.

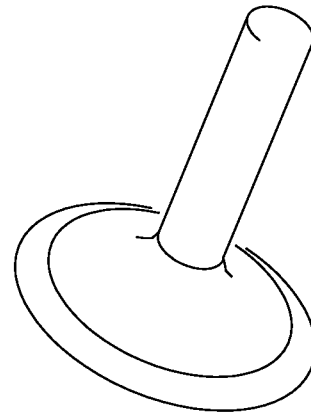
HERRING BONE, TWO FLUTE CUTTER - 20° HELIX ANGLE
DETAIL II

Cutter for Trimming Aramid Panels
Figure 8

**757-200
STRUCTURAL REPAIR MANUAL**

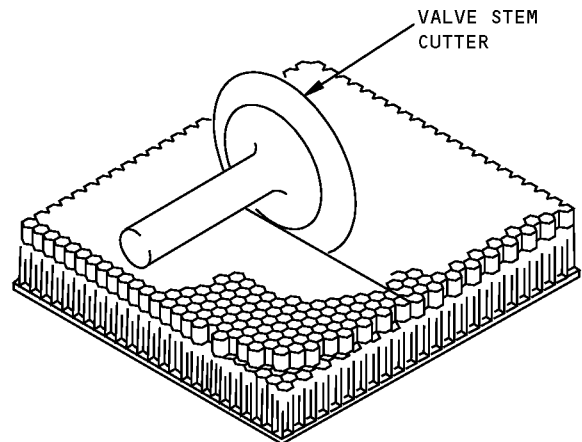
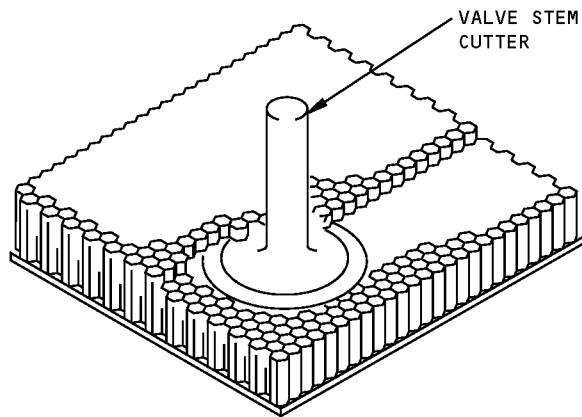


TWO-PIECE CUTTER



ONE-PIECE CUTTER

**VALVE STEM CUTTERS
DETAIL I**

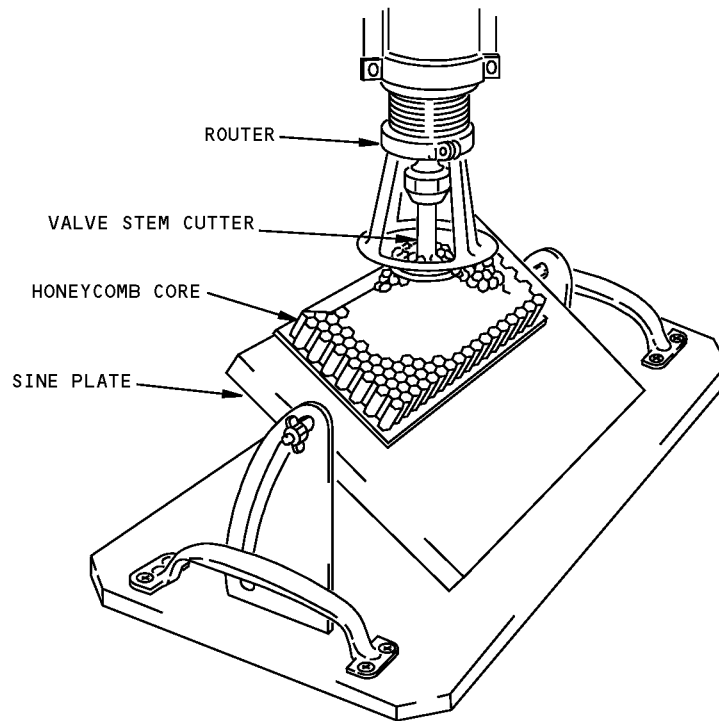


**FLAT CUTTING FOR DOUBLER RECESSES, EDGE STEPS
OR OVERALL THICKNESS REDUCTION**

DETAIL II

**Machining with Valve Stem Cutter
Figure 9 (Sheet 1 of 2)**

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DETAIL III

NOTES

- REFER TO SRM 51-30-05 FOR CUTTER SIZES AND MANUFACTURER
- CUTTERS ATTACH TO POWER ROUTER (SEE DETAIL III)
- MACHINE WITH SINE PLATE FOR MAKING TAPERED CUTS OR WEDGE-SHAPED DETAILS
- NONMETALLIC HONEYCOMB MAY BE STABILIZED BY:
 1. USE OF DOUBLE-BACKED TAPE
 2. BONDING A LAYER OF ADHESIVE FILM TO SURFACE OF HONEYCOMB
 3. BONDING A LAYER OF ADHESIVE FILM AND A LAYER OF PREPREG FIBERGLASS CLOTH
- STABILIZED HONEYCOMB DETAILS MAY BE HELD FOR MACHINING BY USE OF VACUUM, MECHANICAL CLAMPING USING LARGE AREA PADS, DOUBLE-BACKED TAPE OR SHOT BAGS

**Machining with Valve Stem Cutter
Figure 9 (Sheet 2 of 2)**

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STRUCTURAL REPAIR MANUAL

NOTES

- REFER TO SRM 51-40-05 FOR HOLE SIZES IN METAL STRUCTURES

A USE OF ALUMINUM FASTENERS IN GRAPHITE AND HYBRID ARAMID/GRAPHITE PANELS IS NOT RECOMMENDED; CORROSION MAY RESULT. CRES OR TITANIUM FASTENERS ARE RECOMMENDED

RIVET TYPE A	NOMINAL RIVET DIA (INCH)	HOLE SIZE (INCH)			
		ARAMID/EPOXY TAPE OR FABRIC		ARAMID/EPOXY WITH ALUMINUM OR FIBERGLASS WITH AND WITHOUT ALUMINUM	
		MIN	MAX	MIN	MAX
BACR15CE	3/32	0.098	0.103	0.098	0.103
	1/8	0.130	0.137	0.128	0.135
	5/32	0.161	0.169	0.159	0.167
	3/16	0.192	0.200	0.190	0.198
	1/4	0.255	0.261	0.255	0.261
BACR15BA, BACR15BB, BACR15FT	3/32	0.098	0.103	0.098	0.103
	1/8	0.130	0.137	0.128	0.135
	5/32	0.161	0.173	0.159	0.171
	3/16	0.193	0.204	0.191	0.202
	1/4	0.254	0.265	0.254	0.265

HOLE SIZES FOR SOLID RIVETS
TABLE I

NOMINAL RIVET DIAMETER (INCH)	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
5/32	0.159	0.162
3/16	0.190	0.193
7/32	0.224	0.227

HOLE SIZES FOR HOLLOW-ENDED BACR15GA RIVETS (TITANIUM)
TABLE II

Fastener Hole Sizes in Composites Figure 10 (Sheet 1 of 2)



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THREAD SIZE (INCH)	HOLE SIZE (INCH)	
	MINIMUM	MAXIMUM
#4-40	0.114	0.117
#6-32	0.140	0.143
#8-32	0.164	0.167
#10-32	0.190	0.193
1/4-28	0.250	0.253
5/16-24	0.312	0.315
3/8-24	0.375	0.378

HOLE SIZES FOR BOLTS AND NUTS A
TABLE III

NOMINAL OVERSIZE	ORIGINAL HOLE SIZE (INCH)			
	(-6) #10	(-8) 1/4	(-10) 5/16	(-12) 3/8
	0.193 0.190	0.253 0.250	0.315 0.312	0.378 0.375
	HOLE SIZES FOR OVERSIZE REPLACEMENT FASTENERS			
1/64	0.206 0.203	0.269 0.266	0.331 0.328	0.395 0.391
1/32	0.222 0.219	0.284 0.281	0.348 0.344	0.410 0.406

HOLE SIZES (INCHES) FOR OVERSIZE HEX DRIVE FASTENERS A
TABLE IV

Fastener Hole Sizes in Composites
Figure 10 (Sheet 2 of 2)



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GENERAL - REPAIRS TO 250°F (121°C) AND 350°F (177°C) CURED GRAPHITE/ARAMID/FIBERGLASS REINFORCED EPOXY LAMINATES AND NONMETALLIC HONEYCOMB SANDWICH STRUCTURE - 200°F (93°C) TO 230°F (110°C) WET LAYUP REPAIR METHOD

1. General

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of graphite tape or fabric, aramid fabric, fiberglass fabric or a combination of graphite, aramid and fiberglass (hybrids). The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands and at fitting locations. Repairs described herein use dry fabric material which is hand-impregnated with resin (wet layup) and cured at elevated temperatures. These repairs are permanent when applied using the repair manual procedures.

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR RUBBER GLOVES, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

WARNING: DO NOT BREATHE CARBON FIBER DUST. MAKE SURE THAT THERE IS A GOOD FLOW OF AIR WHERE YOU DO THE WORK. USE EQUIPMENT TO HELP YOU BREATHE WHEN YOU WORK IN A CONFINED SPACE. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY.

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.



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(CAUTION PRECEDES)

TEMPERATURES ABOVE 260°F (127°C) MUST NOT BE APPLIED TO AREAS SEALED WITH BMS 5-95 SEALANT, UNLESS SEALANT CAN BE REPLACED FOLLOWING REPAIR.

THESE REPAIRS ARE PERMANENT WHEN APPLIED USING THE REPAIR MANUAL PROCEDURES TO COMPONENTS ORIGINALLY MADE FROM 350°F (177°C) CURE MATERIALS.

SOME REPAIRS MAY REQUIRE CURE TEMPERATURES THAT ARE THE SAME USED FOR THE ORIGINAL CURE OF THE COMPONENT DURING MANUFACTURE. CARE MUST BE TAKEN TO PROPERLY SUPPORT THE AREA ADJACENT TO THE REPAIR TO PREVENT DELAMINATION OF UNDAMAGED AREAS. EXTENDING VACUUM BAGGING A MINIMUM OF 6.0 IN. (15.2 CM) BEYOND THE HEAT BLANKET AND THE USE OF SUPPORT STRUCTURE WHERE REQUIRED ARE RECOMMENDED.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE BARE OR ALUMINUM COATED TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY ALSO BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.

WHEN REINSTALLING ALUMINUM FITTINGS ON GRAPHITE COMPOSITE STRUCTURE, ENSURE THAT THE ORIGINAL CORROSION PROTECTIVE TREATMENT IS MAINTAINED. INSTALL FITTINGS WITH FAYING SURFACE SEAL USING BMS 5-26 IN FUEL TANK AREAS OR BMS 5-95 IN ALL OTHER AREAS.

CAUTION: DO NOT LET CARBON FIBER DUST GO INTO ELECTRICAL EQUIPMENT. CARBON FIBER DUST IS ELECTRICALLY CONDUCTIVE AND IT CAN CAUSE SHORT CIRCUITS IF IT GOES INTO ELECTRICAL EQUIPMENT. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE ELECTRICAL EQUIPMENT.

- B. Use suitable holding fixtures as given in Paragraph 3.F./GENERAL to prevent distortion and delamination of the structure.
- C. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- D. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts. Refer to Paragraph 3.D.(3)/GENERAL for protection when working with resin system.
- E. Store resin and/or adhesive material at 55° to 80°F (12° to 27°C) in sealed containers. An identification label must accompany the material inside the bag, with the following information: BMS type, class, grade, supplier name, batch number, and date of preparation.
- F. Refer to 51-70-02, GENERAL for the locations of principal composite components.
- G. Refer to 51-30-03, GENERAL for source of repair materials.
- H. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
- I. Refer to Figure 1/GENERAL for resin mixes and potting compound data.



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- J. Restore aluminum flame spray and aluminum foil as given in 51-70-14, GENERAL.
- K. Refer to 51-70-16, GENERAL for drilling and machining of composite structures.
- L. Refer to 51-30-06, GENERAL for composite repair material ordering data.
- M. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 3./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 3.A./GENERAL	Determine Damage
Paragraph 3.B./GENERAL	Remove Water and Dry Out Damaged Area
Paragraph 3.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 3.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 3.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 3.F./GENERAL	Layup/Bagging Procedures
Paragraph 3.G./GENERAL	Cure the Repair
Paragraph 3.H./GENERAL	Refinish After Repair
Paragraph 3.I./GENERAL	Perform Post-Repair Requirements
Paragraph 4./GENERAL	Typical Repairs
Paragraph 4.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 4.B./GENERAL	Repair of Puncture, 0.50-inch Diameter or Less, in Honeycomb Panel
Paragraph 4.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50-inch Diameter
Paragraph 4.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 4.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 4.F./GENERAL	Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side Only
Paragraph 4.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 4.H./GENERAL	Repair of Damage and Punctures to Multiple Plies in Solid Laminate Panels
Paragraph 4.I./GENERAL	Repair of Punctures, 0.50-inch Diameter or Less, in Solid Laminate Panels



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Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 4.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 4.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels
Paragraph 4.L./GENERAL	Repair of Surface Dents
Paragraph 4.M./GENERAL	Repair of Damage to Solid Honeycomb Trailing Edge Wedge and Structural Solid Laminate Trailing Edge

2. References

Reference	Title
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-20-05, GENERAL	Repair Sealing
51-30-03, GENERAL	Nonmetallic Materials
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-60	CONTROL SURFACE BALANCING
51-70-02, GENERAL	Locations of the Principal Composite Components
51-70-03, GENERAL	Graphite and/or Aramid Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-06, GENERAL	Glass Fabric Reinforced Epoxy Laminates and Nonmetallic Honeycomb Sandwich Repairs - Room Temperature/150°F (66°C) Cure (Wet Layup)
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
NDT Part 1, 51-01-01	Inspection of Repairs to Composite Structures
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-03	Standard Overhaul Practices Manual
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

3. Repair Procedures Common to Various Repairs

A. Determine Damage.

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- (1) Examine visually for extent of damage.
- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic methods. Remove contaminants. Refer to Paragraph 3.B./GENERAL for water removal instructions.

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- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental nondestructive inspection (NDI) methods or by tap test. For tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bonded area. Refer to NDT Part 1, 51-05-01.

B. Remove Water and Dry Out Damaged Area.

- (1) Remove water from honeycomb sandwich (Figure 6/GENERAL).

- (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum and oil-free compressed air.
- (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
- (c) Apply a fiberglass or metal fine mesh screen over exposed core.
- (d) Apply a thermocouple to the center of the screen.
- (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
- (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
- (g) If the far side is accessible, apply thermocouple and heating blanket to the far side of the honeycomb sandwich panel.

NOTE: If the far side is accessible, it is acceptable to heat the area using a heating blanket only on the far side. An additional heating blanket and vacuum application may be used on the near side at the location shown in Figure 6/GENERAL to accelerate water removal. If the far side is inaccessible, use of a heating blanket on the near side is required.

- (h) When the far side is inaccessible or when using additional heating blanket, place the heating blanket over the bleeder cloth on the near side.
- (i) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
- (j) Evacuate the layup to vacuum of 22 in/Hg (75 kPa) minimum.
- (k) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
- (l) Remove layup materials and proceed with repair procedure.

- (2) Remove water from solid laminate.

- (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
- (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

C. Remove Damage and Prepare Damaged Area.

- (1) Damage removal.

- (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.

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- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. For crush splice repairs (Paragraph 3.D./GENERAL) leave one to three core cells (0.4 in. (10 mm) maximum) visible between core cavity and skin (Figure 7/GENERAL). The core area removed should extend at least 0.5 in. (12.7 mm) further than visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side. In cores greater than 1.0 in. (25.4 mm) thick, partially remove core (at least 0.5 in. (12.7 mm) deep) sufficient to clean up damage.
- (c) In areas where contamination cannot be removed by cleaning or drying as given in Paragraph 3.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 3.C.(1)(a)/GENERAL.
- (e) When core is removed from inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 8/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

- (2) Preparation of damaged area (Refer to Figure 8/GENERAL).

- (a) Determine the number and orientation of plies that have been cut. Mask off area around the cutout allowing 0.5 in. (12.7 mm) or 1.0 in. (25.4 mm) minimum for each ply replacement and each extra ply. Use 1.0 in. (25.4 mm) overlap for heat-affected components and 0.5 in. (12.7 mm) for all others. Refer to the specific component repair chart to find which value to use.

NOTE: Where the number of plies is not apparent, refer to the applicable component structure identification or engineering drawing.

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (non-aerodynamic surface) and noncritical aerodynamic surfaces.
 - 1) Remove the paint finish or Tedlar film in the masked off area using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper.

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- 2) Taper sand each ply or simply abrade the surface around the cleaned up damage a minimum of 0.5 in. (12.7 mm) or 1.0 in. (25.4 mm) per ply. Refer to Paragraph 3.C.(2)(a)/GENERAL.
- 3) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.

(c) External surface of panel (critical aerodynamic surfaces).

- 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over a minimum distance of 0.5 in. (12.7 mm) or 1.0 in. (25.4 mm) for each existing ply of the laminate. Refer to Paragraph 3.C.(2)(a)/GENERAL to determine the required distance. Step sanding is optional to taper sanding on honeycomb sandwich structure in areas of noncritical aerodynamic smoothness. Always taper sand on solid laminate structures.

NOTE: For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.

- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 0.5 in. (12.7 mm) or 1.0 in. (25.4 mm) border using No. 150 or finer sandpaper.

(d) Edgeband of panel.

- 1) Taper sand panel edgeband as given in Paragraph 3.C.(2)(c)/GENERAL.

NOTE: Edgeband is the solid laminate around the outer periphery of the honeycomb panel.

(e) Cleaning of repair area.

- 1) Remove all sanding dust with oil-free compressed air or a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT IMMERSE PARTS IN TRICHLOROETHANE OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with MIBK (methyl isobutyl ketone), MEK (methyl ethyl ketone), trichloroethane, or acetone. Allow solvent to evaporate before proceeding with the repair.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

(1) Fabricate core plug.

- (a) Fabricate core plug. Refer to specific component structural identification section to determine type of core called out on engineering drawing.
- (b) For butt splicing, the honeycomb core plug should fit flush with original core and with ribbon direction the same as in original core. The replacement core must overlap and make intimate contact with the cell walls of surrounding core material.

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- (c) For crush splicing, the honeycomb core plug should be made two to four cells larger than repair cavity, and be made from core material which is a maximum of two grades denser than the original core.

NOTE: Crush splicing applies to fiberglass core (BMS 8-124, Class I) only.

- (d) Trim core plug to full or partial depth of original core (Paragraph 3.C.(1)(b)/GENERAL).

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive between core plug and undamaged core or skin.

- (2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED IMMERSION CRITERIA GIVEN IN PARAGRAPH 3.D.(2)(A)/GENERAL. DAMAGE TO CORE MATERIAL WILL OCCUR.

DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99) bath for 60 seconds, or vapor degrease core (according to SOPM 20-30-03) limiting immersion to 30 seconds per cycle for a maximum of 4 cycles.
- (b) Locally contaminated areas can be wiped with solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99).
- (c) The core must be completely dry, clean, and free of evidence of solvents before installation.
- (3) Install core plug (Refer to Figure 3/GENERAL, Figure 7/GENERAL, Figure 11/GENERAL, Figure 12/GENERAL, Figure 13/GENERAL, and Figure 14/GENERAL).

WARNING: BREATHING VAPORS OR ALLOWING RESIN COMPONENTS TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR RUBBER GLOVES, PROTECTIVE CLOTHING AND EYE GOGGLES. IF GLOVES NEED TO BE REMOVED DURING USE OR A PUNCTURE IS SUSPECTED, REPLACE WITH NEW GLOVES. HANDS SHOULD BE WASHED WITH SOAP AND WATER IMMEDIATELY AFTER REMOVAL OF GLOVES. IF CHEMICAL CONTACT OCCURS WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

- (a) If one skin is undamaged and for full core depth replacement apply two plies of BMS 9-3, Type H-2 or H-3 fiberglass fabric or four plies of BMS 9-3, Type D fiberglass fabric saturated with Resin Mix 2 as given in Paragraph 3.E./GENERAL to the undamaged skin in the repair cavity.

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- (b) If one skin is undamaged and for partial core replacement apply Resin Mix 3 to face of undamaged core in the repair cavity. Then apply 2 plies of BMS 9-3, Type H-2 or H-3 fiberglass fabric or four plies of BMS 9-3, Type D fiberglass fabric saturated with Resin Mix 2 as given in Paragraph 3.E./GENERAL in the repair cavity.
- (c) If both skins of the panel are damaged, repair one surface of the panel and replacement core plug. Repair other surface with subsequent repair cycle. Refer to Paragraph 3.E./GENERAL.
- (d) For butt splicing, apply uniform coat of Resin Mix 1 to the sides of the core plug.

NOTE: It is optional to apply the resin to the inside surface of the existing core instead of to the core plug.

- (e) For crush splicing, prepare and install the core plug as given in Figure 7/GENERAL.
- (f) Apply Resin Mix 3 to lower face of the core plug.
- (g) Insert the core plug into the core cavity. Orient the ribbon direction to align with the original core ribbon.
- (h) Put the layup materials and equipment in place as given in Figure 4 (Sheet 2) and Paragraph 3.F./GENERAL.

NOTE: A heat lamp may be used instead of a heating blanket to gel the core repair resin. Refer to the heat lamp temperature curve (Figure 9/GENERAL).

- 1) If the damage extends through both face skins, vacuum bag both sides of the panel (or the entire part) using the layup shown in Figure 4 (Sheet 2)).
- 2) If the replacement core plug is less than or equal to 0.5 in. (12.7 mm) thick, use the heating blanket on the near side and locate at least two separate thermocouples on the panel surface at the bondline.
- 3) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and both sides are accessible, use heating blankets on both sides. Locate at least two separate thermocouples on the near side at the bondline and one on the far side corresponding to the center of the repair.
- 4) If the replacement core plug is greater than 0.5 in. (12.7 mm) thick and only one side is accessible, use the heating blanket on the near side and put at least two separate thermocouples into the repair hole so the thermocouples touch the repair materials at the bottom of the repair hole.

NOTE: The ends of these thermocouples will be cured into the adhesive. Cut the thermocouples leaving the embedded ends behind before applying the repair plies. Only the portion of the thermocouple embedded in the core can be left in the repair. The thermocouples cannot come between the repair plies and the sanded surfaces of the original plies.

- (i) Cure the core repair as given in Paragraph 3.G./GENERAL.

NOTE: Gelation of the potting resin will occur after 20 minutes at 150°F (66°C). As an option to a full cure, allow the resin to gel then remove the bagging materials and continue with the repair (Figure 5/GENERAL, Detail I). The gelled core repair resin will reach full cure when the skin repair plies are cured (Figure 5/GENERAL, Detail II).

Monitor bondline temperatures throughout the cure. Failure to reach the cure temperature for the entire cure period specified is cause for rejection of the repair.

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- (j) Sand core plug approximately flush with surrounding material, making allowance for adhesive and slight core crush during cure.
- (k) Vacuum to remove sanding residue from core cells.

NOTE: The core plug and the repair plies can be cured at the same time if the temperature can be adequately monitored by thermocouples placed on the outside surfaces of the panel (refer to Paragraph 3.D.(3)(h)2)/GENERAL through Paragraph 3.D.(3)(h)4)/GENERAL). If the thermocouples must be embedded in the repair core adhesive, then the core plug must be cured separately to avoid curing the thermocouple between the repair plies and the sanded surface of the original plies.

E. Prepare and Apply Repair Plies.

NOTE: Refer to applicable paragraphs for preparation of glass and graphite fabrics. For hybrid components, refer to relevant material paragraphs for each individual ply. Aramid fabric damage will be repaired using glass fabric repair plies. Refer to Figure 17/GENERAL for substitution of glass fabric for aramid fabric.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

(1) Prepare glass fabric repair plies (BMS 9-3)

- (a) Refer to the component structure identification to determine number, style, and orientation of glass fabric used in original structure. Repair existing Type 120 plies with Type D plies. Repair existing Type 1581 or 181 plies with Type H-2 plies. Repair existing Type 7781 plies with Type H-3 plies. Refer to specific structural component repair section for extra repair ply requirements. Refer to Figure 17/GENERAL for substitution of glass fabric repair plies.
- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. Each repair ply must be of equivalent thickness and the same orientation as the original plies. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 18/GENERAL for extra repair ply material and orientation.

- (c) When replacing ply over core, a filler ply the size of the cutout is required to minimize surface depression.
- (d) Impregnate repair plies with resin as given in Paragraph 3.E.(3)/GENERAL.

(2) Prepare graphite fabric repair plies (BMS 9-8).

- (a) Refer to the specific structural component identification to determine number, style, and orientation of graphite fabric used in original structure. Refer to the structural component repair section for extra repair ply requirements. Refer to Figure 17/GENERAL for substitution of dry fabric plies for existing prepreg materials.

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- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. Each repair ply must be of equivalent thickness and the same orientation as the original plies. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 18/GENERAL for extra repair ply material and orientation.

- (c) When replacing ply over core a filler ply the size of the cutout is required to minimize surface depression.
 - (d) Impregnate repair plies with resin as given in Paragraph 3.E.(3)/GENERAL.
- (3) Impregnate repair plies with resin.

- (a) Cut two pieces of parting film approximately 3.0 in. (7.6 cm) larger all around than the fabric and tape down one piece to a smooth surface.

NOTE: Use Teflon film or other parting films.

- (b) Lay fabric onto parting film.

NOTE: Cut a piece of fabric that is large enough for cutting the required number of plies for the repair patch.

- (c) Pour Resin Mix 2 to adequately cover fabric and spread out to evenly coat the fabric.
- (d) Cover fabric with parting film.
- (e) Work resin thoroughly and evenly into fabric with squeegee or roller in order to impregnate the fabric and to remove entrapped air.
- (f) Work excess resin to edges of fabric such that fabric weave is barely visible.

NOTE: Resin content of the impregnated fabric should be 55 ± 5 percent by weight.

- (g) Cut the impregnated fabric to the required sizes for each individual ply of the patch. The parting film on both sides of the fabric decreases fraying of the edges while cutting the fabric.

NOTE: The total number of repair plies is to be in accordance with Paragraph 3.E.(2)/GENERAL. Refer to Figure 8/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired. Where repair plies are to be applied over an exposed honeycomb core a filler ply the same size as the cutout is required to minimize surface depression. Extra repair plies must be installed as specified in individual structural component repair sections.

- (4) Apply repair plies

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with filler plies before application of the repair plies.

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CAUTION: ENSURE THAT PARTING FILM IS REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Thoroughly coat face of exposed honeycomb core with Resin Mix 3 just prior to applying repair plies. Use of roller for resin application is recommended.
- (b) Remove parting film from one side of the smallest ply of the patch and place the exposed face against the repair area with orientation as in original structure.

NOTE: The filler ply applied over the honeycomb core is to have the same orientation as the first repair ply.

- (c) Use a squeegee over the parting film that covers the patch to remove wrinkles and entrapped air. Do not apply excessive pressure. Excessive pressure will produce a patch deficient in resin.
- (d) After removing parting film from the contact faces, place the next larger size ply of the impregnated patch over the ply on the repair area with proper orientation and with overlap all around as given in Figure 8/GENERAL.
- (e) Place succeeding plies of the patch as described in Paragraph 3.E.(4)(c)/GENERAL and Paragraph 3.E.(4)(d)/GENERAL.
- (f) Proceed to layup/bagging procedure.

F. Layup/Bagging Procedure (Refer to Figure 4/GENERAL)

- (1) Place a layer of perforated FEP parting film (1 mil thick) over the repair. Cut the FEP so that the edges extend 3 in. (7.6 cm) beyond the edge of the repair patch.
- (2) Secure three thermocouples (spaced evenly around repair) to the panel at the edge of the repair and secure them to the appropriate recorders.
- (3) Place a layer of dry peel ply or Style 120 glass fabric (or equivalent thickness glass fabric) over the perforated FEP as a surface bleeder. Cut the surface bleeder so that the edges extend 2 in. (5.1 cm) beyond the edge of the perforated FEP.
- (4) Place a layer of solid FEP parting film (2 mil thick) over the surface bleeder. Cut the solid FEP so that the edges are even with the edge of the perforated FEP.
- (5) Place a layer of Airweave SS or Style 120 glass fabric over the solid FEP as a surface breather. Cut the surface breather so that the edges extend to the edge of the surface bleeder. Make certain the surface breather makes contact with the surface bleeder along the edges.
- (6) Secure a vacuum line on the edge of the surface breather.

WARNING: USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- (7) If a heat blanket is used as a heat source, perform the following steps:

NOTE: A heat blanket or equivalent heat source may be used to cure the repair. Infrared heat lamps are not recommended for accelerated cures above 180°F (82°C).

If the repair is made on a structure too small to allow the heat blanket to be vacuum bagged, proceed to Paragraph 3.F.(8)/GENERAL and place heat blanket over the vacuum bag. A second vacuum bag may then be placed over the part to hold the heat blanket in place.

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- (a) Place a heat blanket over the surface breather. The heat blanket must extend a minimum of 2 in. (5.1 cm) beyond the repair patch edges.

NOTE: When using a heat blanket larger than 12 in. (30 cm) on one side, an aluminum caul plate (0.016 in. (0.4 mm) thick) can be used under the heat blanket to minimize localized heating. Make the caul plate slightly smaller than the surface breather.

- (b) Place controlling thermocouple over the center of the heat blanket.
- (c) Place 4 to 6 layers of glass fabric over the heat blanket. The glass fabric will insulate the heat blanket and prevent damage to the bagging film.
- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.

CAUTION: THE ENTIRE PART MUST BE VACUUM BAGGED AND RESTRAINED IN PLACE TO PREVENT DELAMINATION AND DISTORTION WHEN THE REPAIR AREA EXCEEDS 15 PERCENT OF PANEL AREA. REGARDLESS OF THE METHOD OF HEAT APPLICATION, RESTRAINING DEVICES THAT MAINTAIN THE CONTOUR AND SUPPORT THE PART MUST BE USED FOR LARGE PARTS WHERE SAGGING AND DISTORTION COULD OCCUR DUE TO THE WEIGHT OF THE PART.

- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. It is optional to vacuum bag the entire part.

CAUTION: HOLLOW COMPOSITE COMPONENTS SUCH AS RUDDERS, ELEVATORS, AND AILERONS MUST NOT BE COMPLETELY VACUUM BAGGED BECAUSE THEY MAY COLLAPSE UNDER 22 IN/HG (75 KPA) VACUUM. ATTACH THE VACUUM BAG TO ONE SIDE OF COMPONENT ONLY OR ATTACH SEPARATE VACUUM BAGS TO EACH SIDE TO ENSURE THAT ATMOSPHERIC PRESSURE INSIDE OF THE COMPONENT IS MAINTAINED DURING REPAIR. COMPONENTS CONSISTING OF A SINGLE PANEL MADE OF FULL DEPTH HONEYCOMB CORE WITH LAMINATE FACESHEETS AND EDGE BANDS MAY BE COMPLETELY VACUUM BAGGED (FIGURE 22/GENERAL).

- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
- (11) Check the vacuum bag for leak paths.
- (12) Cure the repair as given in Paragraph 3.G./GENERAL.

G. Cure the Repair

NOTE: Determination of the temperature must be made by using thermocouples placed at edge of patch.

In honeycomb panels, for repairs to both skins or single skin and partial depth core replacement using a septum, refer to Paragraph 3.D.(3)(h)2)/GENERAL through Paragraph 3.D.(3)(h)4)/GENERAL.

When using a hot bond repair console, consult manufacturer's operating instructions.

WARNING: USE EXPLOSIONPROOF EQUIPMENT DURING CURE. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

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(WARNING PRECEDES)

CAUTION: SURFACE TEMPERATURE MUST NOT EXCEED CURE TEMPERATURE SPECIFIED IN THE COMPONENT REPAIR CHART. DAMAGE OR DISTORTION OF STRUCTURE MAY OCCUR IF TEMPERATURE EXCEEDS THAT SPECIFIED.

- (1) Raise the temperature at a maximum rate of 2°F to 8°F (1°C to 4°C) per minute to follow the cure cycle temperature-time profile shown in Figure 5/GENERAL. Determine cure temperature from thermocouple at the edge of the repair ply that has the lowest reading.

NOTE: Cure time does not include the time required for the mold and part to heat up to temperature. Cure time is the period after the part has reached that temperature.

- (2) Cool down repair after cure period at a rate of 5°F (3°C) per minute maximum while still maintaining vacuum.
- (3) When the repaired area has cooled to less than 125°F (52°C), release vacuum pressure and remove vacuum bagging materials and other layup materials.

H. Refinish After Repair

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of top most repair ply as necessary to fair the edge. Sand surface of repair to produce a smooth finish without damaging fibers.
- (2) Apply finish to the repaired surface using the following applicable methods.
 - (a) Where clear Tedlar film surfaces have been removed, seal with a brush coat of Resin Mix 5 (Figure 1/GENERAL). Cure as given in Figure 1/GENERAL.
 - (b) Where grey or white Tedlar film surfaces have been removed, seal with Resin Mix 5 (Figure 1/GENERAL). Cure as given in Figure 1/GENERAL and apply one coat of BMS 10-11 primer and one coat of BMS 10-60 enamel (grey: BAC705; white: BAC7106).
 - (c) Where the abrasion resistant Teflon finish has been removed from the internal surface of the panel edgeband, reapply the finish as given in AMM 51-24-13.
 - (d) Where the original painted surfaces have been removed, restore original finish as given in AMM 51-21-00/701.
 - (e) Where BMS 10-21 conductive coating has been removed, reapply as given in AMM 51-24-02.
 - (f) Where aluminum flame sprayed areas have been damaged, repair as given in 51-70-14, GENERAL.
 - (g) Where aluminum coated glass fabric (BMS 8-278) has been repaired, aluminum flame spray as given in 51-70-14, GENERAL.
 - (h) Where aluminum foil (BMS 8-289) has been removed, repair as given in 51-70-14, GENERAL.
 - (i) Where sealant has been removed from around fittings or fay surfaces to facilitate repairs, reapply BMS 5-26 in fuel tank areas or BMS 5-95 in all other areas as given in drawing requirements or 51-20-05, GENERAL.
 - (j) Restore sealant applications of BMS 5-95 on exterior aramid surfaces as given in AMM 51-21-12.

I. Perform Post-Repair Requirements

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- (1) Make an inspection of the repair that was done to make sure that the repair is satisfactory. The inspection must include these areas:

- The area that was hot
- A minimum width of 2 in. (5 cm) all around the area that was hot

NOTE: Post repair inspection is recommended. Examples of inspection procedures are given in NDT Part 1, 51-01-01. Other inspection methods that have been examined and found satisfactory by the airline can be used.

WARNING: FLIGHT SAFETY DEMANDS THAT CERTAIN CONTROL SURFACES BE PROPERLY BALANCED AT ALL TIMES.

- (2) Following repair of control surface, balance must be checked to determine whether or not rebalancing is required. Rebalance as necessary as given in CONTROL SURFACE BALANCING, SECTION/51-60.

CAUTION: REPAIRS MADE TO CONTROL SURFACES AND/OR ADJACENT STRUCTURE MUST NOT INTERFERE WITH THE DESIGNED OPERATION OF THE CONTROL SURFACES. DAMAGE TO AIRPLANE STRUCTURE MAY OCCUR.

- (3) Check all repairs for clearance and noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

CAUTION: REPAIRS MUST NOT COVER EXISTING DRAIN HOLES IN PANELS. WATER WILL ACCUMULATE IF DRAIN HOLES ARE COVERED.

- (4) If repair covers the drain hole, drill through the repair at existing location.

NOTE: Drain holes are usually 0.375 in. (9.5 mm) diameter. Refer to AMM 51-40-00.

4. **Typical Repairs**

NOTE: These repairs apply to all graphite/aramid/glass fabric reinforced honeycomb components, except radomes and floor panels, when called out in applicable repair index of specific structure.

CAUTION: ESTABLISH COMPONENT MATERIAL AND REPAIR LIMITS PRIOR TO PROCEEDING WITH ANY REPAIRS.

A. Repair of Delaminations Between Plies

- (1) Delamination of plies over core area of panel (Figure 10/GENERAL).
 - (a) Determine damage as given in Paragraph 3.A./GENERAL. Ensure that water and other contamination are removed as given in Paragraph 3.B./GENERAL.
 - (b) Cut away delaminated plies as given in Paragraph 3.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area as given in Paragraph 3.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband (Refer to Figure 23/GENERAL).

NOTE: As an option, this repair is also permanent if repaired with room temperature cure resins as given in 51-70-03, GENERAL or 51-70-06, GENERAL, Par. 4.A.(2).

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CAUTION: DELAMINATION MUST NOT REACH DEEPER THAN 0.5 IN. (12.7 MM) INTO PANEL EDGE BAND OR EXTEND TO WITHIN 0.5 IN. (12.7 MM) OF HONEYCOMB CORE. SEE FIGURE 23/GENERAL. IF SO, REPAIR PER DAMAGED PLY METHOD.

- (a) Determine extent of damage as given in Paragraph 3.A./GENERAL.
 - (b) Remove all contaminants and water from damaged area. Area must be completely dried out. (Refer to Paragraph 3.B./GENERAL).
 - (c) Force Resin Mix 2 (Figure 1/GENERAL) into delaminated area.
 - (d) Clamp plies together and remove excess resin.
 - (e) Cure at 200°F (93°C) as given in Paragraph 3.G./GENERAL, maintaining pressure until cured. Vacuum pressure is not required for this repair.
 - (f) Perform applicable post-repair requirements as given in Paragraph 3.I./GENERAL before returning the repaired component to flight service.
 - (g) Refinish surface as required.
- B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel (Refer to Figure 24/GENERAL)
- (1) Remove clear or colored Tedlar film surface using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper in the masked off area.
 - (2) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper.
 - (3) Dry out structure around puncture.
 - (4) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape as given in Paragraph 3.C./GENERAL.
 - (5) Prepare Resin Mix 3 as given in Figure 1/GENERAL.
 - (6) Work resin into the hole filling as much as possible.
 - (7) Cure as given in Paragraph 3.G./GENERAL.
 - (8) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.254 mm).
- NOTE:** A 0.010 in. (0.254 mm) thick aluminum template may be used to protect surrounding surface while sanding.
- (9) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
 - (10) Clean repair area as given in Paragraph 3.C.(2)/GENERAL.
 - (11) Prepare and apply two fabric cover plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Refer to Figure 11/GENERAL)
- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from damaged area (Refer to Paragraph 3.B./GENERAL).
 - (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 3.D./GENERAL.

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- (5) Sand core plug flush with surrounding surface leaving allowance for slight core depression into filler plies during cure.
 - (6) Prepare and apply repair plies and complete repairs as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Refer to Figure 12/GENERAL)

NOTE: For repair where access to inner surface is limited, refer to Paragraph 4.F./GENERAL.

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove all contamination and water from damaged area. Refer to Paragraph 3.B./GENERAL.
- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 3.D./GENERAL, except it is not necessary to vacuum bag the core plug installation at this time.
- (5) Prepare and apply repair plies to one surface of the panel as given in Paragraph 3.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
- (6) Bag repair and cure as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
- (7) Sand core plug approximately flush with surrounding material, making allowance for slight core crush during cure.
- (8) Prepare and apply repair plies to the other surface of the panel as given in Paragraph 3.E./GENERAL.
- (9) Bag repair and cure as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL.
- (10) Refinish the repair as given in Paragraph 3.H./GENERAL.
- (11) Perform applicable post-repair requirements as given in Paragraph 3.I./GENERAL before returning the repaired component to flight service.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

- E. Replacement of Honeycomb Core on Damaged Edge of Panel (Refer to Figure 13/GENERAL)
- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
 - (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL.
 - (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 3.D./GENERAL.
 - (5) Sand core plug approximately flush with the surrounding core material leaving allowance for slight core depression into the filler plies during cure.
 - (6) Clean surfaces as given in Paragraph 3.C.(2)(e)/GENERAL.
 - (7) Prepare and apply repair plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.

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- F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side Only (Refer to Figure 14/GENERAL)

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side. Refer to Figure 14/GENERAL when making this repair.

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL.
- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL and do the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = \{d + [N \times (1.0 \text{ in. (25.4 mm) for each ply}]\} + 1.0 \text{ in. (25.4 mm)}$

d = major diameter of oval hole in the inner skin and is limited to 1.5 in. (38 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole.
 - (c) Taper sand the outer skin plies as given in Paragraph 3.C.(2)/GENERAL.
 - (4) Fabricate an airtight patch, (Refer to Figure 14/GENERAL, Details II thru V) to cover the oval hole from the inaccessible side as follows:
 - (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
 - (b) Cover the mold with parting film or release agent.
 - (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 3.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D diameter.
 - (d) Bag and cure the patch as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL. Place thermocouples at the edge of the patch before cure.
 - (e) Remove the patch from the mold.
 - (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
 - (g) Drill a 1/8 inch (3.2 mm) diameter hole in the center of the patch for a Cleco fastener.
 - (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
 - (i) Fabricate a strip of spring steel 1.0 x 10.0 inches (2.5 x 25 cm) and drill a 1/8 inch (3.2 mm) diameter hole in the center for the Cleco fastener.

NOTE: This repair illustrates the use of a spring steel clamp. However, any suitable retaining method may be used.

- (j) Assemble the patch and spring steel together with a 1/8 inch diameter Cleco fastener (Refer to Figure 14/GENERAL).

STRUCTURAL REPAIR MANUAL

- (5) Remove Tedlar, if required and abrade the underside of the inner skin to a distance of 0.4 in. (10.2 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN TRICHLOROETHANE SOLVENT OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean repair area as given in Paragraph 3.C.(2)(e)/GENERAL.
- (7) Bend up both ends of the spring steel and apply BMS 5-109, Type II adhesive paste to the precured patch.
- (8) Holding the spring steel up - insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
- (9) Cure the adhesive as given in Figure 1/GENERAL. When cure is complete, remove the cleco fastener and spring. Fill hole for Cleco fastener with BMS 5-109, Type II adhesive paste or BMS 5-95, Class B 1/2 sealant and let it cure.

NOTE: Cure BMS 5-109 adhesive as given in Figure 1/GENERAL. Cure BMS 5-95 sealant as given in 51-20-05, GENERAL.

- (10) Clean out the repair area as given in Paragraph 3.C.(2)(e)/GENERAL.
 - (11) Lay up the required number of repair plies for the inner skin patch using the procedures of Paragraph 3.E./GENERAL, except all repair plies will have the same diameter D (Paragraph 4.F.(3)(a)/GENERAL). Use one ply for each damaged ply of the original laminate, plus two additional plies.
 - (12) Fabricate, clean, and install core plug as given in Paragraph 3.D./GENERAL.
 - (13) Prepare and apply repair plies to the outer skin surface of the panel as given in Paragraph 3.E./GENERAL.
 - (14) Complete repair as given in Paragraph 3.F./GENERAL through Paragraph 3.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Refer to Figure 15/GENERAL)
- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
 - (2) Remove all contamination and water from damaged area. Area must be completely dried out. Refer to Paragraph 3.B./GENERAL.

CAUTION: DO NOT SAND INTO BOND PLY OR CORE (FIGURE 15/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. BOND PLY IS ADJACENT TO CORE.

- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.

CAUTION: ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURES.

- (4) Prepare and apply repair plies and complete repairs as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.

H. Repair of Damage and Punctures in Solid Laminate Panels (Refer to Figure 19/GENERAL)

NOTE: This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.

STRUCTURAL REPAIR MANUAL

- (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.

- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.

NOTE: Taper sand edges of plies around repair on damaged side of panel.

- (4) Prepare and apply repair plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.

I. Repair of Punctures, 0.5 in. (12.7 mm) Diameter or Less, in Solid Laminate Panels (Refer to Figure 20/GENERAL)

NOTE: This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.

- (1) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper.
- (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL. Area must be completely dried out.
- (3) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape as given in Paragraph 3.C./GENERAL.
- (4) Clean repair area as given in Paragraph 3.C.(2)(e)/GENERAL.
- (5) Prepare Resin Mix 2, including 42 percent ± 3 percent milled glass fiber as given in Figure 1/GENERAL.
- (6) Work resin into the hole filling as much as possible.
- (7) Cure as given in Paragraph 3.G./GENERAL.
- (8) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.254 mm).

NOTE: A 0.010 in. (0.254 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (9) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
- (10) Clean repair area as given in Paragraph 3.C.(2)(e)/GENERAL.
- (11) Prepare and apply two fabric cover plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.

NOTE: Refer to specific component structure identification for laminate material and orientation as the original surface plies.

For aramid, fiberglass or hybrid laminates, use fiberglass repair plies with the same orientation as the original surface plies.

Refer to Figure 17/GENERAL for repair ply substitutions.

J. Repair of Delaminations Between Plies in Solid Laminate Panels

NOTE: This repair applies to components made from laminated fabric or tape plies and epoxy resin without a honeycomb core.

- (1) Repair delaminations using methods described in Paragraph 4.H./GENERAL.

K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels (Refer to Figure 16/GENERAL)

STRUCTURAL REPAIR MANUAL

- (1) Determine the extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage as shown in Figure 16/GENERAL and as given in Paragraph 3.C.(2)(d)/GENERAL.
- (4) Clean area as given in Paragraph 3.C.(2)(e)/GENERAL.

CAUTION: ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURES.

- (5) Prepare and apply repair plies as given in Paragraph 3.E./GENERAL and Figure 16/GENERAL.
- (6) Bag repair and cure as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL.
- (7) Refinish the repair as given in Paragraph 3.H./GENERAL.
- (8) Drill and countersink fastener holes. Refer to 51-70-16, GENERAL for drilling composite structure.
- (9) Perform applicable post-repair requirements as given in Paragraph 3.I./GENERAL before returning the repaired component to flight service.

L. Repair of Surface Dents

- (1) Check for delamination and broken fibers as given in Paragraph 3.A./GENERAL.
- (2) If delamination is found, repair as given in Paragraph 4.A./GENERAL.
- (3) If broken fibers are found, repair as given in Paragraph 4.B./GENERAL or Paragraph 4.C./GENERAL.
- (4) If no delamination or broken fibers are found, repair as given in 51-70-03, GENERAL for graphite, aramid or hybrid components or 51-70-06, GENERAL for fiberglass components.

M. Repair of Damage to Solid Honeycomb Trailing Edge Wedge and Structural Solid Laminate Trailing Edge (Refer to Figure 21/GENERAL)

NOTE: This repair applies to components made with solid honeycomb trailing edge wedge and structural solid laminate trailing edge.

This repair is made in two stages:

- (a) Lower skin and honeycomb core
- (b) Upper skin and solid laminate wedge

REPAIR STAGE I

CAUTION: SOME COMPONENTS HAVE 350°F (177°C) LAMINATED SKINS BONDED TO THE CORE WITH 250°F (121°C) CURE ADHESIVE. REPAIRS MUST BE MADE USING 200°F (93°C) CURE MATERIALS TO PREVENT SKIN-TO-CORE DISBONDING.

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove moisture and debris as given in Paragraph 3.B./GENERAL.

NOTE: Do not taper sand upper surface skin plies during Stage I of repair.

STRUCTURAL REPAIR MANUAL

- (3) Remove damage and prepare lower surface for repair as given in Paragraph 3.C./GENERAL.

NOTE: Caul plate must cover an area that extends a minimum of 2 in. (5 cm) beyond damage cutout. Caul plate must extend aft to the original trailing edge location.

- (4) Attach caul plate to upper surface.

NOTE: Honeycomb core repair wedge must extend aft beyond the original trailing edge location to maintain lower surface contour. Ribbon direction of core repair wedge must be the same ribbon direction as the original core.

- (5) Fabricate a honeycomb core repair wedge as given in Paragraph 3.D./GENERAL. Sand the repair core to a thickness that will accommodate the lower surface skin repair plies and taper the core to conform with the contour of the component.

NOTE: Repair plies must extend aft beyond the existing trailing edge location.

- (6) Prepare the lower surface skin repair plies as given in Paragraph 3.E./GENERAL.

- (7) Apply potting resin to core splice areas and fit repair core wedge in place as given in Paragraph 3.D./GENERAL.

NOTE: Seal caul plate to lower surface or wrap vacuum bag around the trailing edge and enclose both the repair area and the caul plate in order to maintain vacuum pressure during cure.

- (8) Layup the lower surface skin repair plies and vacuum bag repair as given in Paragraph 3.F./GENERAL.

- (9) Cure the repair as given in Paragraph 3.G./GENERAL.

- (10) Remove all bagging materials and caul plate.

REPAIR STAGE II

NOTE: Caul plate must cover an area extending a minimum of 1 in. (25 mm) beyond the periphery of the lower surface repair area and aft a minimum of 2 in. (5 cm) beyond the trailing edge location. Refer to Figure 21 (Sheet 3).

- (11) Attach caul plate to the lower surface.

- (12) Taper sand the upper skin plies, the repair core wedge, and the existing laminate wedge plies to accommodate the wedge repair plies and upper surface skin repair plies. Refer to Paragraph 3.D./GENERAL and Figure 21/GENERAL, Detail II.

NOTE: Wedge repair plies must be layed up so the thickness of the original wedge is obtained. Allow for accommodation of the upper skin repair plies and maintain the contour of the upper skin surface.

- (13) Prepare the laminate wedge repair plies as given in Paragraph 3.E./GENERAL.

- (14) Prepare the upper surface skin repair plies as given in Paragraph 3.E./GENERAL.

- (15) Layup the wedge repair plies and upper surface skin repair and vacuum bag the repair as given in Paragraph 3.F./GENERAL.

- (16) Cure the repair as given in Paragraph 3.G./GENERAL.

- (17) Carefully trim the trailing edge of the repair to conform to the existing trailing edge.

- (18) Restore original finish as given in Paragraph 3.H./GENERAL.

- (19) Perform post repair requirements as given in Paragraph 3.I./GENERAL.

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RESIN TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME A B
RESIN MIX 1 (POTTING RESIN) (BMS 5-28, TYPE 7)	CG-1305 RESIN CG-1305 HARDENER MICROBALLOONS	100 ±5 22 ±1 6	60 MINUTES AT 77°F (25°C)	12 HRS AT 75°F (24°C) 2 HRS AT 125°F (52°C)
	FR 7162A RESIN FR 7162B HARDENER MICROBALLOONS	100 ±5 40 ±2 7		
RESIN MIX 2 (LAMINATING RESIN) (BMS 8-301, CLASS I)	EA 9390A BASE EA 9390B HARDENER	100 ±5 56	2 HOURS AT 77°F (25°C)	SEE TEXT AND FIG. 5
BMS 8-301 CLASS 2 LAMINATING RESIN	FR 7020 PART A RESIN BASE PART B HARDENER EY3804 PART A RESIN BASE PART B HARDENER	100 ± 2 58 ± 0.5	30 MINUTES AT 75°F	180 MINUTES AT 150°F (68°C) 5 DAYS AT ROOM TEMP 68°F (20°C)
RESIN MIX 3 (POTTING RESIN)	RESIN MIX 2 CAB-O-SIL (FUMED SILICA)	100 4 ±0.5	SAME AS RESIN MIX 2	SAME AS RESIN MIX 2
RESIN MIX 4 (POTTING RESIN)	RESIN MIX 2 MILLED GLASS FIBER (1/32-INCH LONG)	80 20	SAME AS RESIN MIX 2	SAME AS RESIN MIX 2
RESIN MIX 5 (SEALER RESIN) (BMS 8-207, TYPE 1, CLASS I)	EC1838A RESIN EC1838B HARDENER	50 50	20 MINUTES AT 75° TO 79°F (24° TO 26°C)	2 HRS AT 105° (41°C) TO 125°F (52°C)
RESIN MIX 5 (SEALER RESIN) ALTERNATE (BMS 8-207, TYPE 1, CLASS II)	FR-40 RESIN FR-5413C HARDENER	100 ±1 15 ±0.5	20 MINUTES AT 75° TO 79°F (24° TO 26°C)	12 HRS MIN AT ROOM TEMP (65°F MIN) (19°C MIN) 1 HR MIN AT 150°F (66°C) TO 170°F (77°C)
BMS 8-219 (250°F PREPREG) STYLE 120	NOT APPLICABLE		C	250°F TO 270°F FOR 90 MINUTES
BMS 8-219 (250°F PREPREG) STYLE 285	NOT APPLICABLE		C	250°F TO 270°F FOR 90 MINUTES
RESIN MIX 5 (SEALER RESIN) ALTERNATE	EPIBOND 156A RESIN EPIBOND 941 HARDENER	100 ±2 10 ±0.5	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 9
RESIN MIX 5 (SEALER RESIN) ALTERNATE	EPIBOND 156A RESIN EPIBOND 156B HARDENER	100 ±2 6 ±0.3	15 TO 25 MINUTES AT 77°F (25°C)	12 HRS AT 70°F (21°C) OR 1 TO 3 HRS AT 150°F (66°C)
RESIN MIX 5 (SEALER RESIN) ALTERNATE	FR-5318S RESIN FR-5318C HARDENER	100 ±2 50 ±1	45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 9

**Resin Specifications and Mixing Procedures
Figure 1 (Sheet 1 of 2)**

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RESIN TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
RESIN MIX 5 EPOX-O WELD (SEALER RESIN) ALTERNATE	TWO COMPONENT KIT	FOLLOW MANUFACTURERS INSTRUCTIONS FURNISHED WITH EACH KIT		
			45 TO 60 MINUTES AT 70°F (21°C)	SEE FIG. 9
BMS 5-25 TYPE II, GRADE 1 ADHESIVE	EPIBOND 1539A EPIBOND 1539B	113 ±5.6 100 ±5.0	60 MINUTES AT 70°F (21°C) TO 80°F (27°C)	12 HRS MIN AT 65°F (19°C) TO 100°F (38°C). 2 HRS MIN AT 115°F (46°C) TO 135°F (57°C)
BMS 5-92 TYPE I ADHESIVE	EC2216A GRAY EC2216B WHITE	140 100	2 HRS BELOW 100°F (38°C)	24 HRS MIN AT 65°F (19°C) TO 100°F (38°C). 180 ±10 MIN- UTES AT 110°F (43°C) TO 130°F (54°C)
BMS 5-109, TYPE II (ADHESIVE PASTE)	EA 9394 PART A EA 9394 PART B OR EA 934 NA PART A EA 934 NA PART B	REFER TO MANUFACTURERS DATA	30 MINUTES	130 MINUTES ±10 MINUTES AT 150°F (66°C) ±20°F (7°C)

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

MIXING PROCEDURE	
RESIN MIX 1	1. ADD PHENOLIC MICROBALLOONS TO RESIN AND MIX THOROUGHLY. 2. ADD HARDENER AND MIX THOROUGHLY.
RESIN MIX 2 RESIN MIX 5 BMS 5-25 BMS 5-92 BMX 8-301	ADD HARDENER TO RESIN AND MIX THOROUGHLY.
RESIN MIX 3	ADD CAB-O-SIL TO RESIN MIX 2 AND MIX THOROUGHLY.
RESIN MIX 4	ADD MILLED GLASS FIBERS TO RESIN MIX TO PROVIDE A CONSISTENCY SIMILAR TO A THIN PUTTY.

NOTES

- REFER TO SRM 51-30-03 FOR SOURCES OF MATERIALS.
- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

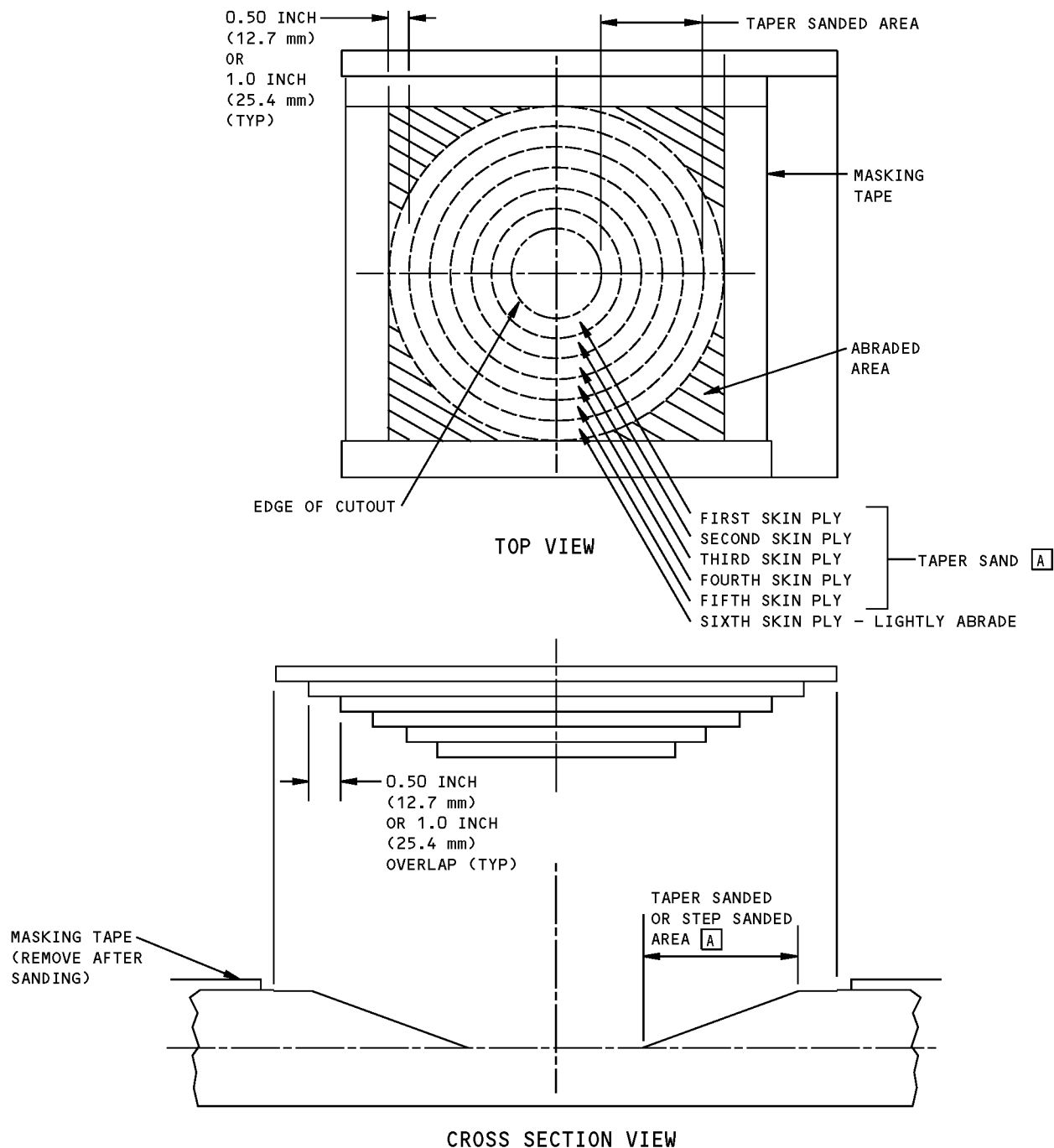
A CURE TIME IS THE MINIMUM TIME REQUIRED TO CURE PRIOR TO HANDLING OR SANDING.

B IF HEAT LAMP IS USED AS A HEAT SOURCE, SEE FIG. 9 FOR HEAT LAMP TEMPERATURE CURVE.

C OUT-TIME OF THIS MATERIAL IS 200 EXPOSURE UNITS. ONE EXPOSURE UNIT IS ACCUMULATED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 10°F (-12°C) AND 80°F (27°C). THREE EXPOSURE UNITS ARE ACCUMULATED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 81°F (27°C) AND 100°F (38°C). MATERIALS EXPOSED TO TEMPERATURES ABOVE 100°F (38°C) ARE TO BE REJECTED.

Resin Specifications and Mixing Procedures Figure 1 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

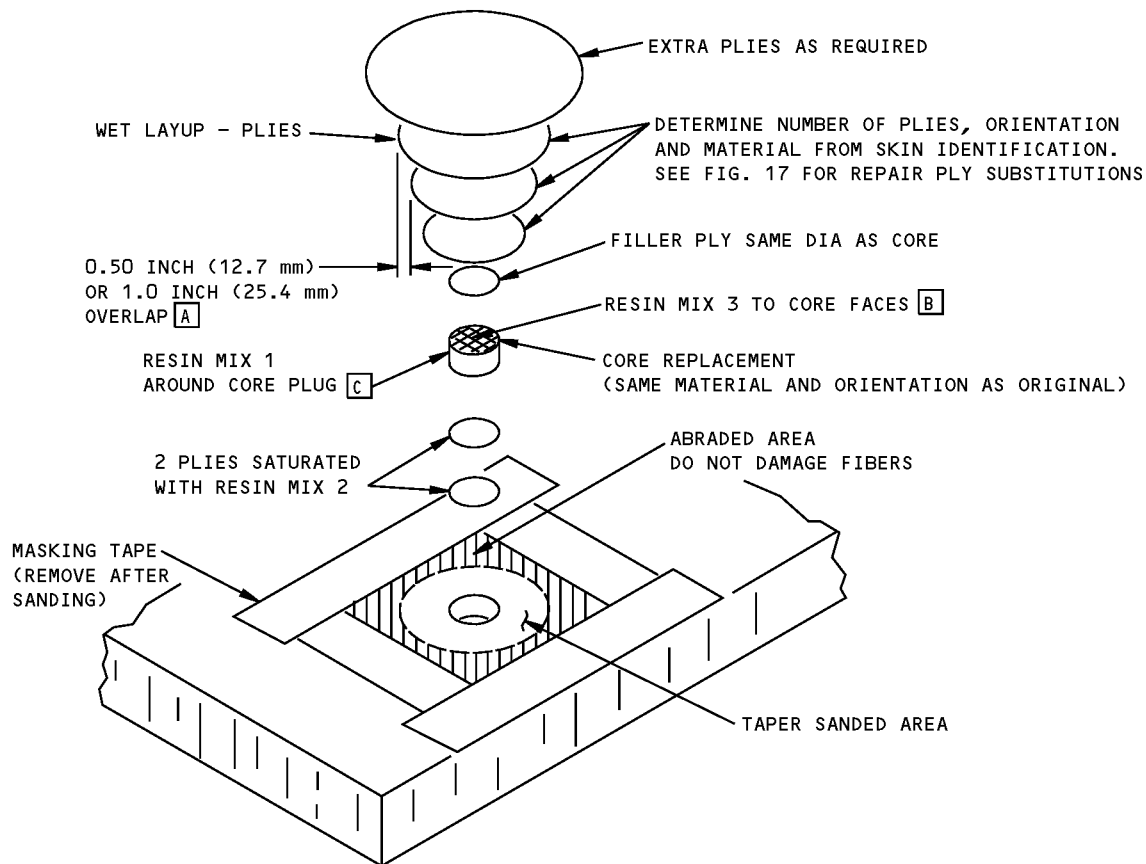


NOTES

- [A] TAPER SANDING FOR SOLID LAMINATES SHOWN. SANDING FOR HONEYCOMB AREAS SIMILAR - OPTIONAL USE STEP TAPER (TAPER SANDING NOT REQUIRED IN NONCRITICAL AERODYNAMIC AREAS OF HONEYCOMB SKIN)

**Sanding
Figure 2**

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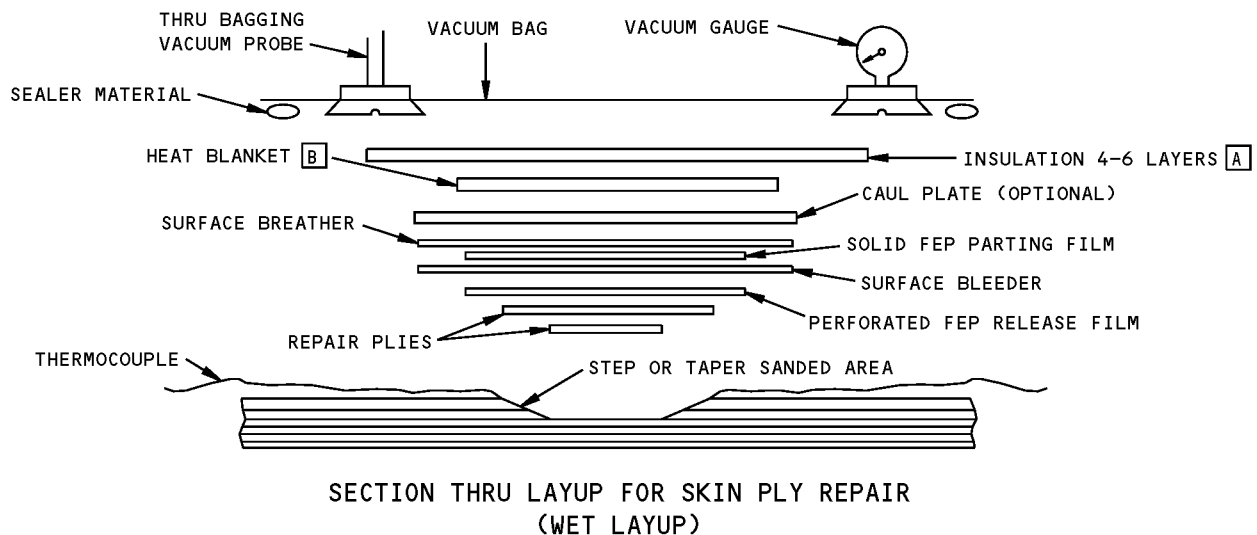
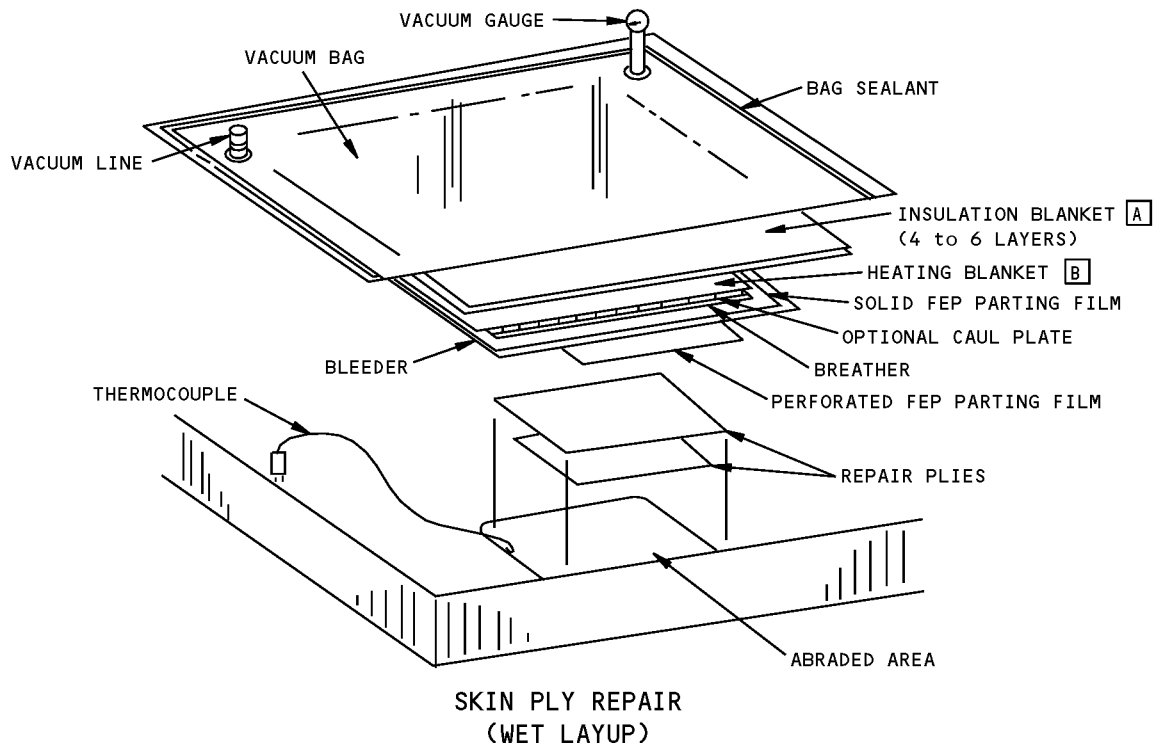


NOTES

- A** SOME 350°F (177°C) ORIGINAL CURE TEMPERATURE COMPONENTS IN HEAT-AFFECTED ZONES REQUIRE 1.00 INCH (25.4 mm) MINIMUM OVERLAP FOR EACH REPAIR PLY AND ARE IDENTIFIED IN THE COMPONENT REPAIR CHARTS. ALL OTHER COMPONENTS REQUIRE 0.50 INCH (12.7 mm) MINIMUM OVERLAP
- B** APPLY RESIN MIX 3 TO LOWER FACE JUST PRIOR TO CORE PLUG INSERTION AND TO UPPER FACE JUST PRIOR TO REPAIR PLY APPLICATION
- C** RESIN MIX 1 MAY BE APPLIED TO PERIPHERY OF EXISTING CORE INSTEAD OF ON CORE PLUG

**Typical Repair for Hole Damage thru One Skin and Core
Figure 3**

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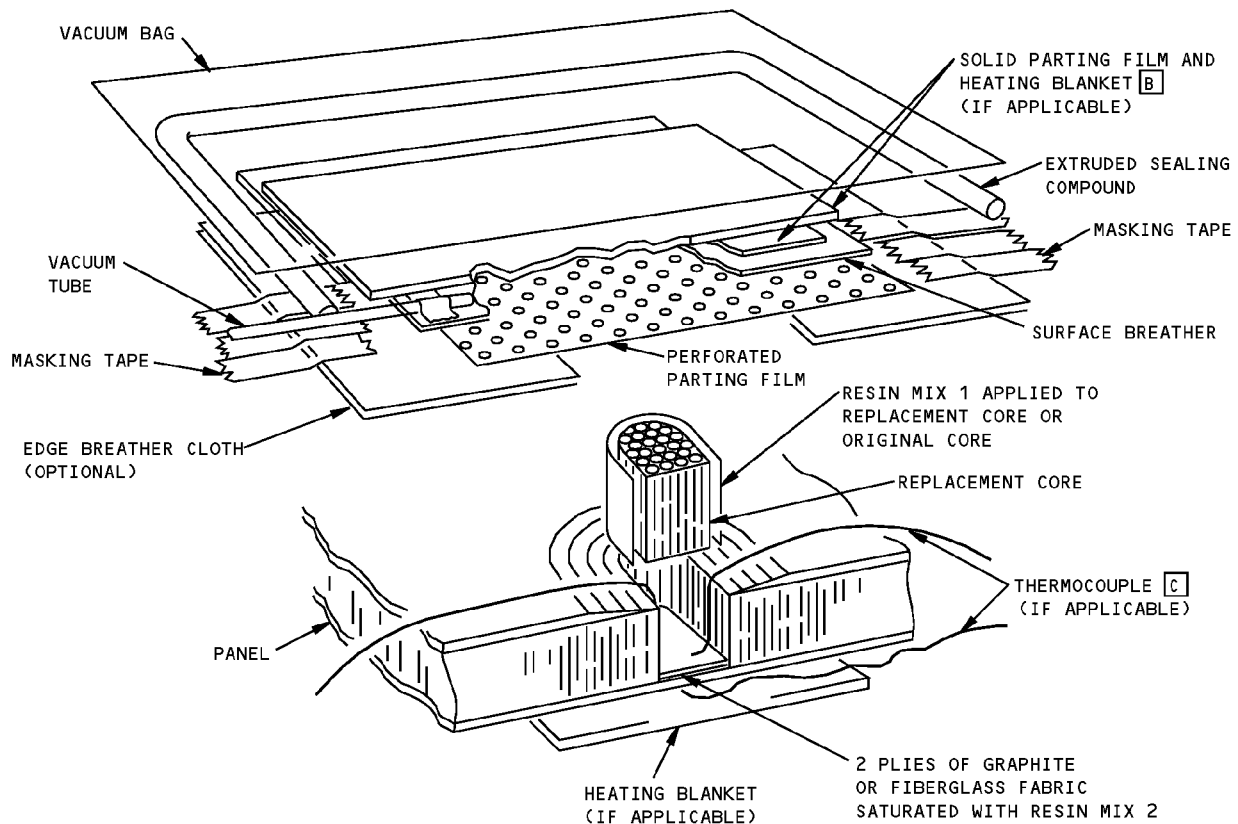
NOTES

- [A] WHEN USING A HEATING BLANKET, USE 4 TO 6 LAYERS OF BREATHER MATERIAL TO PREVENT DAMAGE TO VACUUM BAG
- [B] HEATING BLANKET MUST EXTEND A MINIMUM OF 2 INCHES (5 cm) BEYOND EDGE OF REPAIR PATCH

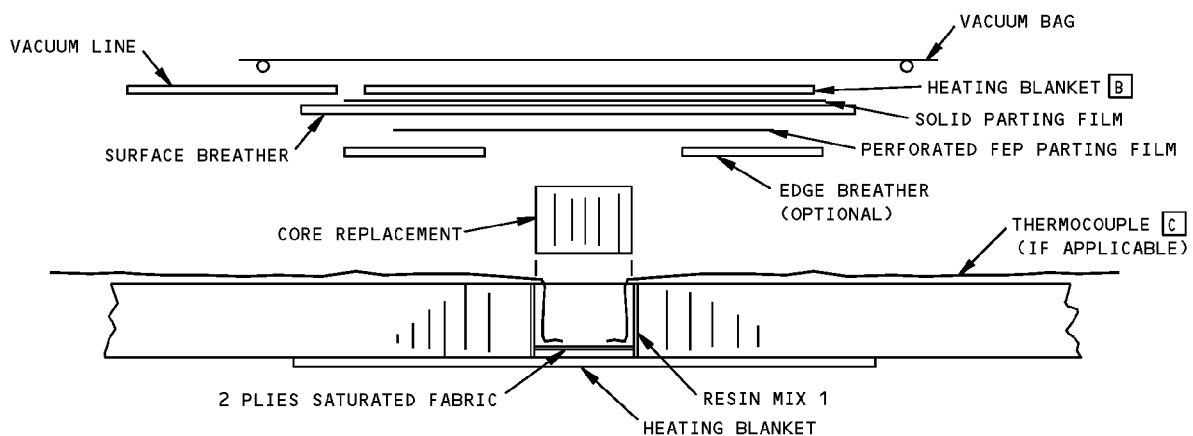
- [C] IT IS PERMISSIBLE TO LEAVE A THERMOCOUPLE BONDED TO THE INSIDE OF A HONEYCOMB CORE CELL PROVIDED IT DOES NOT INTERFERE WITH SUBSEQUENT SKIN REPAIR (REFER TO PAR. 3.D.(3)(h))

Application of Pressure During Cure - Wet Layup Figure 4 (Sheet 1 of 2)

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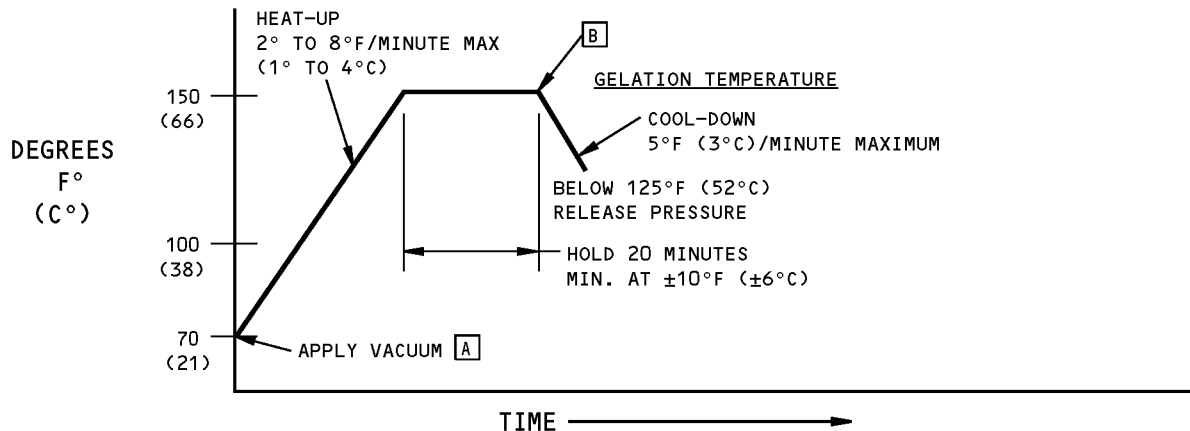
**BAGGING SEQUENCE FOR CORE REPLACEMENT
(WET LAYUP ONLY)**



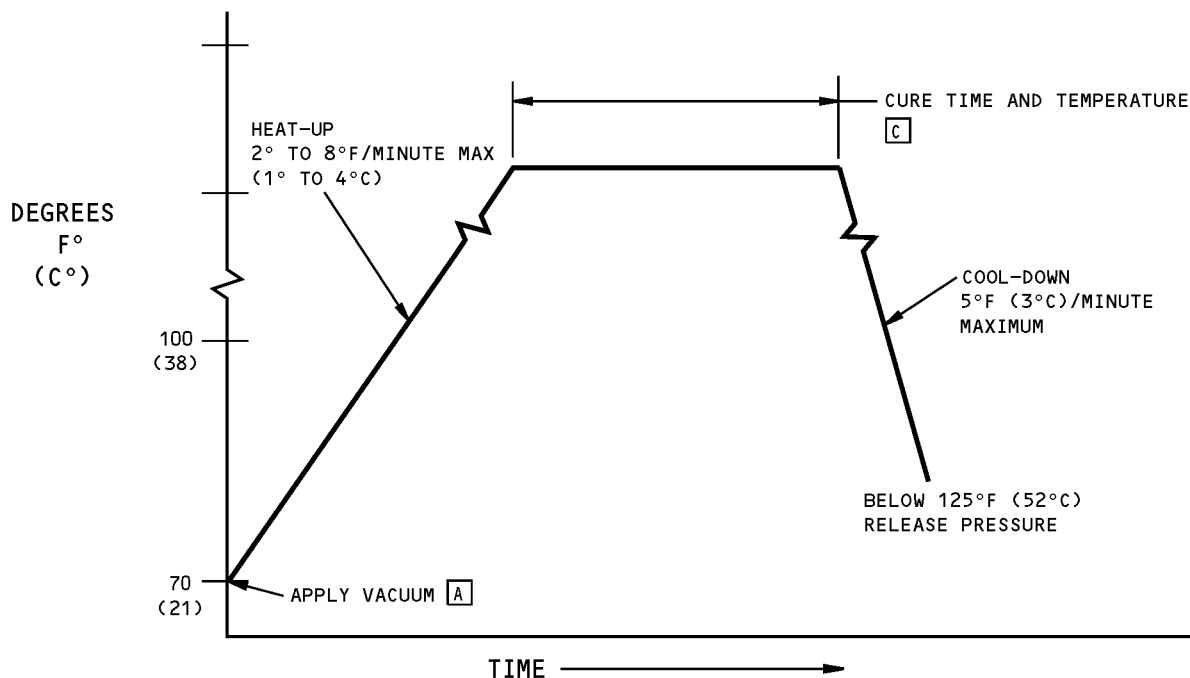
**SECTION THRU LAYUP FOR CORE REPLACEMENT
(WET LAYUP ONLY)**

**Application of Pressure During Cure - Wet Layup
Figure 4 (Sheet 2 of 2)**

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GELATION CYCLE FOR HONEYCOMB CORE REPAIR RESIN (RESIN MIX 3 AND 4)
DETAIL I



FULL CURE CYCLE FOR REPAIR PLY AND CORE RESINS (RESIN MIX 2, 3 AND 4)
DETAIL II

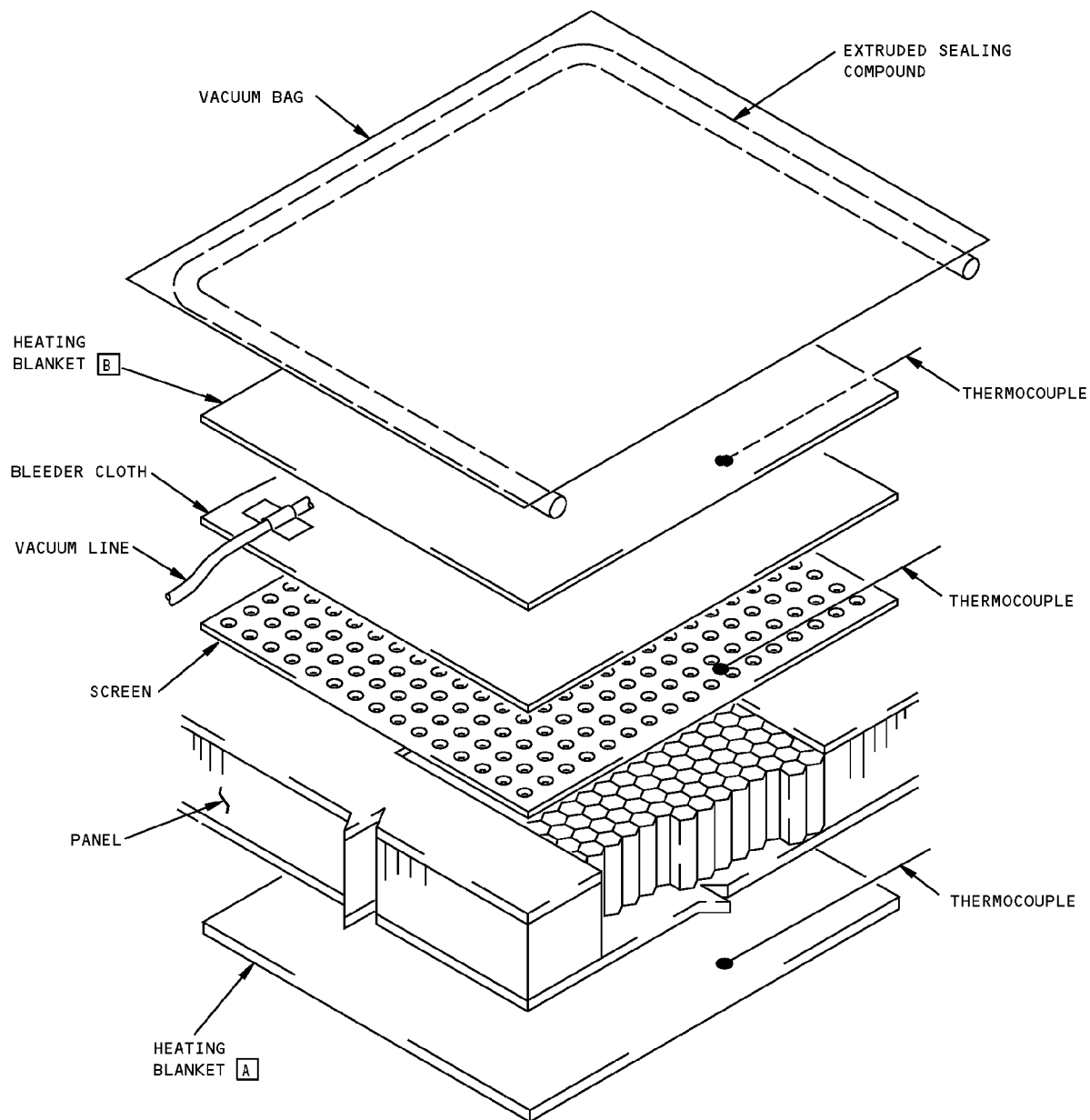
NOTES

- [A] MAINTAIN 22 INCHES OF MERCURY (75 kPa) VACUUM MINIMUM DURING ENTIRE CURE CYCLE

[B] TO GEL CORE REPAIR RESIN, TURN HEAT OFF AT THIS POINT, SAND THE CORE AND APPLY SKIN REPAIR PLIES. THE CORE REPAIR RESIN WILL REACH FULL CURE WHEN THE SKIN REPAIR PLIES ARE CURED PER DETAIL II
- [C] CURE BMS 8-301, CLASS 1, 220 MINUTES AT 200 ±10°F (93 ±6°C) OR 180 MINUTES AT 230 ±10°F (110 ±6°C)

**Cure Cycle
Figure 5**

757-200 STRUCTURAL REPAIR MANUAL



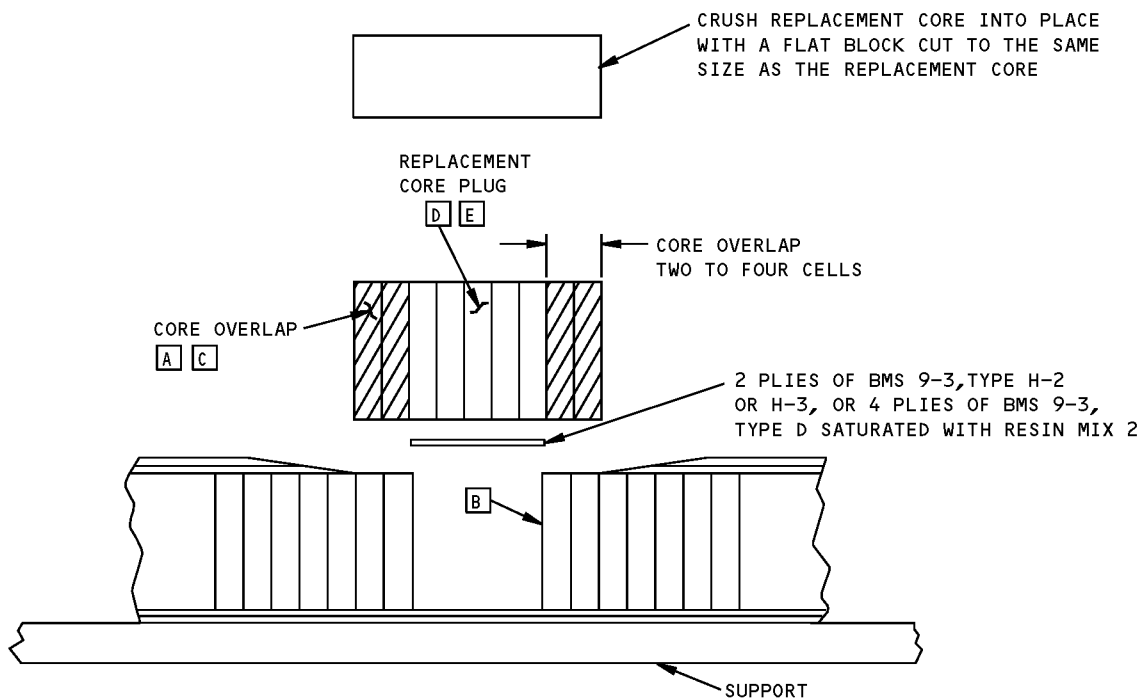
NOTES

- [A]** PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B]** ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

**Water Removal From Honeycomb Sandwich
Figure 6**

757-200

STRUCTURAL REPAIR MANUAL

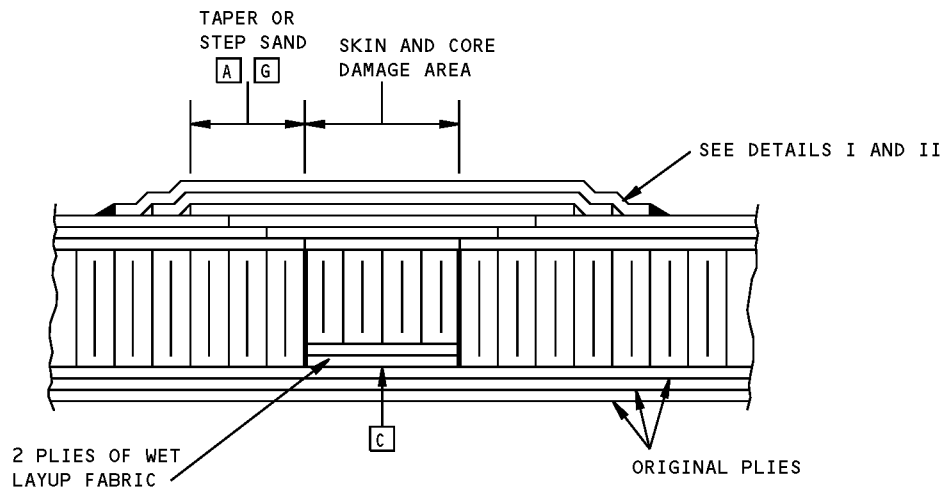


NOTES

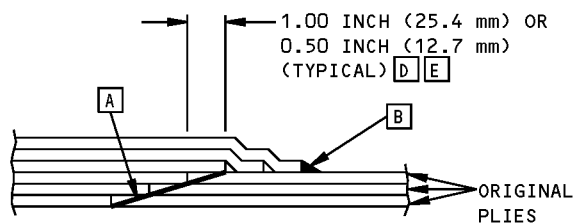
- | | |
|--|---|
| <p>A WHEN CRUSH SPLICING CORE 1.0 INCH (25.4 mm) OR THICKER, THE JOINT MAY BE CHAMFERED.</p> <p>B PRIOR TO SPLICING CORE MAY BE STABILIZED WITH SC 1008 PHENOLIC RESIN. LIMIT RESIN APPLICATION TO A MAXIMUM OF 1.0 INCH (25.4 mm) BEYOND THE EDGE CORE THAT IS TO BE SPLICED. THINNING RESIN WITH ACETONE IS PERMITTED.</p> | <p>C USE BMS 8-301 CLASS 2 OR BMS 8-124 EPOXY RESIN AFTER SPLICING TO KEEP THE SPLICE FROM SEPARATING.</p> <p>D ALIGN HONEYCOMB CELLS OF REPAIR PLUG WITH ORIGINAL CORE</p> <p>E REPLACEMENT CORE PLUG MUST BE MADE FROM CORE MATERIAL A MAXIMUM OF TWO GRADES DENSER THAN THE ORIGINAL CORE</p> |
|--|---|

Core Crush Splicing Requirements
Figure 7

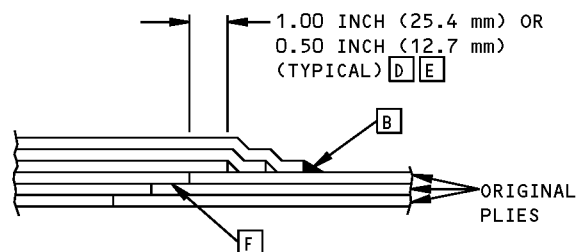
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(WET LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



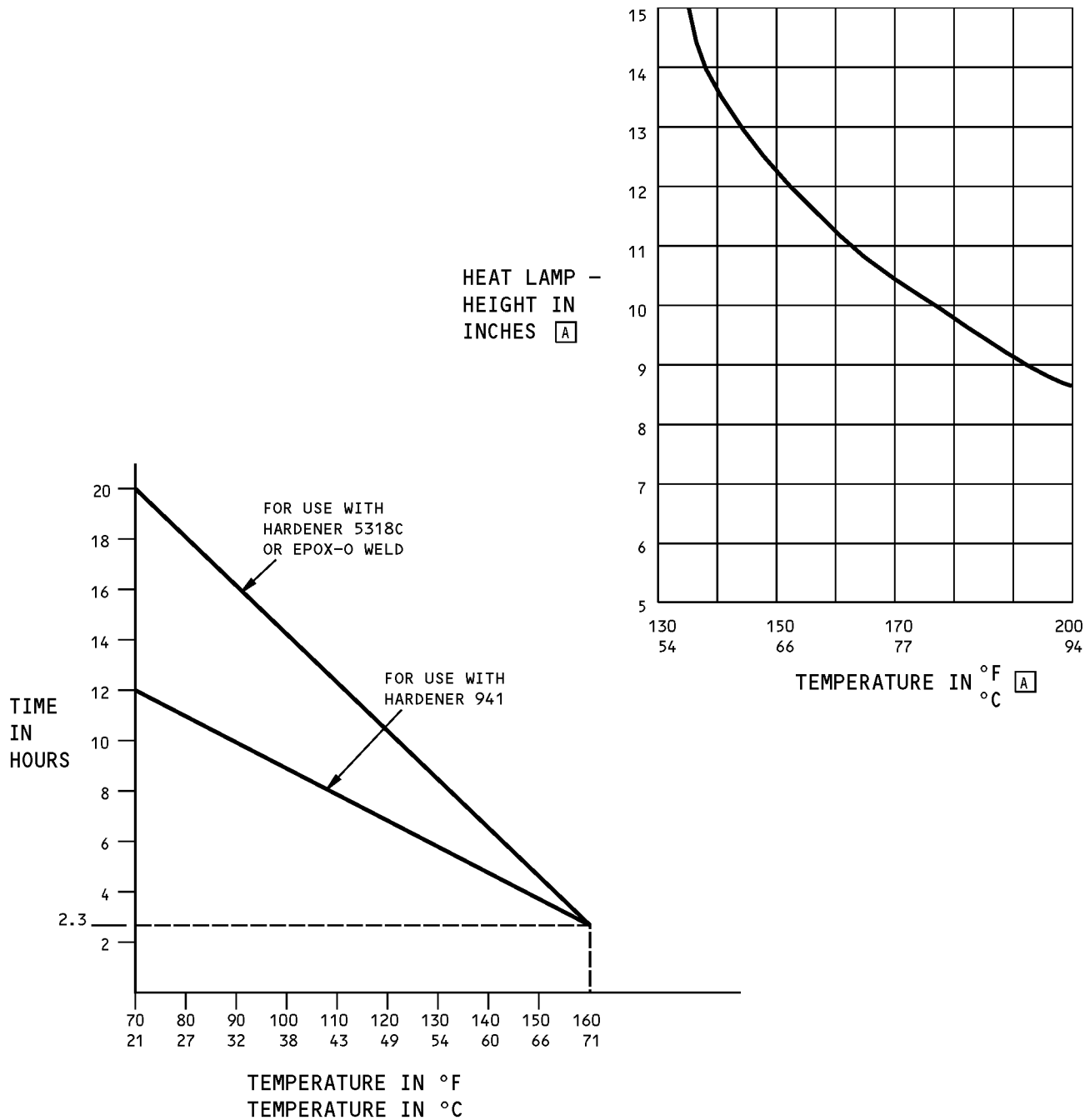
STEP SANDED SKIN
DETAIL II

NOTES

- A** TAPER SAND AROUND REPAIR AREA OVER DISTANCE OF 0.50 INCH (12.7 mm) OR 1.00 INCH (25.4 mm) FOR EACH EXISTING PLY **G**
- B** DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING
- C** SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)
- D** EACH PLY MUST OVERLAP AT LEAST 0.50 INCH (12.7 mm) OR 1.00 INCH (25.4 mm) PAST EDGE OF PRECEEDING PLY **E**
- E** THE MINIMUM OVERLAP REQUIREMENT OF 0.50 INCH (12.7 mm) IS TYPICAL FOR MOST REPAIRS. SOME HEAT-AFFECTED ZONES MADE OF 350°F (177°C) ORIGINAL CURE TEMPERATURE REQUIRE 1.00 INCH (25.4 mm) MINIMUM OVERLAP AND ARE IDENTIFIED IN COMPONENT REPAIR CHARTS
- F** REMOVE DAMAGED PLIES IN STEPS OF 0.50 INCH (12.7 mm) OR 1.00 INCH (25.4 mm) FOR EACH EXISTING PLY **E**
- G** TAPER SAND SURFACES IN AREAS OF CRITICAL AERODYNAMIC SMOOTHNESS. REFER TO SRM 51-10-01

Sanding and Overlap Requirements
Figure 8

757-200 STRUCTURAL REPAIR MANUAL



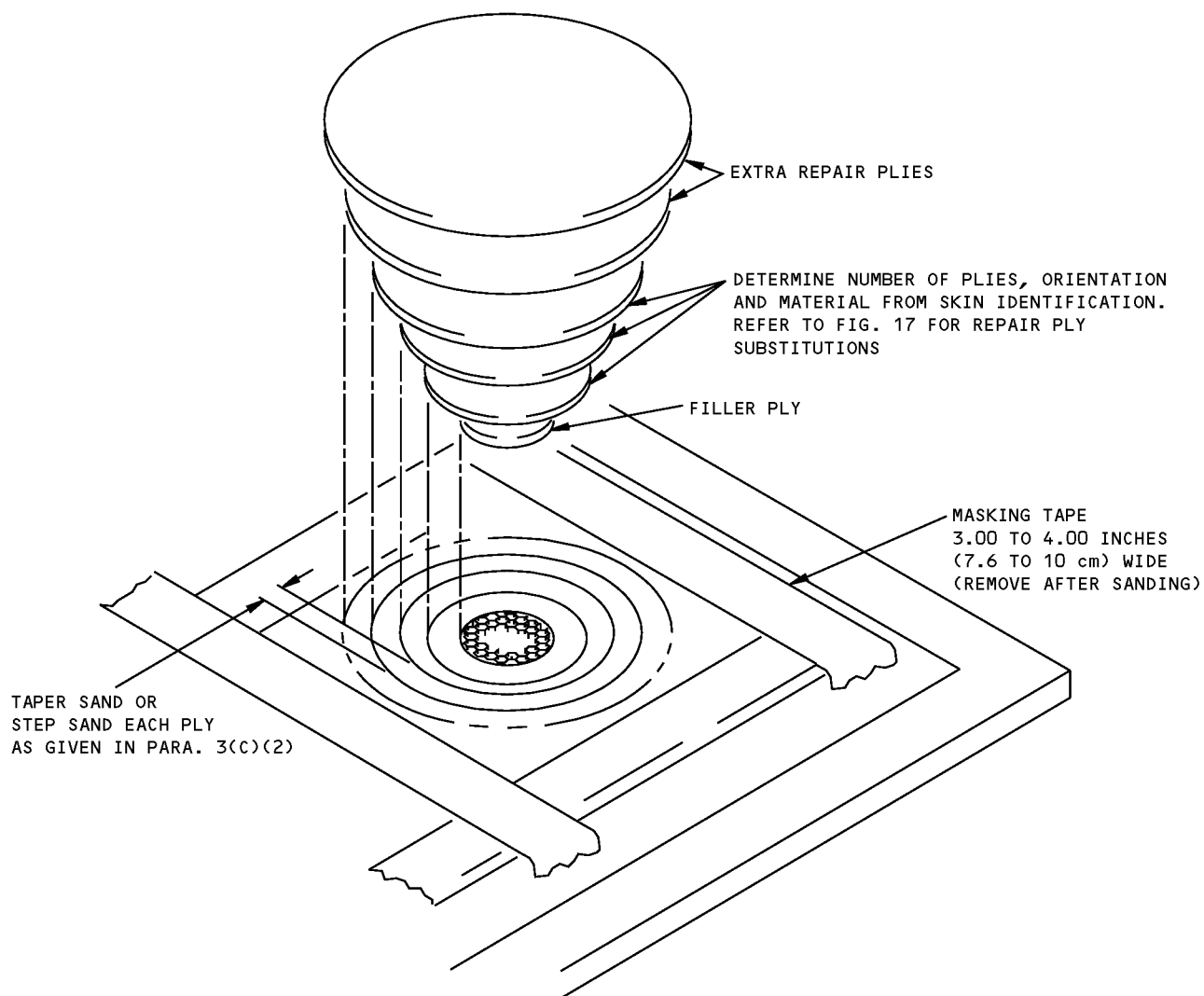
NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE

[A] THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

**Potting and Laminating Resin Cure Temperature
Figure 9**

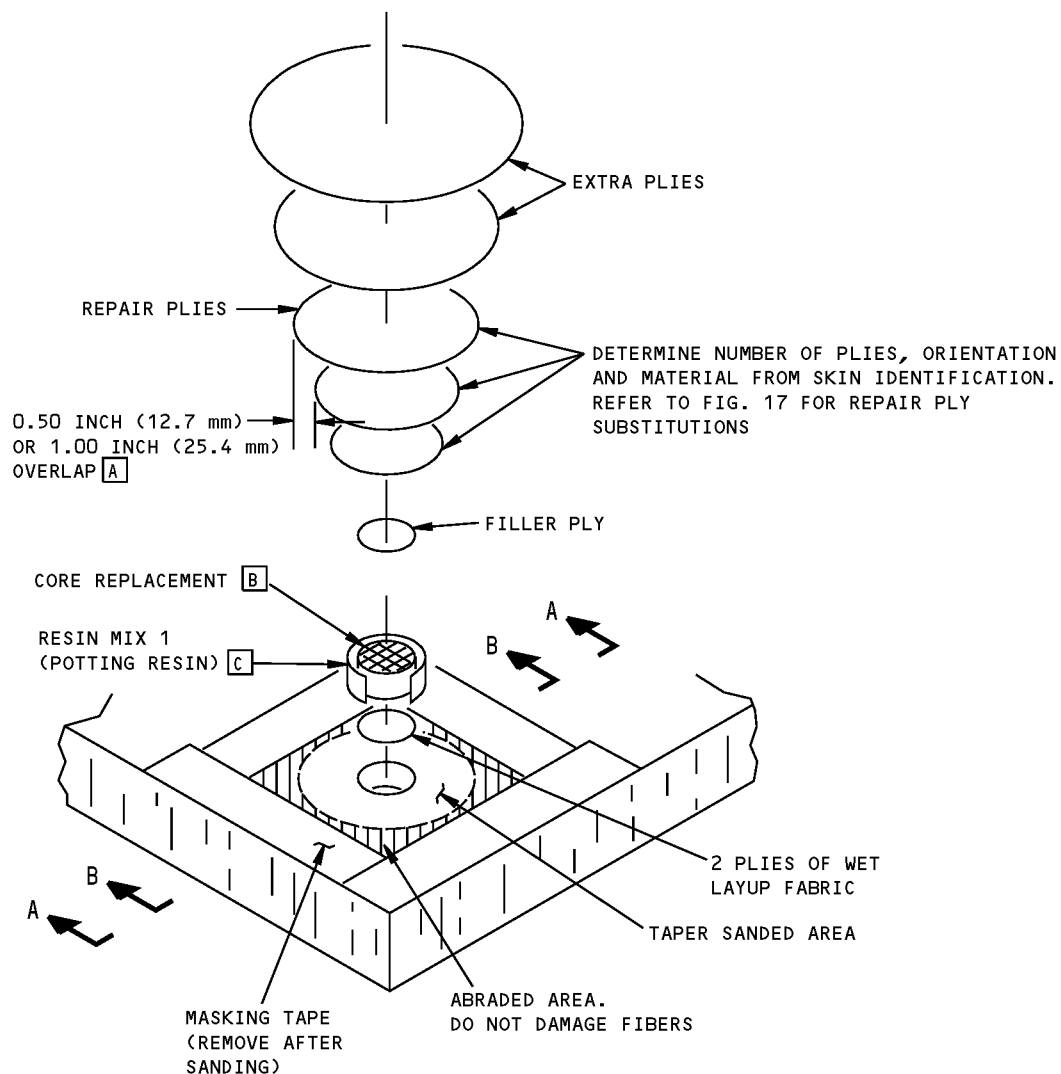
757-200
STRUCTURAL REPAIR MANUAL



REPAIR PLY WET LAYUP ONLY

Repair of Damaged External or Internal Skins of a Sandwich Panel
Figure 10

757-200 STRUCTURAL REPAIR MANUAL

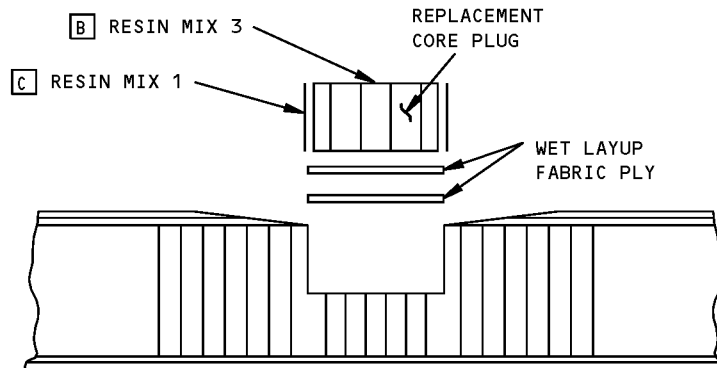


NOTES

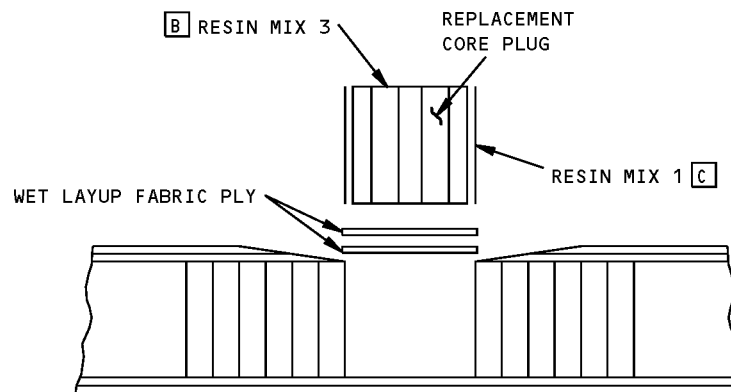
- | | |
|--|--|
| <p>A SOME 350°F (177°C) ORIGINAL CURE TEMPERATURE COMPONENTS IN HEAT-AFFECTED ZONES REQUIRE 1.00 INCH (25.4 mm) MINIMUM OVERLAP FOR EACH REPAIR PLY AND ARE IDENTIFIED IN COMPONENT REPAIR CHARTS. ALL OTHER COMPONENTS REQUIRE 0.50 INCH (12.7 mm) MINIMUM OVERLAP</p> | <p>B APPLY RESIN MIX 3 TO LOWER FACE JUST PRIOR TO CORE INSERTION AND TO UPPER FACE JUST PRIOR TO REPAIR PLY APPLICATION</p> <p>C RESIN MIX 1 MAY BE APPLIED TO PERIPHERY OF EXISTING CORE INSTEAD OF ON CORE PLUG</p> |
|--|--|

Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage
Figure 11 (Sheet 1 of 2)

757-200
STRUCTURAL REPAIR MANUAL



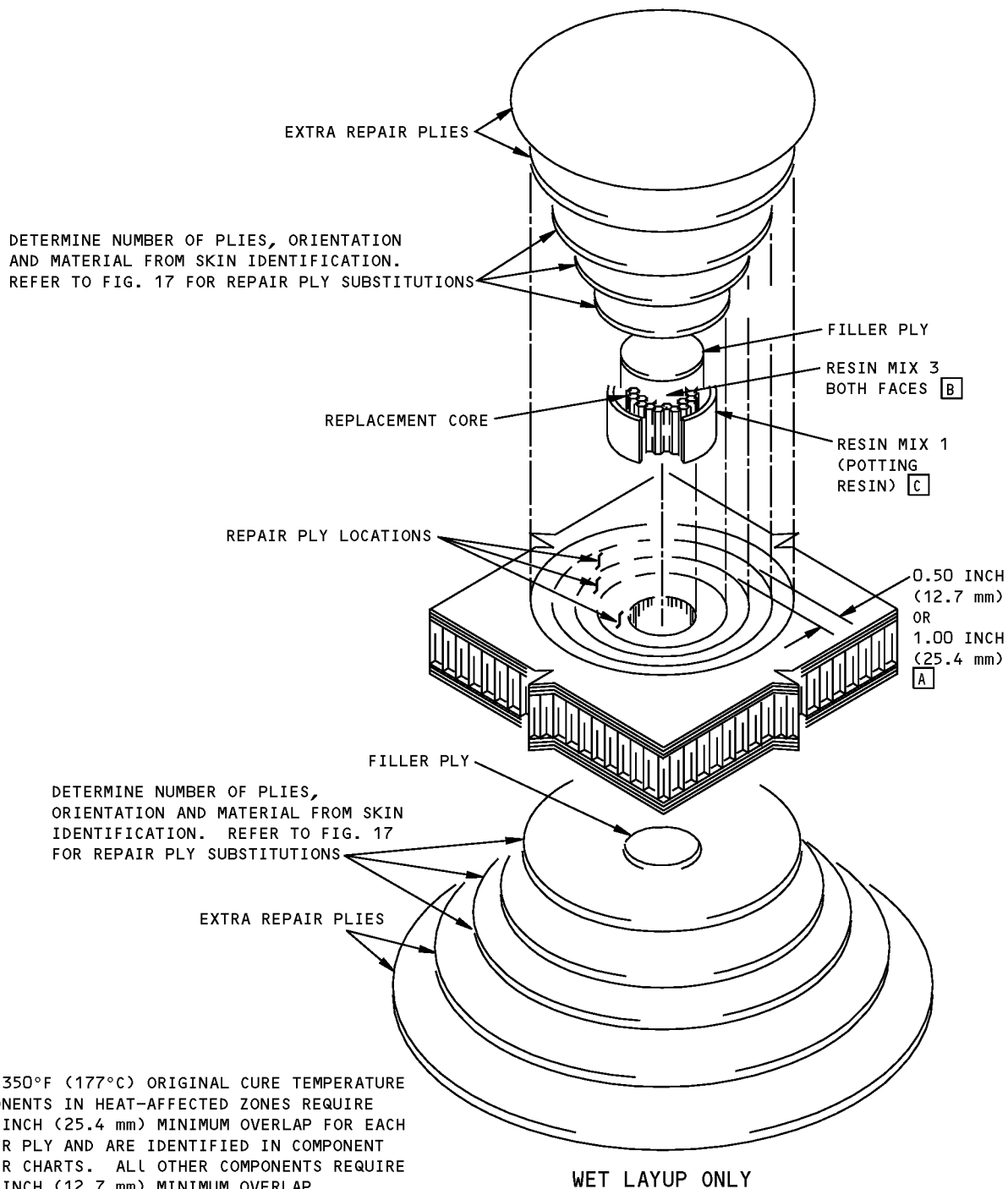
SECTION THRU REPAIR AREA -
PARTIAL DEPTH CORE REPLACEMENT
SECTION A-A



SECTION THRU REPAIR AREA -
FULL DEPTH CORE REPLACEMENT
SECTION B-B

Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage
Figure 11 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

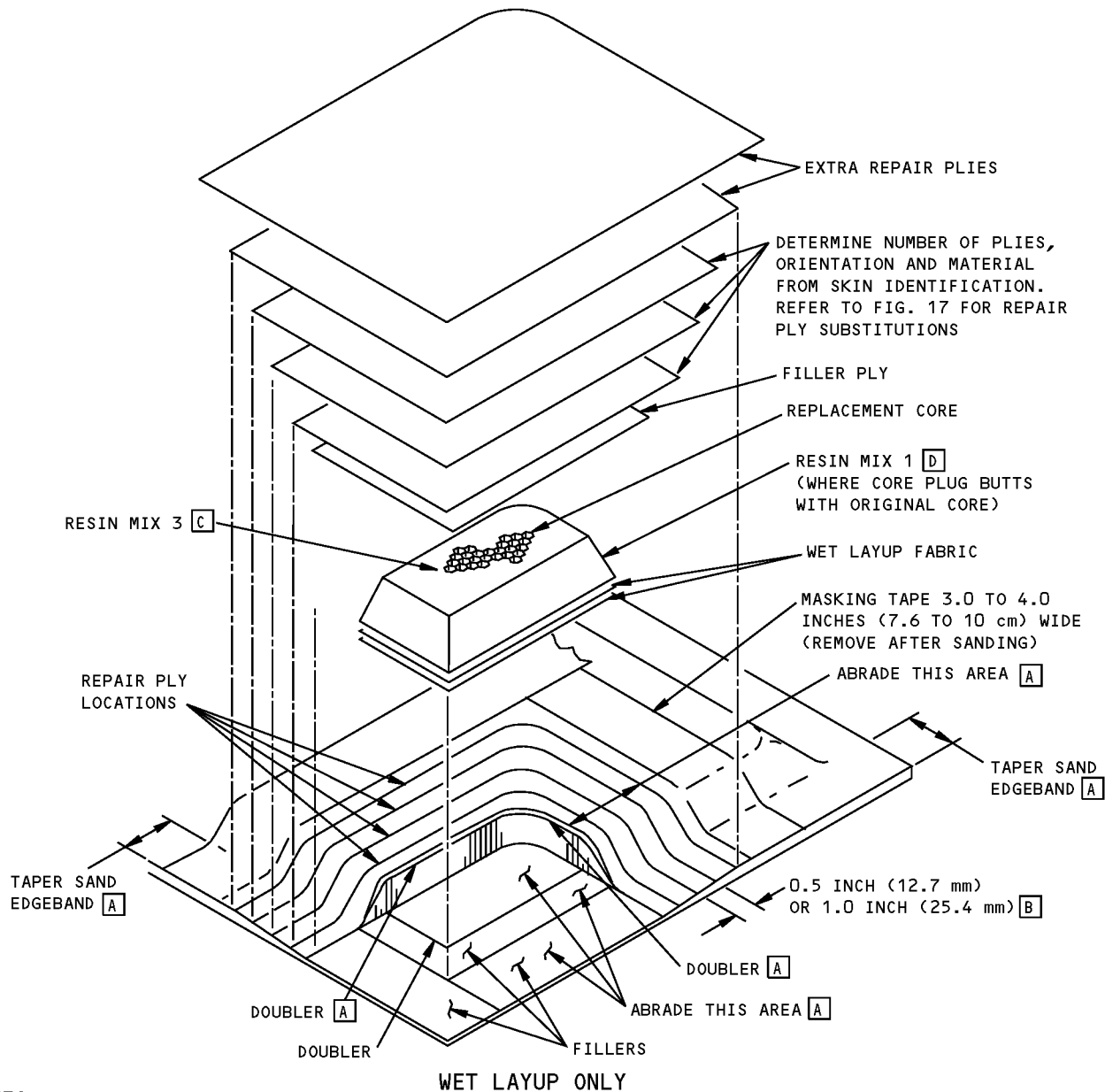


NOTES

- [A] SOME 350°F (177°C) ORIGINAL CURE TEMPERATURE COMPONENTS IN HEAT-AFFECTED ZONES REQUIRE 1.00 INCH (25.4 mm) MINIMUM OVERLAP FOR EACH REPAIR PLY AND ARE IDENTIFIED IN COMPONENT REPAIR CHARTS. ALL OTHER COMPONENTS REQUIRE 0.50 INCH (12.7 mm) MINIMUM OVERLAP
- [B] APPLY RESIN MIX 3 TO HONEYCOMB CORE FACES JUST PRIOR TO REPAIR PLY APPLICATION
- [C] RESIN MIX 1 MAY BE APPLIED TO PERIPHERY OF EXISTING CORE INSTEAD OF ON CORE PLUG

Repair of Large Punctures thru Both Skins of a Sandwich Panel Including Core Damage
Figure 12

757-200 STRUCTURAL REPAIR MANUAL

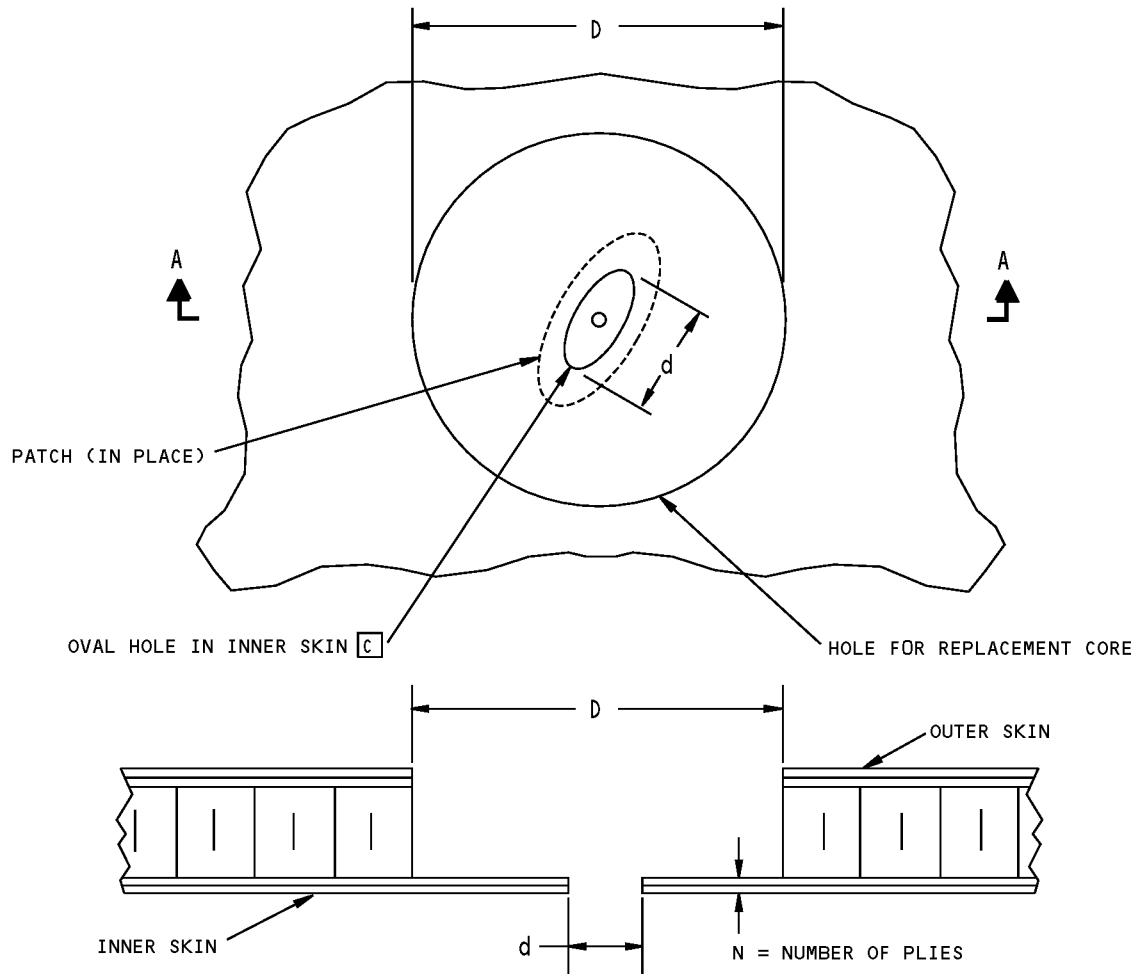


NOTES

- | | |
|---|---|
| <p>[A] TAPER SANDING IS OPTIONAL TO JUST ABRADING THE SURFACE OF THE SKIN AND DOUBLER PLIES ABOVE AND BELOW THE HONEYCOMB CORE. HOWEVER, TAPER SANDING IS REQUIRED ON THE EDGE BAND</p> <p>[B] SOME 350°F (177°C) ORIGINAL CURE TEMPERATURE COMPONENTS IN HEAT-AFFECTED ZONES REQUIRE 1.0 INCH (25.4 mm) MINIMUM OVERLAP FOR EACH REPAIR PLY AND ARE IDENTIFIED IN THE COMPONENT REPAIR CHARTS. ALL OTHER COMPONENTS REQUIRE 0.5 INCH (12.7 mm) MINIMUM OVERLAP</p> | <p>[C] APPLY RESIN MIX 3 TO LOWER FACE JUST PRIOR TO CORE PLUG INSERTION AND TO UPPER FACE JUST PRIOR TO REPAIR PLY APPLICATION</p> <p>[D] RESIN MIX 1 MAY BE APPLIED TO PERIPHERY OF EXISTING CORE INSTEAD OF ON CORE PLUG</p> |
|---|---|

**Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel
Figure 13**

757-200 STRUCTURAL REPAIR MANUAL



SECTION A-A
(PATCH NOT SHOWN)
DETAIL I

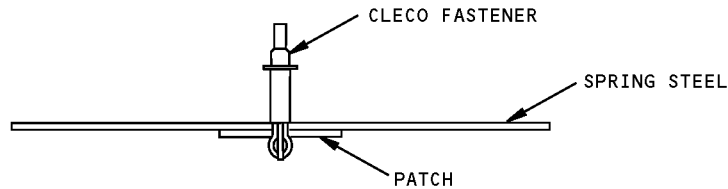
NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
- $D = d + \{N \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)}\}$
 d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN
 N = NUMBER OF PLIES
 D = DIAMETER OF HOLE FOR REPLACEMENT CORE
 FOR EXAMPLE:
 IF $d = 0.50 \text{ INCH (12.7 mm)}$ THEN,
 $D = 0.50 \text{ INCH (12.7 mm)} + \{[2 \text{ PLIES}] \times [1.0 \text{ INCH (25.4 mm) FOR EACH PLY}] + 1.0 \text{ INCH (25.4 mm)}\}$
 $= 3.50 \text{ INCH (88.9 mm) DIAMETER}$

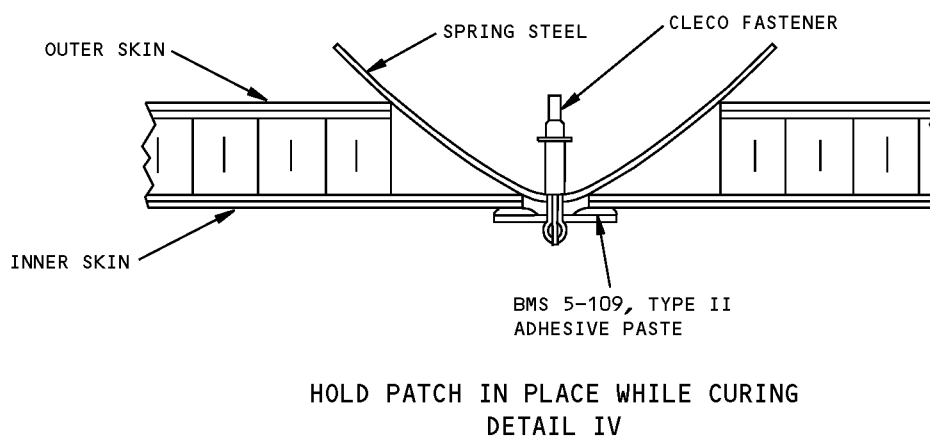
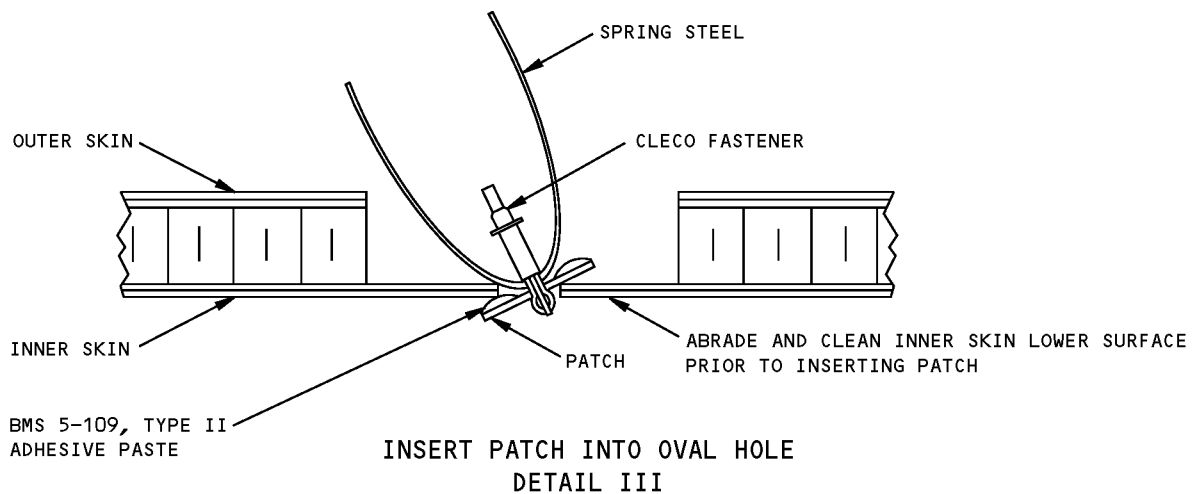
- [A] RESIN MIX 3 APPLIED TO CORE PLUG OR ORIGINAL CORE
- [B] MAKE TAPER AND OVERLAP PER FIGURE 8
- [C] MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCH (38 mm) FOR THIS REPAIR

Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 14 (Sheet 1 of 3)

757-200 STRUCTURAL REPAIR MANUAL

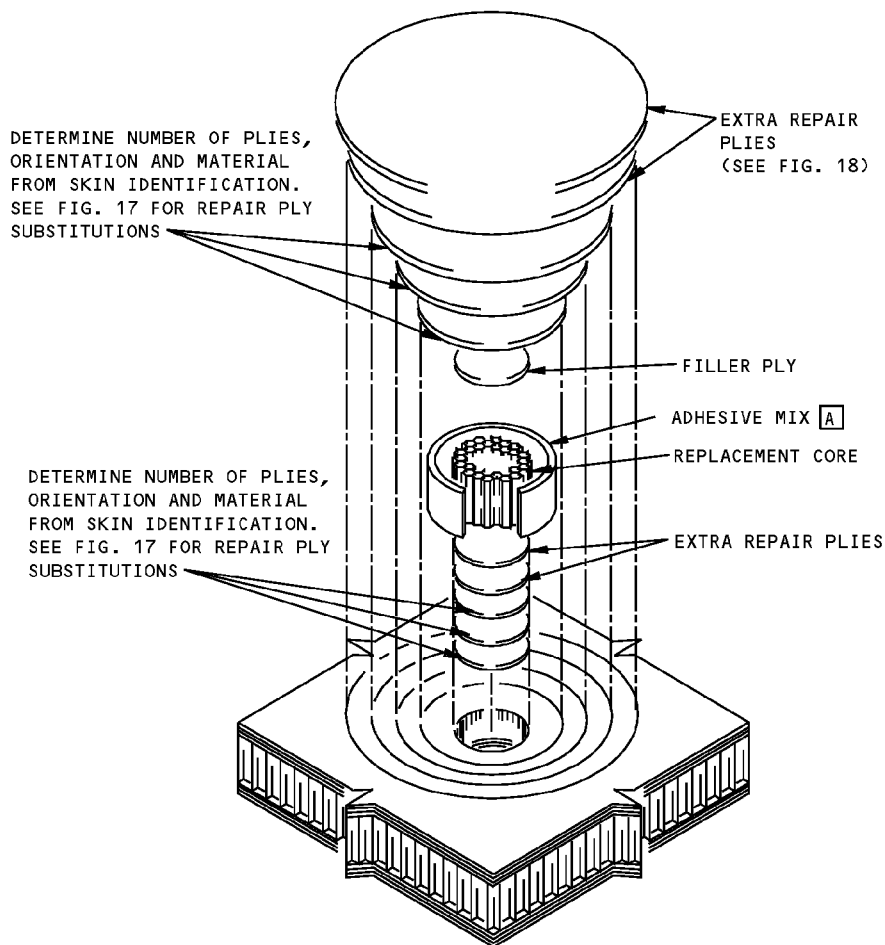


ASSEMBLE PATCH AND SPRING STEEL
DETAIL II

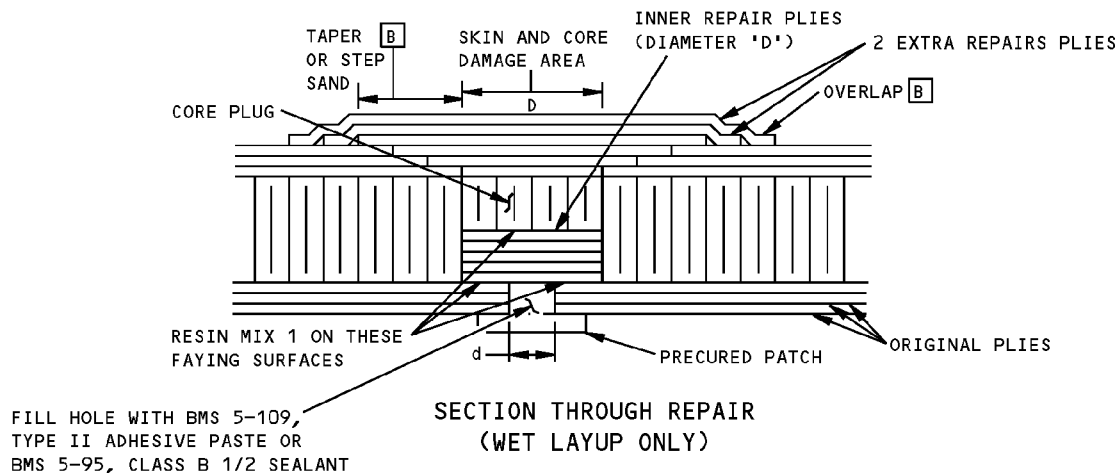


Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 14 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL

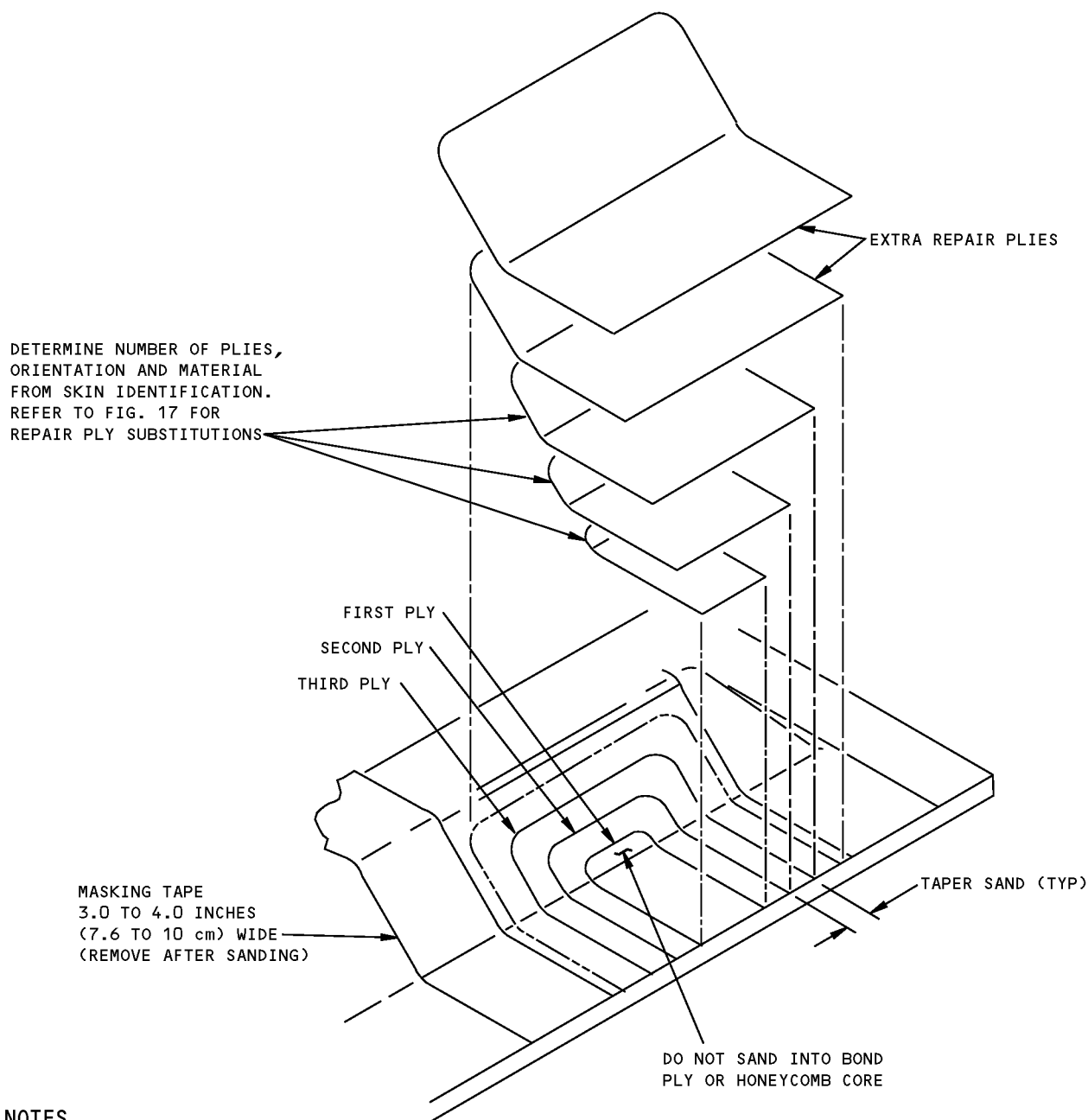


WET LAYUP ONLY



Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 14 (Sheet 3 of 3)

757-200
STRUCTURAL REPAIR MANUAL



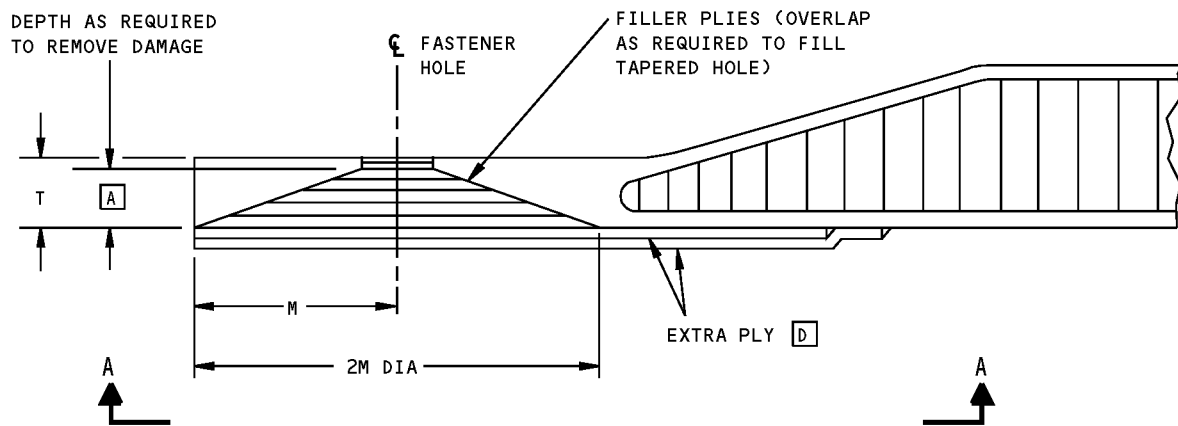
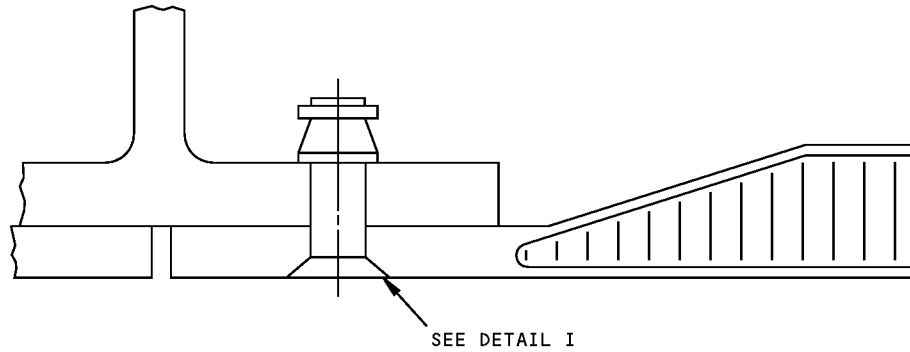
NOTES

- REFER TO PARAGRAPH 4.G. FOR THE REPAIR INSTRUCTIONS.

WET LAYUP ONLY

Repair of Damaged Skin Plies On A Panel Edge
Figure 15

757-200
STRUCTURAL REPAIR MANUAL



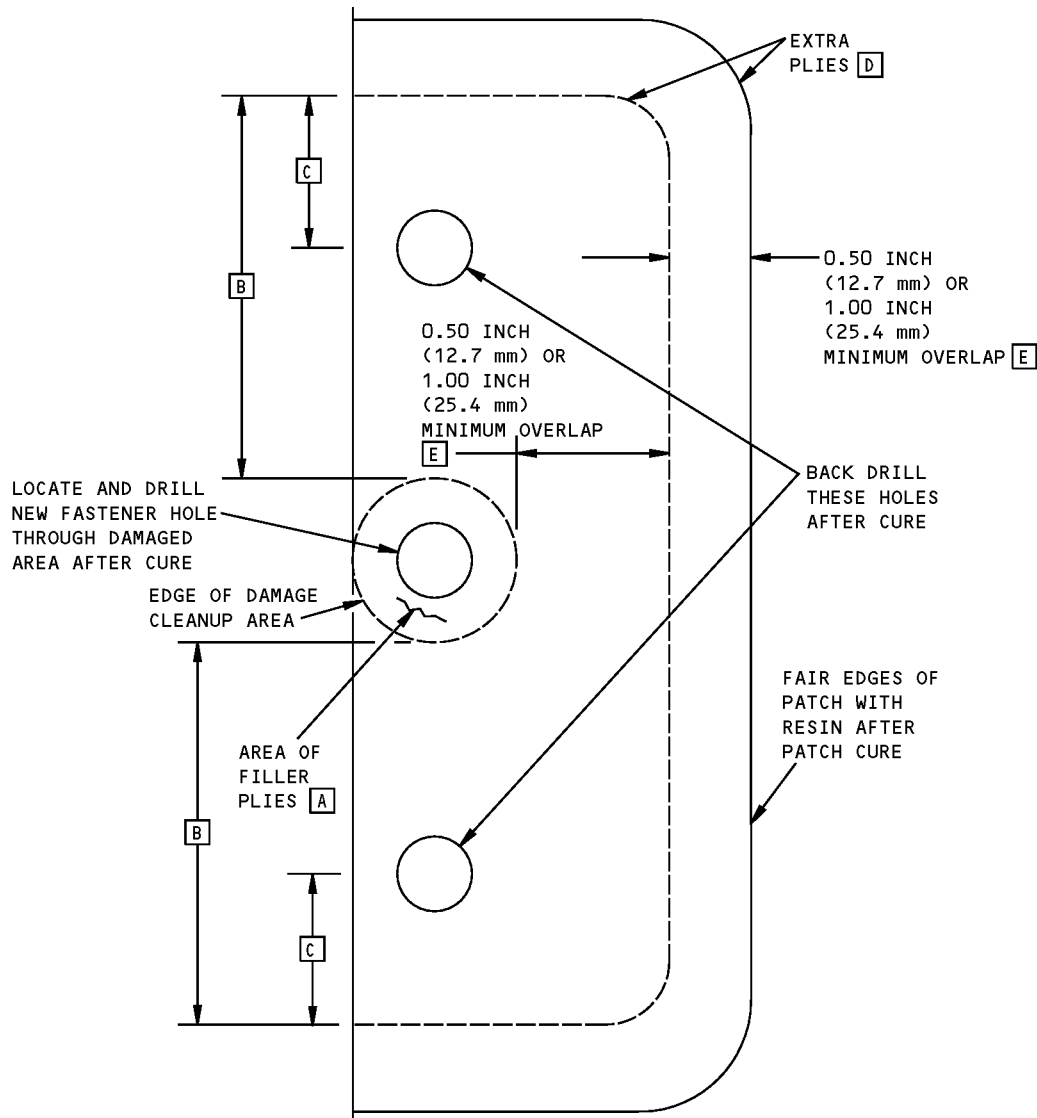
NOTES

DETAIL I

- REFER TO PARAGRAPH 4.L. FOR THE REPAIR INSTRUCTIONS.

Repair of Damaged Panel Attach Hole
Figure 16 (Sheet 1 of 2)

757-200
STRUCTURAL REPAIR MANUAL



SECTION A-A

NOTES

- D EQUALS FASTENER DIAMETER
 - M = 5T MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE
 - THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES
- A** APPLY FILLER PLYS AS REQUIRED TO FILL THE DAMAGED AREA
- B** EXTEND FIRST EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 0.50 INCH (12.7 mm) OR 1.00 INCH (25.4 mm) PAST EDGE OF DAMAGED AREA **E**

- C EXTEND FIRST EXTRA PLY FAR ENOUGH TO PROVIDE AT LEAST 2D EDGE MARGIN
- D ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER (REFER TO FIG. 15)
- E SOME 350°F (177°C) ORIGINAL CURE TEMPERATURE COMPONENTS IN HEAT-AFFECTED ZONES REQUIRE 1.00 INCH (25.4 mm) MINIMUM OVERLAP FOR EACH REPAIR PLY AND ARE IDENTIFIED IN THE COMPONENT REPAIR CHARTS. ALL OTHER COMPONENTS REQUIRE 0.50 INCH (12.7 mm) MINIMUM OVERLAP

Repair of Damaged Panel Attach Hole

Figure 16 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

ORIGINAL PLY MATERIAL		REPAIR PLY MATERIAL	REPAIR PLY SUBSTITUTE MATERIAL
GLASS FABRIC	BMS 8-79, TYPE 120	BMS 9-3, TYPE D A	BMS 9-3, TYPE H-2 OR H-3 B
	BMS 8-139, TYPE 120		
	BMS 8-79, TYPE 1581	BMS 9-3, TYPE H-2 A	BMS 9-3, TYPE D OR H-3 C D
	BMS 8-139, TYPE 181		
ARAMID FABRIC	BMS 8-218, STYLE 120	BMS 9-3, TYPE D A (GLASS FABRIC)	BMS 9-3, TYPE H-2 OR H-3 B
	BMS 8-219, STYLE 120		
	BMS 8-218, STYLE 285	BMS 9-3, TYPE H-2 OR H-3 A (GLASS FABRIC)	BMS 9-3, TYPE D C
	BMS 8-219, STYLE 285		
GRAPHITE TAPE	BMS 8-168, TYPE II, CLASS 1, ALL GRADES	BMS 9-8, TYPE I, CLASS 2, STYLE 3K-70-P E (GRAPHITE FABRIC)	NONE
	BMS 8-212, TYPE II, CLASS 1 OR 3, ALL GRADES		
GRAPHITE FABRIC	BMS 8-168, TYPE II, CLASS 2, STYLE 3K-70-PW	BMS 9-8, TYPE I, CLASS 2, STYLE 3K-70-P	NONE
	BMS 8-212, TYPE IV, CLASS 2, STYLE 3K-70-PW		
	BMS 8-256, TYPE I, CLASS 2, STYLE 3K-70-PW		
	BMS 8-258, CLASS 2, STYLE 3K-70-PW		
	BMS 8-212, TYPE III, CLASS 2, STYLE 3K-135-8H	BMS 9-8, TYPE I, CLASS 2, STYLE 3K-135-8H	NONE

NOTES

- A** BMS 9-3, CLASSES 2,5 THRU 13, AND 16 THRU 19 CAN BE USED.
- B** USE ONE PLY OF TYPE H-2 OR H-3 IN PLACE OF TWO PLIES OF TYPE D.
- C** USE THREE PLIES OF TYPE D IN PLACE OF ONE PLY OF TYPE H-2 OR H-3.
- D** USE ONE PLY OF TYPE H-3 IN PLACE OF ONE PLY OF TYPE H-2.
- E** TWO CONSECUTIVE PLIES OF GRAPHITE FABRIC ARE REQUIRED FOR EACH PLY OF GRAPHITE TAPE. ALIGN THE FABRIC WARP FIBERS IN THE SAME DIRECTION AS THE TAPE FIBERS.

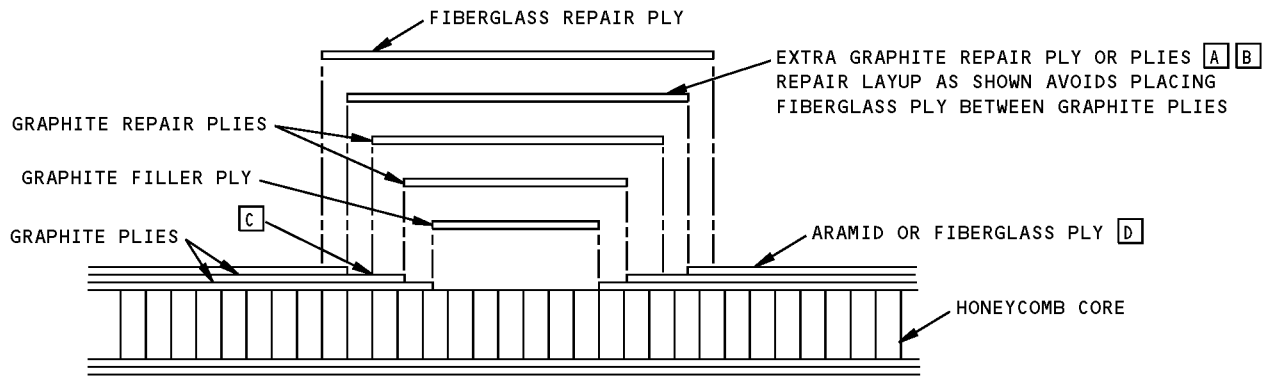
Repair Ply Substitutions
Figure 17

STRUCTURAL REPAIR MANUAL

COMPONENT MATERIAL	EXTRA PLY MATERIAL
GRAPHITE FABRIC	GRAPHITE FABRIC, STYLE 3K-70-P [B]
GRAPHITE/ARAMID/GLASS	GRAPHITE FABRIC, STYLE 3K-70-P [A] [B]
ARAMID	GLASS FABRIC, TYPE H-2 OR H-3 [B]
GLASS FABRIC	GLASS FABRIC, TYPE H-2 OR H-3 [B]

NOTES

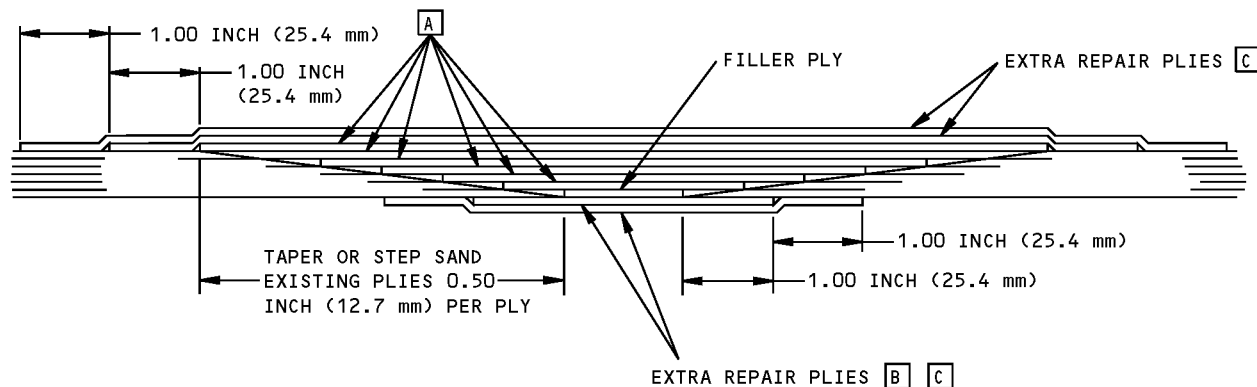
- [A] ON HYBRID PANELS, GRAPHITE EXTRA PLIES MUST BE BONDED TO GRAPHITE PLY. SEE DETAIL I.
- [B] THE ORIENTATIONS OF THE EXTRA REPAIR PLIES MUST REPEAT THE ORIENTATIONS OF THE EXISTING PLIES IN THE ORIGINAL LAMINATE STARTING WITH THE OUTERMOST PLY
- [C] WHEN EXTRA GRAPHITE REPAIR PLY OR PLIES ARE REQUIRED, THE EXISTING OUTER PLY OF ARAMID, ALUMINIZED GLASS FABRIC OR FIBERGLASS MUST BE SANDED TO ALLOW AN OVERLAP OF 1.00 INCH (25.4 mm) FOR EACH EXTRA REPAIR PLY
- [D] IF OUTER PLY CONSISTS OF AN ALUMINIZED GLASS FABRIC PLY OR OTHER CONDUCTIVE COATING, REFER TO SRM 51-70-04, SRM 51-70-05 OR SRM 51-70-14 AS APPLICABLE FOR REPAIR OF THE CONDUCTIVE COATING



SECTION THRU HYBRID HONEYCOMB SANDWICH
DETAIL I

Extra Repair Ply Materials
Figure 18

757-200 STRUCTURAL REPAIR MANUAL

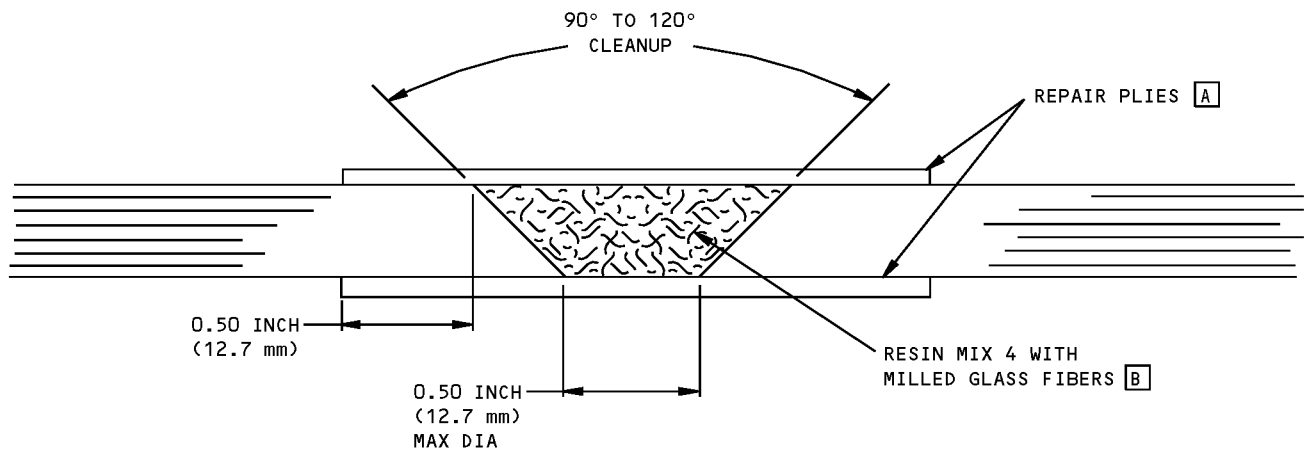


NOTES

- [A] DETERMINE NUMBER OF PLIES, ORIENTATION, AND MATERIAL FROM SPECIFIC COMPONENT STRUCTURE IDENTIFICATION
- [B] EXTRA REPAIR PLIES AT THIS LOCATION ARE REQUIRED ONLY IF THE DAMAGE PENETRATES THIS SURFACE
- [C] THE ORIENTATION OF THE EXTRA REPAIR PLY IS TO BE THE SAME AS THE OUTER PLY OF THE ORIGINAL LAMINATE

Solid Laminate Repair - 200 Degrees F (94 Degrees C) to 350 Degrees F (177 Degrees C)
Figure 19

757-200
STRUCTURAL REPAIR MANUAL



NOTES

- [A]** REPAIR PLIES ARE TO HAVE THE SAME ORIENTATION AS THE ORIGINAL SURFACE PLIES
- [B]** USE 1 PART BY WEIGHT OF LAMINATING RESIN TO 1 PART BY WEIGHT OF MILLED GLASS FIBERS

Repair of Punctures, 0.50 Inch Diameter or Less, in Solid Laminate Panels
Figure 20



757-200 STRUCTURAL REPAIR MANUAL

NOTES

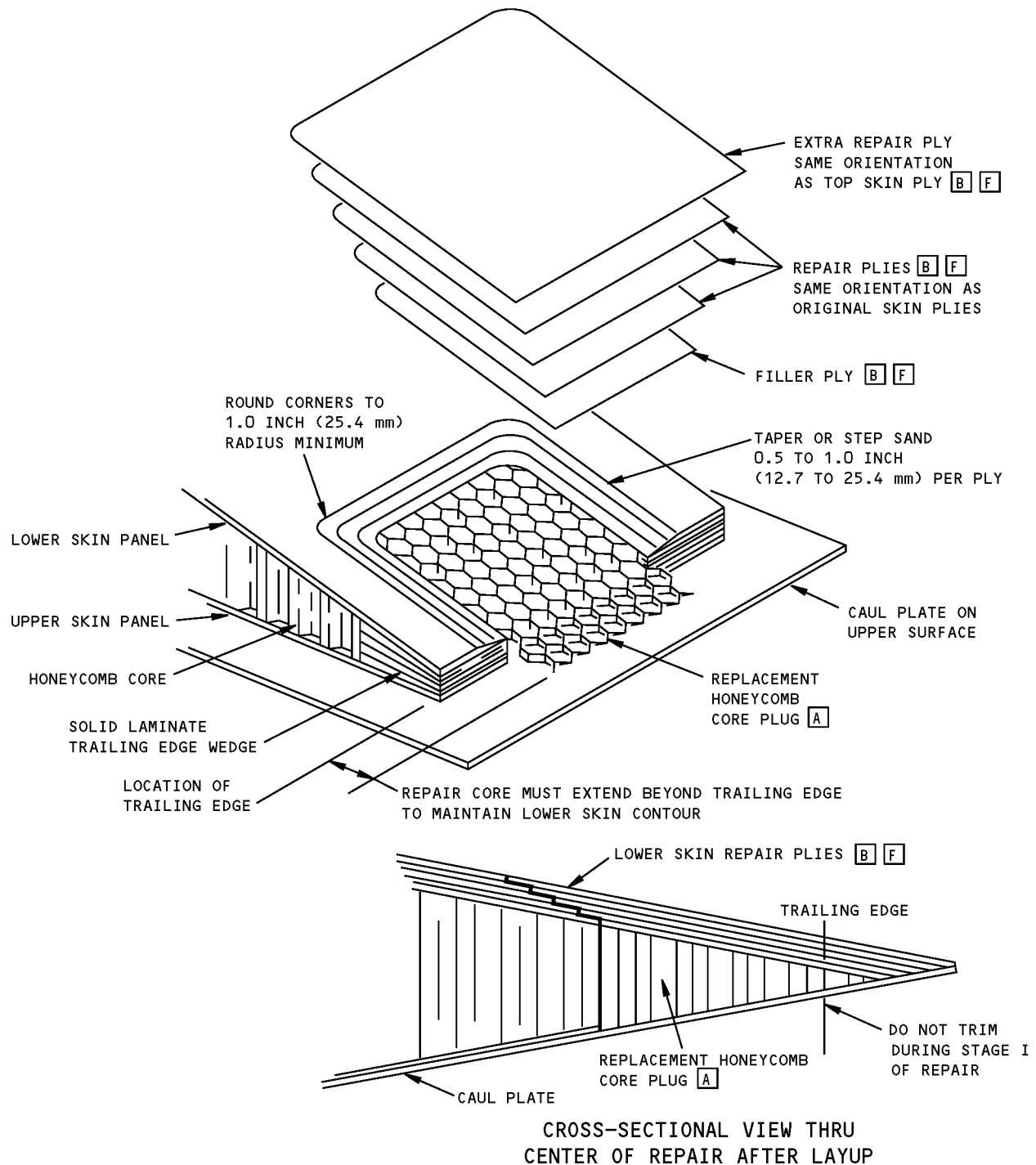
- READ ALL REPAIR INSTRUCTIONS IN PAR. 4.N. BEFORE MAKING THIS REPAIR
- THIS REPAIR IS MADE IN TWO STAGES:
 - (A) LOWER SKIN AND HONEYCOMB CORE
 - (B) UPPER SKIN AND SOLID LAMINATE WEDGE
- DO NOT TRIM TRAILING EDGE UNTIL AFTER STAGE II OF REPAIR

- A** TRAILING EDGE OF CORE WEDGE MUST EXTEND BEYOND THE EXISTING TRAILING EDGE. WEDGE MUST BE TAPERED TO CONFORM TO THE CONTOUR OF THE LOWER SKIN SURFACE. REPAIR CORE RIBBON DIRECTION MUST MATCH ORIGINAL CORE RIBBON DIRECTION
- B** REPAIR PLIES MUST EXTEND BEYOND THE EXISTING TRAILING EDGE LOCATION
- C** TAPER SAND REPAIR CORE WEDGE TO ACCOMMODATE THE WEDGE REPAIR PLIES. DO NOT SAND INTO LOWER SKIN PLIES
- D** WEDGE REPAIR PLIES MUST BE LAYERED SO THAT THE THICKNESS OF ORIGINAL WEDGE IS OBTAINED. ALLOW FOR ACCOMMODATION OF UPPER SKIN REPAIR PLIES AND MAINTAIN CONTOUR OF UPPER SKIN SURFACE

- E** LAY UP WEDGE REPAIRS AS FOLLOWS:
45° FOR THE PLY NEXT TO THE CORE. 0°,0°,45°,0°,0°,45° FOR ALL OTHER PLIES. REPEAT THIS SEQUENCE AS REQUIRED
- F** LAY UP REPAIR PLIES WITH SAME ORIENTATION AS ORIGINAL SKIN PLIES. LAY UP EXTRA PLIES WITH SAME ORIENTATION AS ORIGINAL SKIN OUTER PLY

Repair of Damage to Honeycomb Trailing Edge Wedge and Structural Solid Laminate Trailing Edge
Figure 21 (Sheet 1 of 3)

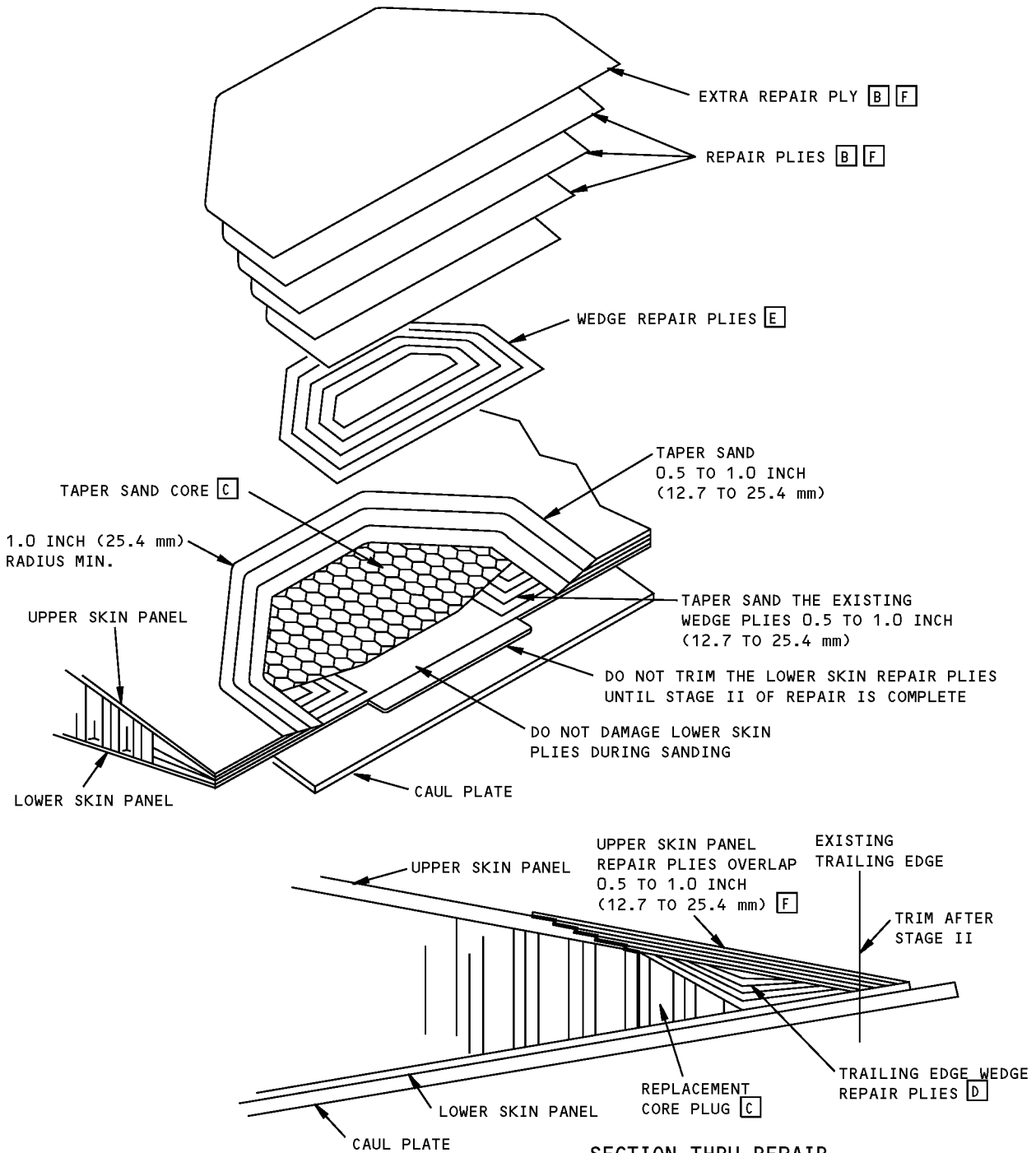
757-200 STRUCTURAL REPAIR MANUAL



REPAIR STAGE I
REPAIR TO LOWER SKIN PLIES AND TRAILING EDGE WEDGE
DETAIL I

Repair of Damage to Honeycomb Trailing Edge Wedge and Structural Solid Laminate Trailing Edge
Figure 21 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL

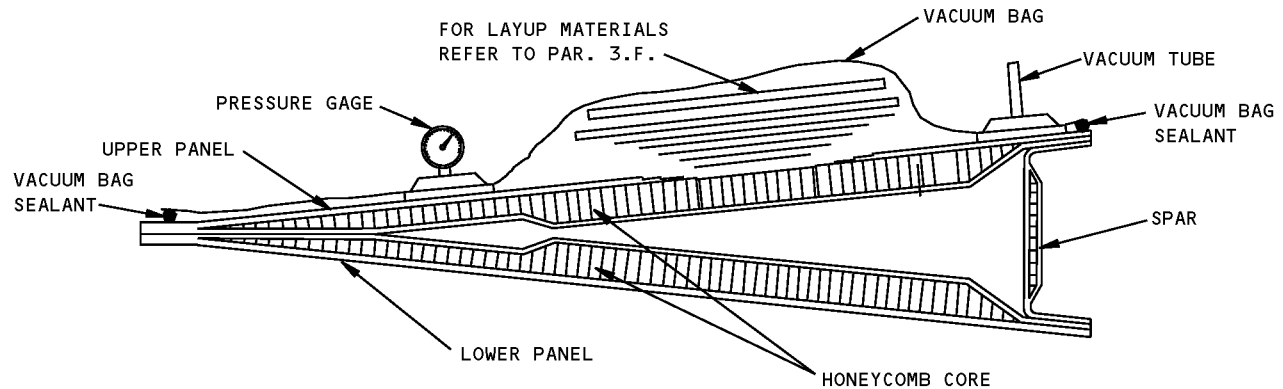


SECTION THRU REPAIR

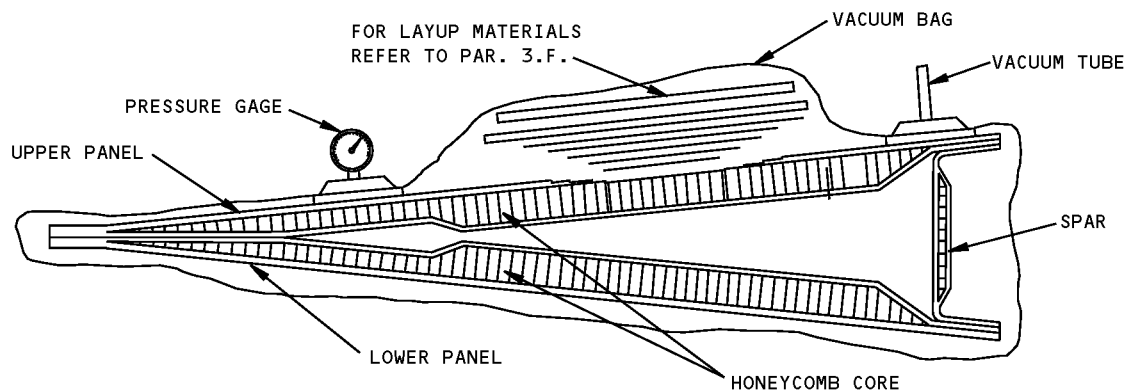
REPAIR STAGE II REPAIR TO UPPER SKIN PLIES AND TRAILING EDGE WEDGE DETAIL II

**Repair of Damage to Honeycomb Trailing Edge Wedge and Structural Solid Laminate Trailing Edge
Figure 21 (Sheet 3 of 3)**

757-200 STRUCTURAL REPAIR MANUAL



ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



NOT ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF UPPER AND LOWER PANELS A

NOTES

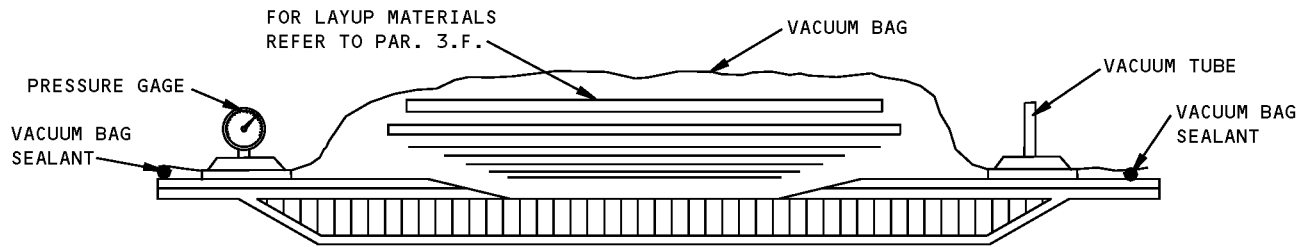
- REFER TO PAR. 3.F. FOR LAYUP AND BAGGING PROCEDURES

A THIS TYPE OF COMPONENT MUST NOT BE COMPLETELY SEALED IN A VACUUM BAG. DAMAGE TO PART WILL OCCUR. VACUUM BAG ONE SIDE OF COMPONENT ONLY

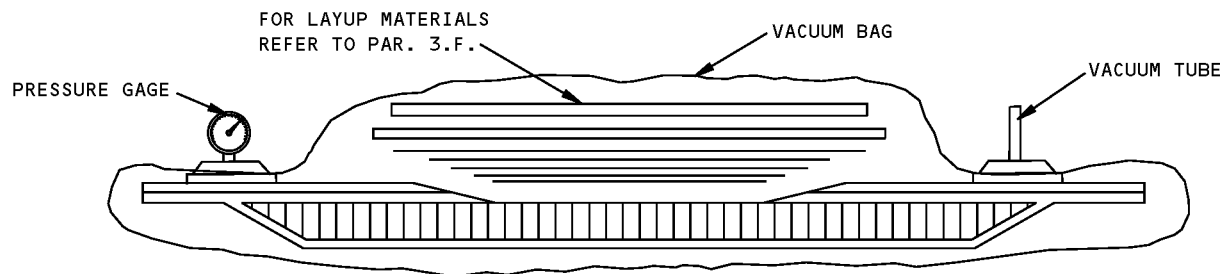
B THIS TYPE OF COMPONENT MAY BE COMPLETELY SEALED IN A VACUUM BAG OR MAY BE SEALED ON ONE SIDE ONLY

Vacuum Bagging Restrictions
Figure 22 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**



ACCEPTABLE - VACUUM BAG SEALED TO ONE SIDE ONLY

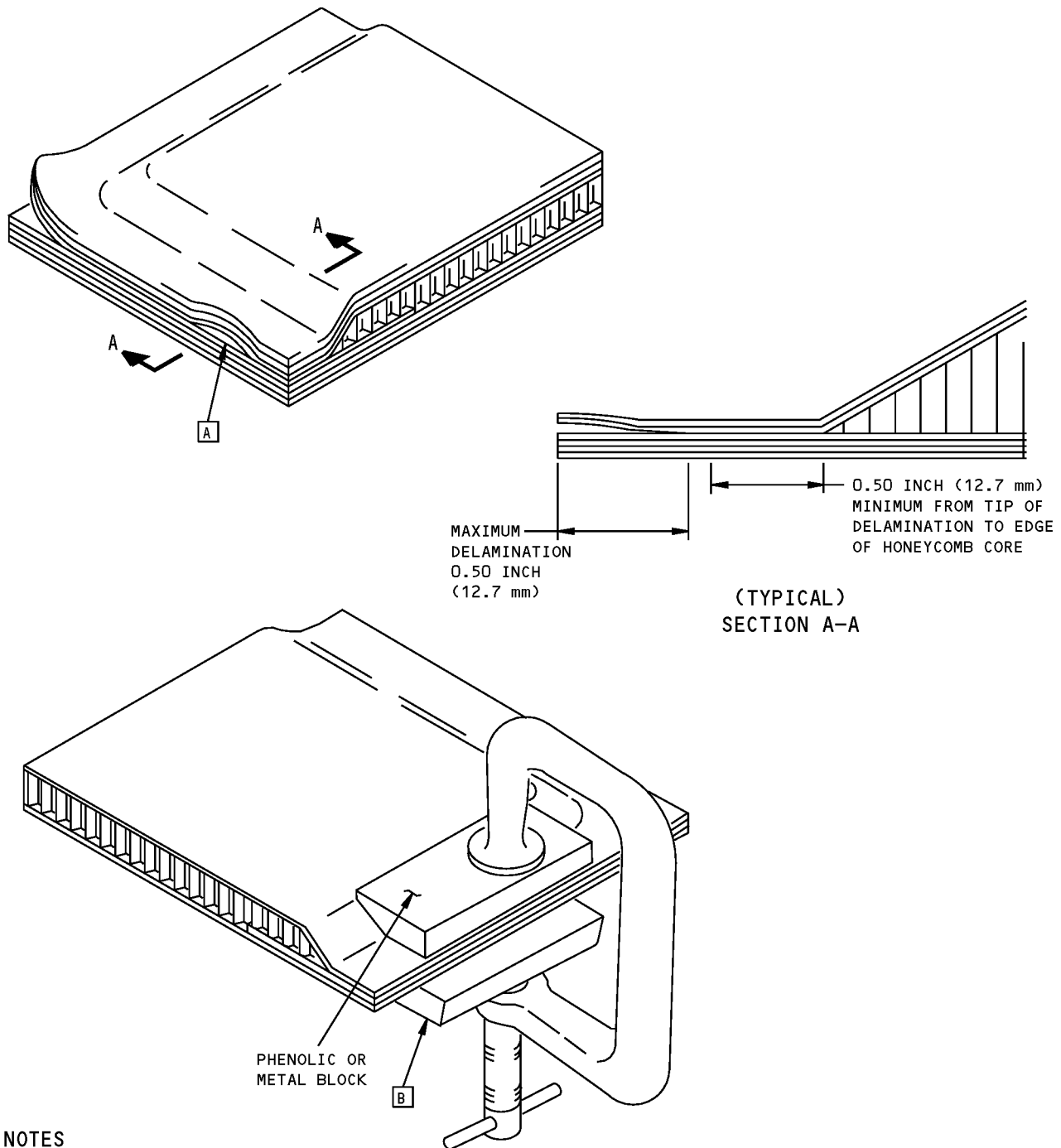


ACCEPTABLE - VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

**Vacuum Bagging Restrictions
Figure 22 (Sheet 2 of 2)**

757-200
STRUCTURAL REPAIR MANUAL



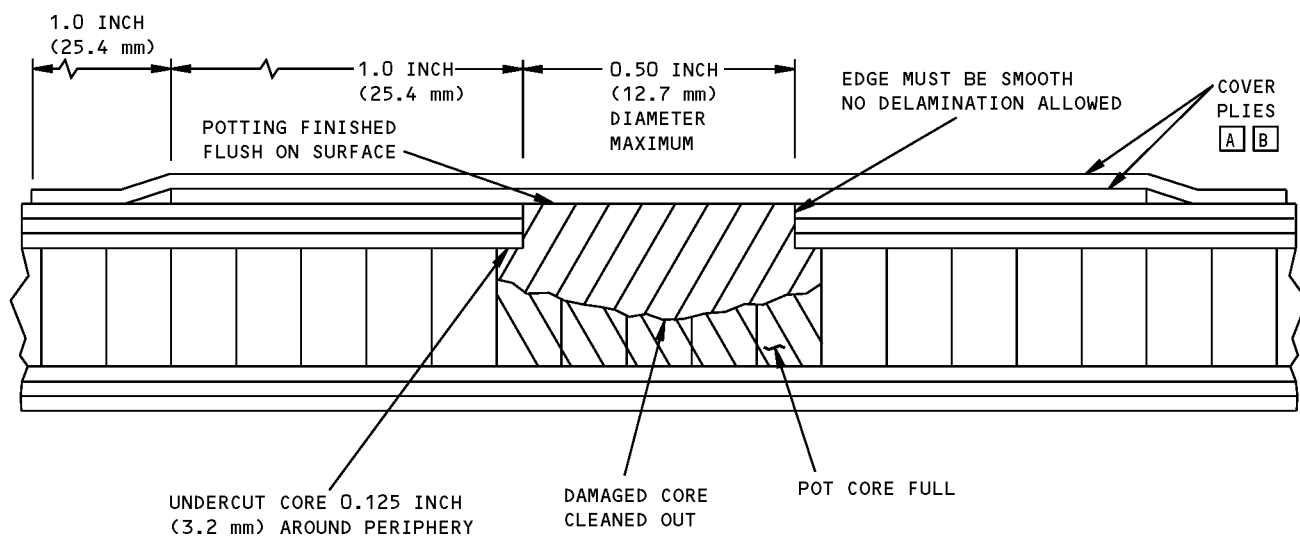
NOTES

- REFER TO PARAGRAPH 4.A.(2) FOR COMPLETE REPAIR INSTRUCTIONS

- [A] FORCE RESIN MIX 2 INTO DELAMINATED AREA
- [B] CLAMP PLIES TOGETHER AND CURE

Repair of Delaminations Between Plies of Panel Edgeband
Figure 23

757-200 STRUCTURAL REPAIR MANUAL



TYPICAL SECTION

NOTES

- OVERLAP COVER PLIES AS GIVEN IN FIG. 8.
DO NOT TAPER SAND OR STEP SAND ANY PLIES
- A ORIENT COVER PLIES IN THE SAME DIRECTION
THE ORIGINAL OUTER LAYER
- B PREPARE AND APPLY TWO GLASS FABRIC COVER
PLIES AS GIVEN IN PAR. 4.E, EXCEPT USE TYPE
H-2 OR H-3 PLIES ONLY

Typical Puncture Repair, 0.50-inch Diameter or Less - Wet Layup
Figure 24



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STRUCTURAL REPAIR MANUAL

GENERAL - TIME-LIMITED METAL OVERLAY REPAIRS TO COMPOSITE SECONDARY STRUCTURE, GRAPHITE/ARAMID/FIBERGLASS HONEYCOMB SANDWICH PANELS

1. Applicability

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

TIME-LIMITED METAL OVERLAY REPAIRS WILL NOT RESTORE EITHER THE STRENGTH OR THE DURABILITY OF THE ORIGINAL 250°F (121°C) OR 350°F (177°C) CURE COMPONENTS. FOR SIZE AND LIMITS OF SUCH REPAIRS, SEE APPLICABLE REPAIR SECTION.

TIME-LIMITED METAL OVERLAY REPAIRS MUST NOT BE USED IN STRESS CRITICAL AREAS OF PRIMARY STRUCTURAL COMPONENTS. FAILURE TO COMPLY WILL RESULT IN AN INADEQUATE REPAIR.

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of graphite, aramid, fiberglass, or hybrid fabrics. A hybrid can contain layers of graphite, aramid, and fiberglass. The most common construction is a sandwich of two laminated skins separated by a nonmetallic honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands and at fitting locations.

This section describes repairs made to composite panels, with accessibility to both sides, using a metal overlay plate sealed and bolted over the damaged area (Figure 1/GENERAL).

- B. These repairs have FAA approval, provided that metal overlay repairs are limited to secondary structure and replaced with a permanent repair within 300 flight hours.

NOTE: Metal overlay repairs are not permitted on nose radome, HF antenna window, wing leading edge, or flight control surfaces. Refer to 51-00-04, GENERAL for structural classification diagram.

- C. Maximum repairable damage size permitted by this repair is 1.5 times the allowable damage for hole (see maximum hole diameter in specific component allowable damage section), or 0.75 times the interim repair for hole (see maximum hole diameter in specific component repair section), whichever is smaller.
- D. Damage location must not be closer than 3D (edge to edge) from panel edgeband, fastener hole, or other damage ("D" is the maximum dimension of area to be repaired).

2. General

WARNING: HEAT FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.



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(WARNING PRECEDES)

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR NEOPRENE GLOVES WITH COTTON LINERS, PROTECTIVE CLOTHING, EYE GOGGLES, AND FACE SHIELD. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE BARE OR ALUMINUM COATED TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY ALSO BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.

WHEN REINSTALLING ALUMINUM FITTINGS ON GRAPHITE COMPOSITE STRUCTURE, ENSURE THAT THE ORIGINAL CORROSION PROTECTIVE TREATMENT IS MAINTAINED. INSTALL FITTINGS WITH FAYING SURFACE SEAL USING BMS 5-26 IN FUEL TANK AREAS OR BMS 5-95 IN ALL OTHER AREAS.

- A. Specific allowable damage and interim repair sizes can be found in the chapter/section/subject associated with each structural component.
- B. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- C. Protect surfaces from contamination. Do not touch cleaned parts or sealant with bare hands.
- D. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- E. Refer to 51-10-01, GENERAL for aerodynamic smoothness requirements.
- F. Refer to 51-70-16, GENERAL for drilling and machining of composite parts.

3. **References**

Reference	Title
51-00-04, GENERAL	Structural Classification
51-10-01, GENERAL	Aerodynamic Smoothness Requirements
51-30	REPAIR MATERIALS
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure

4. **Repair Preparation**

- A. Determine Damage

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- (1) Examine visually for extent of damage.

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- (2) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental NDI methods or by tap test. For tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bonded area. Refer to NDT Part 1, 51-05-01.

- B. Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic methods. Remove contaminants. Refer to Paragraph 4.C./GENERAL for water removal instructions.
- C. Remove any water present by means of suction or blowing warm air over the damaged area.
- D. Preparation of damage area
- (1) Mark out area 2.0 in. (5 cm) beyond periphery of damage or delamination.
 - (2) Abrade surface common to patch using No. 240 or finer Scotch-Brite, or equivalent abrasive. Do not damage fibers.
 - (3) Surface should be smooth with no resin burns.

CAUTION: DO NOT USE PAINT STRIPPERS FOR REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE SYSTEM WILL OCCUR.

DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- E. Wipe the area around damage with clean cheesecloth moistened with MEK, MIBK, trichloroethane, or acetone.

5. Install the Repair Plate

- A. Mark out damaged area and determine size of repair plate (Figure 1/GENERAL).

NOTE: Multiple repairs in large bays shall be no closer, edge to edge than three times the maximum damage diameter.

- B. Manufacture repair plate from aluminum, CRES, or titanium to closely fit damage area. Mark and drill fastener holes as given in Figure 1/GENERAL.
- C. Drill fastener holes through panel from repair plate.
- D. Remove all nicks, scratches, burrs, and rough edges from repair plate.
- E. If an aluminum repair plate and washers are used, apply Alodine 1200S or anodize and apply one coat of BMS 10-79, Type III primer and one coat of BMS 10-60, Type II enamel to all surfaces of plate.

NOTE: CRES and titanium plates do not require finish.

- F. Wipe fay surface with clean cheesecloth moistened with MEK, MIBK, trichloroethane, or acetone.
- G. Spread layer of BMS 5-95, B-1/2 sealant over area to be covered by repair plate, and on faying surface, with washers on far side.
- H. Fit repair plate and insert CRES, titanium, or cadmium plated steel removable fasteners with wet BMS 5-95 sealant taking care not to contaminate area to be painted.

NOTE: Only CRES or titanium fasteners are allowed in graphite or graphite hybrid composites.

- I. Use 0.75 in. (19 mm) minimum diameter washers, or plate of same material as repair plate under nuts. Torque nuts carefully to avoid crushing honeycomb core.



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- J. Cap and fay seal fasteners with BMS 5-95 and refinish reworked area. Fillet seal around periphery of plate, bolt heads, nuts, and washers.

6. Refinish Repair Area

- A. Refinish repair as given in AMM 51-21-00/701.

7. Removal of Time-Limited Repair for a Permanent Repair

- A. To remove plate prior to making permanent repair, heat plate to 150°F (66°C) maximum.
- B. Remove bolts and plate, taking care not to damage underlying composite structure.

STRUCTURAL REPAIR MANUAL

- THIS REPAIR TO BE USED ON SECONDARY STRUCTURES ONLY. METAL OVERLAY REPAIRS ARE NOT PERMITTED ON NOSE RADOME, HF ANTENNA WINDOW, WING LEADING EDGE, OR FLIGHT CONTROL SURFACES
- MULTIPLE REPAIRS IN LARGE BAYS SHALL BE NO CLOSER, EDGE TO EDGE, THAN 3 TIMES THE MAX DAMAGE DIAMETER
- REFER TO THE FOLLOWING WHEN YOU USE THIS REPAIR
 - SRM 51-00-04 FOR STRUCTURAL CLASSIFICATION DIAGRAM
 - SRM 51-20-05 FOR SEALING OF REPAIRS
 - SRM 51-40 FOR FASTENER CODE, REMOVAL, INSTALLATION, HOLE SIZES, AND EDGE MARGINS
 - SRM 51-70-16 FOR MACHINING, DRILLING, HOLE QUALITY REQUIREMENTS, AND HOLE SIZES IN COMPOSITE STRUCTURES

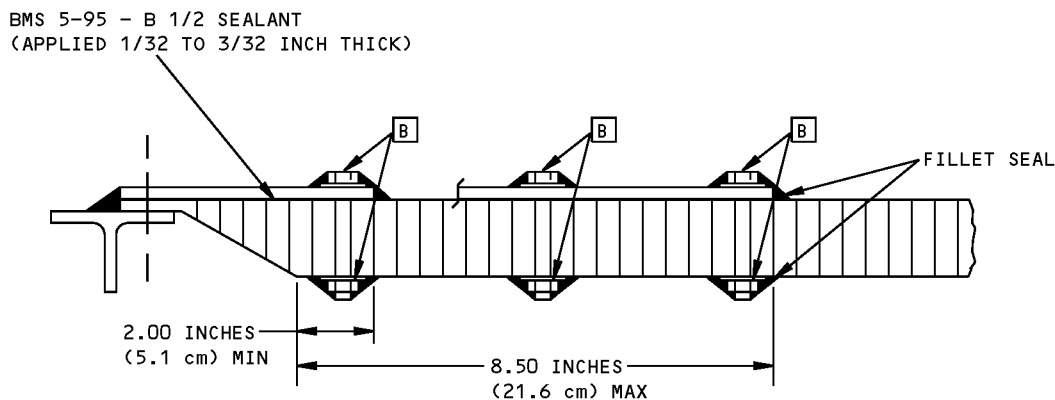
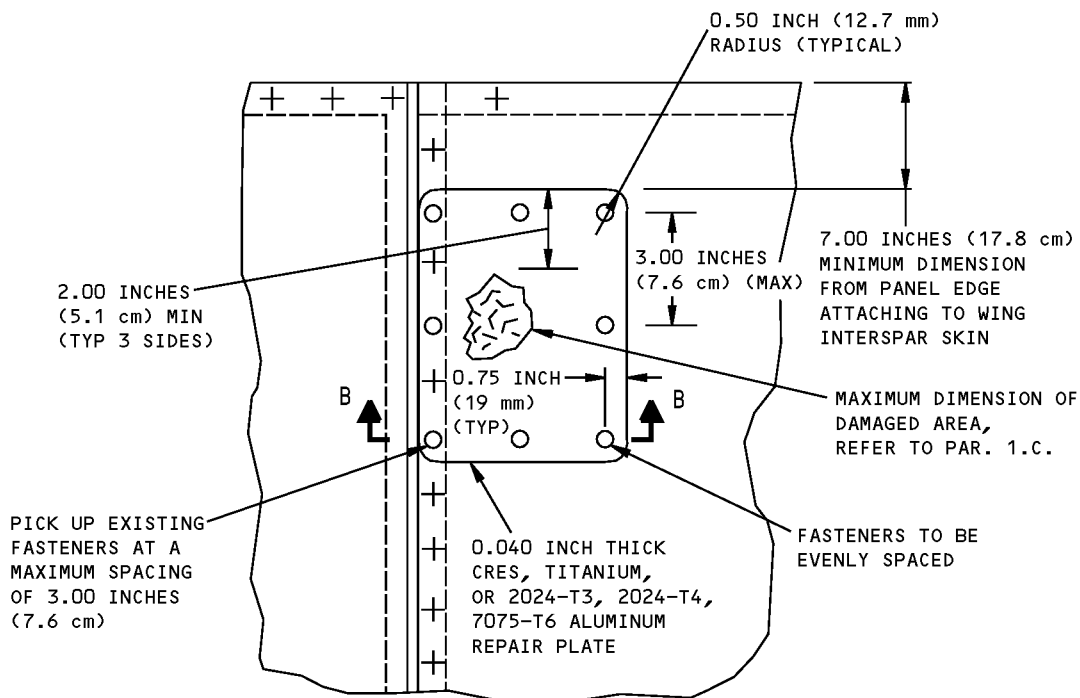
- A** FOR DAMAGE CLOSE TO PANEL EDGE USE REPAIR II
- B** 3/16 INCH DIAMETER BOLT OR SCREW WITH LOCKNUT. ALUMINUM WASHERS, 0.75 INCH DIA X 0.06 INCH THICK. BOLTS MUST BE INSTALLED WET WITH BMS 5-95 SEALANT. CAP AND FAY SEAL PROTRUDING FASTENER HEADS AND NUTS/WASHERS. FILLET SEAL AROUND PERIPHERY OF PLATE, BOLT HEADS, NUTS, AND WASHERS



Time-Limited Metal Overlay Repair to Composite Panel

Figure 1 (Sheet 1 of 2)

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TYPICAL REPAIR NEAR EDGEBAND
REPAIR II
SECTION B-B

Time-Limited Metal Overlay Repair to Composite Panel
Figure 1 (Sheet 2 of 2)

STRUCTURAL REPAIR MANUAL

GENERAL - REPAIRS TO GRAPHITE OR ARAMID REINFORCED LAMINATES, SOLID LAMINATE AND ALUMINUM HONEYCOMB SANDWICH STRUCTURE - 350°F (177°C) CURE
1. Applicability

WARNING: DO NOT BREATHE CARBON FIBER DUST. MAKE SURE THAT THERE IS A GOOD FLOW OF AIR WHERE YOU DO THE WORK. USE EQUIPMENT TO HELP YOU BREATHE WHEN YOU WORK IN A CONFINED SPACE. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY.

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

THESE REPAIRS ARE PERMANENT WHEN APPLIED USING THE REPAIR MANUAL PROCEDURES TO COMPONENTS ORIGINALLY MADE FROM 350°F (177°C) CURE MATERIALS.

CAUTION: DO NOT LET CARBON FIBER DUST GO INTO ELECTRICAL EQUIPMENT. CARBON FIBER DUST IS ELECTRICALLY CONDUCTIVE AND IT CAN CAUSE SHORT CIRCUITS IF IT GOES INTO ELECTRICAL EQUIPMENT. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE ELECTRICAL EQUIPMENT.

- A. This section contains repairs to components made from epoxy resin reinforced with aramid or graphite fabric. The most common construction is a sandwich of two laminated skins separated by an aluminum honeycomb core. Solid laminate is used for fairings, honeycomb panel edgebands, and at fitting locations. This section describes repairs made using 350°F (177°C) cure materials (prepreg layup).
- B. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage
Paragraph 4.B./GENERAL	Remove Water from Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedures

STRUCTURAL REPAIR MANUAL

Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50-inch Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50-inch Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.G./GENERAL	Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels
Paragraph 5.H./GENERAL	Repair of Punctures, 0.25-inch Diameter or Less, in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminated Panels

2. General

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR RUBBER GLOVES, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE BARE OR ALUMINUM COATED TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY ALSO BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.

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(CAUTION PRECEDES)

- A. Use suitable holding fixtures as given in Paragraph 4.F./GENERAL to prevent distortion and delamination of the structure.
- B. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- C. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- D. Store rolls or precut kits of prepreg and adhesive material below 10°F (-12°C) in sealed moisture proof bags. An identification label must accompany the material inside the bag, with the following information: BMS type, class, grade, supplier name, batch number, roll number, prepreg lot number and date of kit preparation. Record storage time in and out of refrigeration.
- E. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- F. Refer to 51-11-01, GENERAL for aerodynamic smoothness requirements.
- G. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- H. Refer to 51-10-02, GENERAL for inspection and removal of damage.
- I. Refer to 51-70-16, GENERAL for hole drilling and machining of composite structures.
- J. Refer to 51-30-06, GENERAL for composite repair material ordering data.

3. References

Reference	Title
51-10-02, GENERAL	Inspection and Removal of Damage
51-11-01, GENERAL	Aerodynamic Smoothness - RB211-535 Engine Nacelle
51-20-05, GENERAL	Repair Sealing
51-30	REPAIR MATERIALS
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-70-14, GENERAL	Allowable Damage and Repair of Flame-Sprayed Aluminum Coatings, Aluminum-Coated Glass Fabric (BMS 8-278), Aluminum Foil (BMS 8-289), and Expanded Aluminum Foil Mesh (BMS 8-336)
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
AMM 51-21-00/701	Interior and Exterior Finishes - Cleaning/Painting
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-03	Standard Overhaul Practices Manual
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Common Repair Procedures

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- A. Determine Damage.
 - (1) Examine visually for extent of damage.
 - (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic methods. Remove contaminants. Refer to Paragraph 4.B./GENERAL for water removal instructions.

STRUCTURAL REPAIR MANUAL

- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental NDI methods or by tap test. For the tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bond area. Refer to NDT Part 1, 51-05-01.

B. Remove Water From Damaged Area.

- (1) Remove water from honeycomb sandwich (Figure 10/GENERAL).

- (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum and oil-free compressed air.
- (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
- (c) Apply screen over exposed core.
- (d) Apply a thermocouple to the center of the screen.
- (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
- (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
- (g) When opposite face is accessible, apply thermocouple to the opposite side of honeycomb sandwich panel.
- (h) When opposite face is accessible, apply heating blanket to opposite side of honeycomb sandwich panel.

NOTE: When opposite face is accessible, it is acceptable to heat the area using a heating blanket only on the opposite face. An additional heating blanket and vacuum application may be used on the near face at the location shown in Figure 10/GENERAL. Additional heating blanket accelerates water removal. When opposite face is inaccessible, use of a heating blanket on the near side is required.

- (i) When opposite face is inaccessible or when using additional heating blanket, perform the following steps:
 - 1) Apply a thermocouple to the center of the bleeder cloth.
 - 2) Place the heating blanket over the bleeder cloth.
 - (j) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
 - (k) Evacuate the layup to a vacuum of 22 in/Hg (75 kPa) minimum.
 - (l) Heat the area for 1 hour minimum at 150°F (66°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
 - (m) Remove layup materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
- (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
 - (b) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

C. Remove Damage and Prepare Damaged Area.

- (1) Damage removal.

STRUCTURAL REPAIR MANUAL

- (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape, extending 0.50 in. (12.7 mm) beyond any detectable damage. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.

- (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. The core area removed should extend at least 0.50 in. (12.7 mm) further than visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side.
- (c) In areas where contamination cannot be removed by cleaning or drying as given in Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 4.C.(1)(a)/GENERAL.
- (e) When core is removed from inner surface of opposite skin, carefully smooth core down to adhesive film.
- (f) Inspect cut out area to ensure that all damage has been removed.

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 12/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

DO NOT SAND INTO BOND PLY OR HONEYCOMB CORE (FIGURE 8/GENERAL). BOND PLY IS THE PLY BONDED TO THE HONEYCOMB CORE.

- (2) Preparation of damaged area (Figure 12/GENERAL).

- (a) Determine the number of plies that have been cut. Mask off the area around the cutout allowing 0.75 in. (19 mm) minimum overlap for each ply replacement, plus 0.75 in. (19 mm) extra for each extra repair ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the applicable component structure identification or engineering drawing.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.

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- 1) Remove the paint finish or Tedlar film in the masked off area using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper.
 - 2) Taper or step sand each ply around the cleaned up damage a minimum of 0.50 in. (12.7 mm) per ply. Refer to Figure 13/GENERAL.
 - 3) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
 - 4) Abrade surfaces around repair using No. 150 or finer Scotch-Brite abrasive.
- (c) External surface of panel (critical aerodynamic surfaces).
- 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over a minimum distance of 0.50 in. (12.7 mm) for each existing ply of the laminate. Step sanding as given in Paragraph 4.C.(2)(b)2)/GENERAL may be done instead of taper sanding. Refer to 51-11-01, GENERAL for locations of areas of critical aerodynamic smoothness. Taper sanding must always be done on solid laminate structures.
- NOTE:** For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.
- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the component using No. 150 or finer sandpaper. The width of the border shall be the number of plies multiplied by 0.75 in. (19 mm).
- (d) Edgeband of panel.
- 1) Taper sand panel edgeband as given in Paragraph 4.C.(2)(c)/GENERAL.
- (e) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PART. DAMAGE TO PART WILL OCCUR.

- 1) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (AMM 20-30-99 or SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

- (1) Fabricate core plug.
 - (a) Fabricate core plug from core called out on engineering drawing. Refer to specific component structural identification section to determine type of core called out on engineering drawing.
 - (b) For butt splicing, the honeycomb core plug should fit flush with original core and with ribbon direction the same as in original core. The replacement core must overlap and make intimate contact with the cell walls of surrounding core material.

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- (c) Trim core plug to full or partial depth of original core (Refer to Paragraph 4.C.(1)(b)/GENERAL and Figure 2/GENERAL).

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive film between core plug and undamaged core or skin (Refer to Figure 2/GENERAL and Figure 12/GENERAL).

When greater than 1/8 inch cell honeycomb is used, it is probable that sagging of prepreg repair plies will occur during cure. In such cases, the precured patch technique would be more appropriate.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED IMMERSION CRITERIA GIVEN IN PARAGRAPH 4.D.(2)(A)/GENERAL DAMAGE TO CORE MATERIAL WILL OCCUR.

DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PART. DAMAGE TO PART WILL OCCUR.

- (2) Clean core plug.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99) bath for 60 seconds, or vapor degrease core (Refer to SOPM 20-30-03) limiting immersion to 30 seconds per cycle for a maximum of 4 cycles.
- (b) Locally contaminated areas can be washed with solvent, Series 99 (AMM 20-30-99 or SOPM 20-30-99).
- (c) The core must be completely dry, clean, and free of evidence of solvents before installation.

CAUTION: WEAR CLEAN WHITE GLOVES WHEN HANDLING ADHESIVE FILM TO PREVENT CONTAMINATION.

STRUCTURAL REPAIR MANUAL

(CAUTION PRECEDES)

DO NOT TOUCH THE ADHESIVE FILM WITH BARE HANDS OR OTHER PARTS OF THE BODY.

DO NOT FOLD, STRETCH OR OTHERWISE THIN THE ADHESIVE FILM. BONDING OF THE REPAIRED ASSEMBLY MUST BE COMPLETED WITHIN 48 HOURS AFTER THE ADHESIVE HAS BEEN REMOVED FROM REFRIGERATED STORAGE. QUALITY OF THE ADHESIVE WILL BE REDUCED AFTER THIS TIME LIMIT.

- (3) Install core plug (Refer to Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, Figure 12/GENERAL, and Figure 13/GENERAL typical).

NOTE: Before opening the adhesive film wrapper, condition refrigerated adhesives to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of adhesive horizontally through its axis free from other rolls or objects.

- (a) For partial core replacement, cut two pieces of BMS 5-154, Grade 03 or 05 adhesive film and one piece of 120 fiberglass prepreg fabric to fit the repair hole. Place in position as shown in Figure 2 (Sheet 2), Section A-A.
- (b) For full depth core replacement, where damage does not extend through both skins, trim a piece of BMS 5-154, Grade 05 adhesive film to fit repair hole. Place on the inside surface of the undamaged skin (Refer to Figure 2/GENERAL, Figure 3/GENERAL, Figure 7/GENERAL, and Figure 12/GENERAL). If both skins are damaged, apply a metal caul plate (such as 0.032 in. (0.8 mm) thick aluminum) against the exterior surface of the far side skin and tape in place.
- (c) For butt splicing, wrap the edges of the core plug with BMS 5-90, Type III, Class 350, Grade 50 foaming adhesive and install in the repair cavity. Align the honeycomb ribbon with the original core ribbon direction.

CAUTION: HEATING BLANKET HEAT SOURCES MAY NOT ADEQUATELY CURE SPLICE ADHESIVES DUE TO THERMAL GRADIENT. USE BURIED THERMOCOUPLE TO VERIFY CORRECT ADHESIVE TEMPERATURE.

- (d) Put the layup materials and equipment in place as shown in Figure 3 (Sheet 2). If damage extends through both face skins, vacuum bag both sides of the panel (or the entire part) using the layup shown in Figure 3 (Sheet 2).

NOTE: Locate thermocouples at bond line to monitor temperature.

- (e) Evacuate the repair area to a vacuum of 22 in/Hg (75 kPa) minimum.
- (f) Cure a minimum of 120 minutes at 338 to 356°F (170 to 180°C) (Refer to Figure 13/GENERAL).
- (g) Allow the repair area to cool under vacuum until the temperature of the repair area is 125°F (52°C) or less. Then release restraints (if applicable) and remove layup materials and equipment.
- (h) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.

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- (i) Vacuum to remove sanding residue from core cells.

NOTE: The above procedure is based on the core plug installation being cured separately from the repair plies. As an option, core plug installation and repair plies may be cured at the same time. When this option is used, ensure that temperature on both sides of panel is equal by using thermocouples in both adhesive films.

CAUTION: THE PREIMPREGNATED MATERIAL AND ADHESIVE MUST REMAIN FREE OF CONTAMINATION DURING CUTTING AND HANDLING. WEAR CLEAN WHITE GLOVES WHEN HANDLING.

CAUTION: TAPE IS A UNIDIRECTIONAL FIBER. WHEN USED IN A LAYUP, THE PREDOMINATE STIFFNESS IS IN THE DIRECTION OF THE FIBER. TAPE HAS LITTLE OR NO STIFFNESS IN THE TRANSVERSE DIRECTION.

FABRIC HAS BIDIRECTIONAL PROPERTIES. WHEN SUBSTITUTED FOR TAPE, FABRIC ADDS STIFFNESS IN THE TRANSVERSE DIRECTION. THE EFFECTS OF THIS ADDITIONAL TRANSVERSE STIFFNESS ON THE COMPONENT AND SUBSTRUCTURE MUST BE CONSIDERED PRIOR TO COMMITTING A MAJOR SUBSTITUTION IN A REPAIR.

ENSURE THAT PARTING FILM AND POLYETHYLENE SEPARATOR ARE REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURES.

E. Prepare and Apply Preimpregnated (Prepreg) Repair Plies.

NOTE: Refer to applicable paragraphs for preparation of prepreg glass, aramid and graphite fabrics. For hybrid components refer to applicable material paragraphs for each individual ply.

Before opening the prepreg material or adhesive film wrapper, condition refrigerated materials to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of material horizontally through its axis free from other rolls or objects.

- (1) Prepare prepreg aramid fabric repair plies (BMS 8-218).

NOTE: Before opening the prepreg material or adhesive film wrapper, condition refrigerated materials to room temperature until moisture no longer condenses on the wrapper.

During use, suspend the film roll of material horizontally through its axis free from other rolls or objects.

- (a) Refer to the specific component structural identification to determine number, style and orientation of aramid fabric used in original structure (Figure 2/GENERAL).

STRUCTURAL REPAIR MANUAL

- (b) From each type of material required, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(1)(c)/GENERAL for the substitution for prepreg aramid fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 15/GENERAL for extra repair ply material and orientation.

Refer to Figure 12/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) Substitution of prepreg glass fabric plies (Figure 11/GENERAL) for aramid plies.
- 1) If BMS 8-139, Style 1581 prepreg material is not available, three plies of BMS 8-139, Style 120 prepreg material may be substituted for each ply of Style 1581 prepreg material required.
 - 2) One ply of BMS 8-139, Style 120 prepreg material can be used for each ply of BMS 8-218, Style 120 aramid prepreg material.
 - 3) One ply of BMS 8-139, Style 1581 prepreg material can be used for each ply of BMS 8-218, Style 285 aramid prepreg material.
- (2) Prepare prepreg graphite repair plies (BMS 8-212 and BMS 8-256).
- (a) Refer to the specific component structural identification section to determine number, style, and orientation of graphite tape or fabric plies used in original structure (Figure 2/GENERAL). Use the same material for the repair plies as was used in the original component except substitute graphite fabric for graphite tape (Figure 11/GENERAL).
- (b) From each type of material required, cut the required number of plies.

NOTE: Refer to Paragraph 4.E.(2)(c)/GENERAL for the substitution of prepreg fabric plies.

In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 14/GENERAL for extra repair ply material and orientation.

Refer to Figure 12/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired.

- (c) No substitutes are permitted for graphite fabric repair plies. Graphite fabric however, may be used as a substitute for graphite tape. Refer to Figure 11/GENERAL.
- (3) Apply the repair plies (Figure 2/GENERAL and Figure 12/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with strips of graphite preimpregnated material before application of the repair plies. Use the same graphite material as used in the repair plies.

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- (a) Cut two plies of BMS 5-154, Type II, Class I, Grade 05 adhesive film, 0.125 in. (3.2 mm) larger than the largest patch ply which also covers the entire repair area.
- (b) Place one layer of adhesive film over the entire repair area.
- (c) Apply repair plies starting with the smallest, with orientation as in original structure and overlap all around as in Figure 12/GENERAL.
- (d) Place the second ply of adhesive film over the replaced plies.
- (e) If the repair area has a layer of aluminum foil, repair the foil as given in 51-70-14, GENERAL. before proceeding with the bagging and cure of the part.

F. Layup and Bagging Procedure (Figure 3/GENERAL).

- (1) Place one layer of perforated FEP parting film over the replacement plies and extending at least one inch beyond the largest patch ply.
- (2) Secure three thermocouples (spaced evenly around the repair) to the panel at the edge of the repair and secure them to the temperature recording device.
- (3) Place a layer of dry peel ply over the perforated FEP.

NOTE: The peel ply must be cut large enough to make contact with the surface breather.

- (4) Place one layer of solid FEP parting film over the layup extending to 0.5 in. (12.7 mm) short of the edge of the dry peel ply.
- (5) Place the heating blanket over the repair.

NOTE: The heating blanket must extend a minimum of 2 in. (5 cm) beyond the edge of the patch.

When using a heating blanket that is longer than 12 in. (30 cm) on a side, an aluminum pressure plate (0.040 in. (1 mm) thick maximum) should be used to minimize localized heating.

When two or more pads are used, a pressure plate must be used.

- (6) Place a layer of Airweave SS or Style 120 glass fabric over the solid FEP as a surface breather, or, if heat blanket is used, place four to six layers of breather material over the heat blanket to act as an insulator and a surface breather.

NOTE: The surface breather material and the dry peel ply must make contact.

- (7) Lay the vacuum line over the edge of the breather material.
- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.
- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. In some cases, it is optional to vacuum bag the entire part.

NOTE: The entire repair surface must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts sagging and distortion could occur due to the weight of the part.

- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum during the entire cure cycle.

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- (11) Check the vacuum bag for leak paths.
- (12) Cure the repair as given in Paragraph 4.G./GENERAL.

WARNING: USE EXPLOSIONPROOF EQUIPMENT DURING CURE. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

CAUTION: SURFACE TEMPERATURE MUST NOT EXCEED 365°F (185°C). DAMAGE OR DISTORTION OF STRUCTURE WILL OCCUR IF TEMPERATURE EXCEEDS 365°F (185°C).

MAINTAIN PRESSURE AS GIVEN IN PARAGRAPH 4.F./GENERAL DURING ENTIRE CURE CYCLE.

G. Cure the Repair.

NOTE: Determination of the temperature must be made by using thermocouples placed at edge of patch.

In honeycomb panels, for repairs to both skins or single skin and partial depth core replacement using a septum, thermocouples must be located in both repair surfaces to monitor cure temperatures.

When using a hot bond repair console, consult manufacturer's operating instructions.

- (1) Raise the temperature at a rate of 1 to 5°F (1 to 3°C) per minute to between 338 and 356°F (170 to 180°C) and cure at this temperature for a minimum of 120 to 180 minutes maximum. Determine cure temperature from thermocouple at the edge of the adhesive that has the lowest reading (Refer to Figure 13/GENERAL).

Cool down at a rate of 5°F (3°C) per minute maximum under vacuum.

NOTE: Cure time does not include the time required for the mold and part to heat up to temperature. Cure time is the period after the part has reached that temperature.

- (2) When the repaired area has cooled to less than 125°F (52°C), release vacuum pressure and remove vacuum bagging materials and other layup materials.

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

H. Refinish After Repair.

- (1) Lightly sand edge of top most repair ply as necessary to fair the edge. Sand surface of repair to produce a smooth finish without damaging fibers.
- (2) Apply finish to the repaired surface using the following applicable methods.
 - (a) Where the original painted surfaces have been removed, restore original finish as given in AMM 51-21-00/701.
 - (b) Where the aluminum foil tape has been removed, during repair, from the inner surface of panels, reapply as given in AMM 71-11-04.
 - (c) Where sealant has been removed from around fittings or fay surfaces to facilitate repairs, reapply BMS 5-95 sealant as given in 51-20-05, GENERAL.
 - (d) Where bolts have been removed from aluminum fittings common to graphite, reinstall bolts wet with BMS 5-95 sealant and fillet seal around bolt heads and nuts.

I. Perform Post-Repair Requirements.

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- (1) Inspect completed repairs for voids or bonding flaws using instrumented nondestructive inspection methods. Inspection should cover an area that includes a band 2 in. (5 cm) minimum around the area heated. If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: For NDI procedures, refer to 757 Nondestructive Test Manual, D634N301.

- (2) Where instrumented NDI methods are not available, tap testing may be used for interim inspection of the completed repair. Use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bonded area. Tap testing is not considered a reliable method for inspecting the finished repair. Instrumented NDI methods should be used to confirm repair integrity at the earliest opportunity.

5. Typical Repairs

CAUTION: ESTABLISH COMPONENT MATERIAL AND REPAIR LIMITS PRIOR TO PROCEEDING WITH ANY REPAIRS.

ALWAYS REFER TO PARAGRAPH 4./GENERAL, COMMON REPAIR PROCEDURES, WHEN MAKING THESE REPAIRS.

A. Repair of Delaminations Between Plies

- (1) Delamination of plies over core area of panel (Figure 5/GENERAL).
 - (a) Determine damage as given in Paragraph 4.A./GENERAL. Ensure that water and other contamination are removed as given in Paragraph 4.B./GENERAL.
 - (b) Cut away delaminated plies as given in Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area as given in Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.

B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel (Figure 15/GENERAL)

- (1) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper.
- (2) Dry out structure around puncture as given in Paragraph 4.B./GENERAL.
- (3) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape as given in Paragraph 4.C./GENERAL.
- (4) Clean repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (5) Prepare Resin Mix 8, as given in Figure 1/GENERAL.
- (6) Work resin into the hole filling as much as possible.
- (7) Cure repair as given in Paragraph 4.G./GENERAL.
- (8) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.254 mm).

NOTE: A 0.010 in. (0.254 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (9) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
- (10) Clean repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (11) Prepare and apply two fabric cover plies as given in Paragraph 4.E./GENERAL.

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- (12) Apply vacuum and cure as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
 - (13) Refinish the repair as given in Paragraph 4.H./GENERAL.
 - (14) Perform applicable post-repair requirements as given in Paragraph 4.I./GENERAL before returning the repaired component to flight service.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Figure 2/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from damaged area. Refer to Paragraph 4.B./GENERAL.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 4.D./GENERAL.
 - (5) Sand core plug flush with surrounding surface, leaving allowance for film adhesive and slight core crush during cure.
 - (6) Prepare and apply repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Figure 6/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area. Refer to Paragraph 4.B./GENERAL.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 4.D./GENERAL, except do not perform Paragraph 4.D.(3)(e)/GENERAL through Paragraph 4.D.(3)(i)/GENERAL.
 - (5) Prepare and apply repair plies to one surface of the panel as given in Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
 - (6) Apply vacuum and cure as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
 - (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
 - (8) Prepare and apply repair plies to the other surface of the panel as given in Paragraph 4.E./GENERAL.
 - (9) Complete repair as given in Paragraph 4.F./GENERAL through Paragraph 4.I./GENERAL.
- NOTE:** The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.
- E. Replacement of Honeycomb Core on Damaged Edge of Panel (Figure 7/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area. Refer to Paragraph 4.B./GENERAL.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.

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- (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 4.D./GENERAL.
 - (5) Sand core plug approximately flush with surrounding core material, leaving allowance for film adhesive and slight core crush during cure.
 - (6) Clean surfaces as given in Paragraph 4.C.(2)(e)/GENERAL.
 - (7) Prepare and apply repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- F. Repair of Damaged Skin Plies in Panel Edgeband (Figure 8/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area. Area must be completely dried out. Refer to Paragraph 4.B./GENERAL.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
 - (4) Prepare and apply repair plies and complete the repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- G. Repair of Damage and Punctures in Solid Laminate Panels
- NOTE:** This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
- NOTE:** Step sand edges of plies around repair on damaged side of panel. Refer to Figure 12/GENERAL, Detail I.
- (4) Prepare and apply repair plies and complete the repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- NOTE:** If cleaned up damage penetrates solid laminate, secure a metal caul plate (such as 0.016 in. (0.4 mm) thick aluminum) to far side of panel to support repair plies.
- H. Repair of Punctures, 0.25 in. (6.35 mm) Diameter or Less, in Solid Laminate Panels
- NOTE:** This repair applies to components made from laminated graphite/aramid/hybrid fabric or tape plies and epoxy resin without a honeycomb core.
- (1) Check for delamination as given in Paragraph 4.A./GENERAL.
 - (2) If no delamination is found, clean up damage to a smooth, rounded shape. Repair as given in Paragraph 5.B./GENERAL.
 - (3) If delamination is found, repair as given in Paragraph 5.G./GENERAL.
- I. Repair of Delaminations Between Plies in Solid Laminate Panels
- NOTE:** This repair applies to components made from laminated graphite/aramid/hybrid fabric or tape plies and epoxy resin without a honeycomb core.
- (1) Repair delaminations using methods described in Paragraph 5.G./GENERAL.
- J. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels (Figure 9/GENERAL)

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- (1) Determine the extent of damage as given in Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage as given in Figure 9/GENERAL and Paragraph 4.C.(2)(d)/GENERAL.
- (4) Clean area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (5) Repair and apply repair plies as given in Paragraph 4.E./GENERAL and Figure 10/GENERAL.
- (6) Apply vacuum and cure as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (7) Refinish the repair as given in Paragraph 4.H./GENERAL.
- (8) Drill and countersink fastener holes.
- (9) Perform applicable post-repair requirements as given in Paragraph 4.I./GENERAL before returning the repaired component to flight service.

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME A
RESIN MIX 8 (POTTING RESIN)	RESIN MIX 1 MILLED GLASS FIBER	80 20	SAME AS RESIN MIX 1	SAME AS RESIN MIX 1
BMS 5-90 TYPE III CLASS 350-10-10, GRADE 50 (FOAMING ADHESIVE FILM)	FM490A MA562 PL685		B C	SEE TEXT
BMS 5-90 TYPE IV CLASS 350-10-10, GRADE 50 (FOAMING EXTRUDABLE ADHESIVE)	AF-3024 FOAMING PL460 ADHESIVE FILM		B C	SEE TEXT
BMS 5-154, TYPE II CLASS 1, GRADE 03	METLBOND 1515-3M 03 PSF ADHESIVE FILM METLBOND 1515-3M-HT 03 PSF ADHESIVE FILM PL795 03 PSF ADHESIVE FILM		10 DAYS AT 95°F (35°C)	SEE TEXT
BMS 5-154, TYPE II CLASS 2, GRADE 03	PL795 03 PSF ADHESIVE FILM		30 DAYS AT 95°F (35°C)	SEE TEXT
BMS 5-154, TYPE II CLASS 1, GRADE 05	METLBOND 1515-3M 05 PSF ADHESIVE FILM METLBOND 1515-3M-HT 05 PSF ADHESIVE FILM PL795 05 PSF ADHESIVE FILM		10 DAYS AT 95°F (35°C)	SEE TEXT
BMS 5-154, TYPE II CLASS 2, GRADE 05	PL795 05 PSF ADHESIVE FILM		30 DAYS AT 95°F (35°C)	SEE TEXT

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 1 of 3)

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME A
BMS 8-139 (GLASS PREPREG) CLASS II TYPES: 120 181	120-F164-6-F50 1581-F164-6-F50		15 DAYS AT 65°F (18°C) TO 80°F (27°C) 1 DAY AT 81°F (27°C) TO 110°F (43°C)	SEE TEXT
BMS 8-218 (ARAMID PREPREG) STYLE 120 STYLE 285	KEVLAR 49-120 F161-188 KEVLAR 49-285 F161-188		A	SEE TEXT
BMS 8-212 (GRAPHITE PREPREG) CLASS II (FABRIC) TYPE I: STYLE 3K-70-PW STYLE 3K-135-8H TYPE III: STYLE 3K-135-8H	RIGIDITE 5208 WOVEN T-300 STYLE 3K-70-PW-42 PERCENT RIGIDITE 5208 WOVEN T-300 STYLE 3K-135-8H-42 PERCENT F3C-584-42-F263-7 F3T-584-42-F263-7 HMF-133/34-III RIGIDITE 5208 WOVEN T-300 STYLE 3K-135-8H-37 PERCENT RIGIDITE 5208F WOVEN T-300 STYLE 3K-135-8H-37 PERCENT RIGIDITE 5208 WOVEN C3000 STYLE 3K-135-8H-37 PERCENT		17 DAYS AT 65°F (18°C) TO 80°F (27°C) ↓	SEE TEXT ↓

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 2 of 3)

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WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

	MIXING PROCEDURE
RESIN MIX 1	ADD HARDENER TO RESIN AND MIX THOROUGHLY
RESIN MIX 8	ADD MILLED GLASS FIBERS TO RESIN MIX TO PRODUCE A CONSISTENCY SIMILAR TO A THIN PUTTY

NOTES

- REFER TO SRM 51-30-00 FOR SOURCES OF MATERIALS.
- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

A OUT-TIME OF THIS MATERIAL IS SPECIFIED IN TERMS OF 168 EXPOSURE UNITS AT TEMPERATURES BETWEEN 40°F (4°C) AND 80°F (27°C) AND 24 UNITS OF EXPOSURE BETWEEN 80°F (27°C) AND 110°F (43°C). OUT-TIME ACCUMULATES FROM THE DATE OF PURCHASER RECEIPT UNTIL THE CURE CYCLE IS INITIATED. MATERIALS EXPOSED TO TEMPERATURES ABOVE 110°F (43°C) SHALL BE REJECTED. ONE EXPOSURE UNIT IS ACQUIRED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 40°F (4°C) AND 80°F (27°C). SEVEN EXPOSURE UNITS ARE ACQUIRED EACH HOUR THE MATERIAL IS EXPOSED TO TEMPERATURES BETWEEN 81°F (27°C) AND 110°F (43°C).

C REMOVE THE ADHESIVE MATERIAL FROM THE COLD STORAGE AREA. KEEP THE MATERIAL IN AN AREA WHERE THE TEMPERATURE IS 65°F (18°C) TO 90°F (32°C) FOR A MINIMUM OF 30 MINUTES FOR EACH POUND OF WEIGHT.

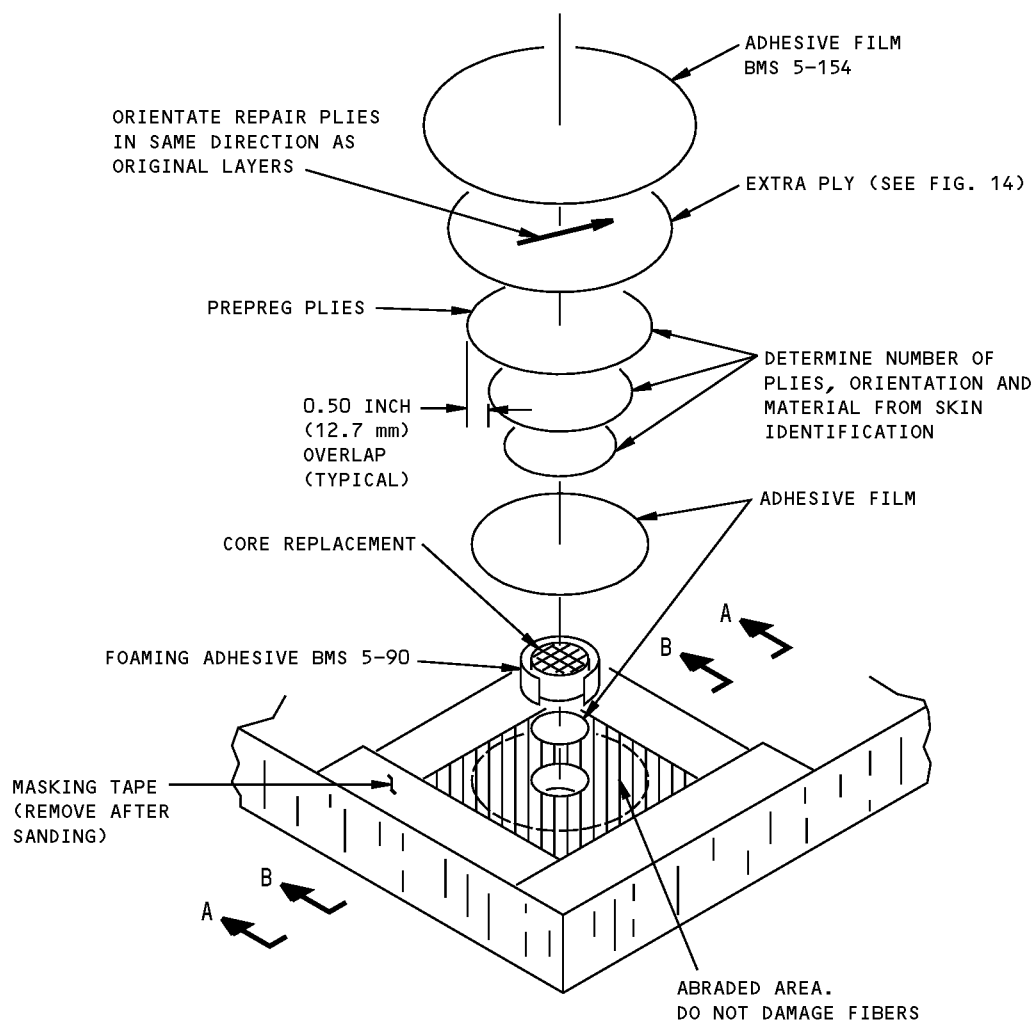
CONDENSATION ON THE EXTERIOR OF THE ROLL IS NOT AN ACCURATE INDICATOR THAT THE MATERIAL IS READY TO BE USED. MAKE SURE THE MATERIAL TEMPERATURE IS EQUAL TO ROOM TEMPERATURE BEFORE YOU USE IT.

D IF THE TOTAL TIME OUT OF COLD STORAGE IS NOT MORE THAN 10 DAYS, THE MATERIAL CAN BE PUT BACK INTO COLD STORAGE. THIS CAN BE DONE ONE OR MORE TIMES.

Resin, Prepreg, and Adhesive Type Specifications and Mixing Procedures
Figure 1 (Sheet 3 of 3)

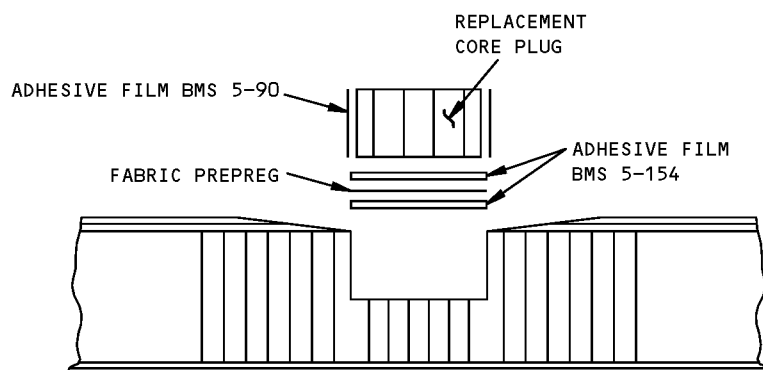
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STRUCTURAL REPAIR MANUAL

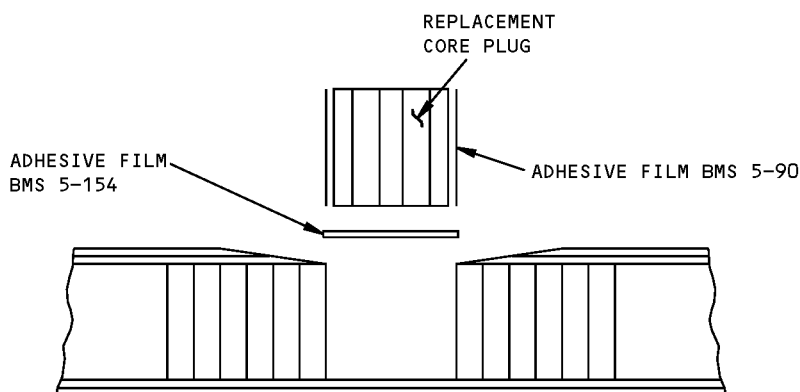


Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage (350 Degrees F (177 Degrees C) Cure)
Figure 2 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



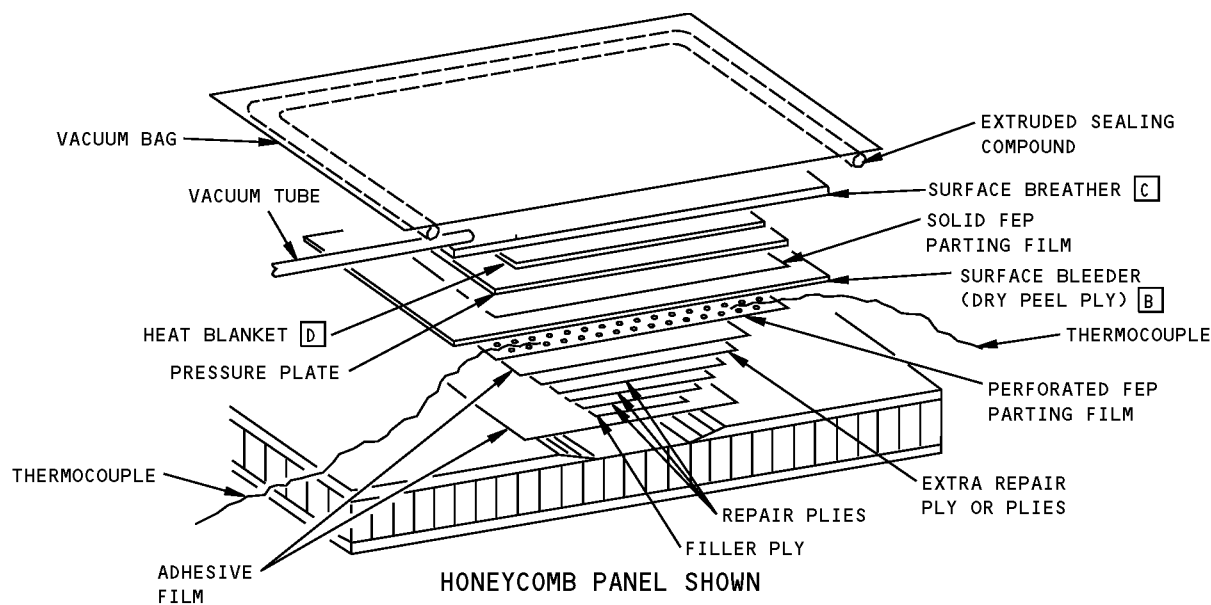
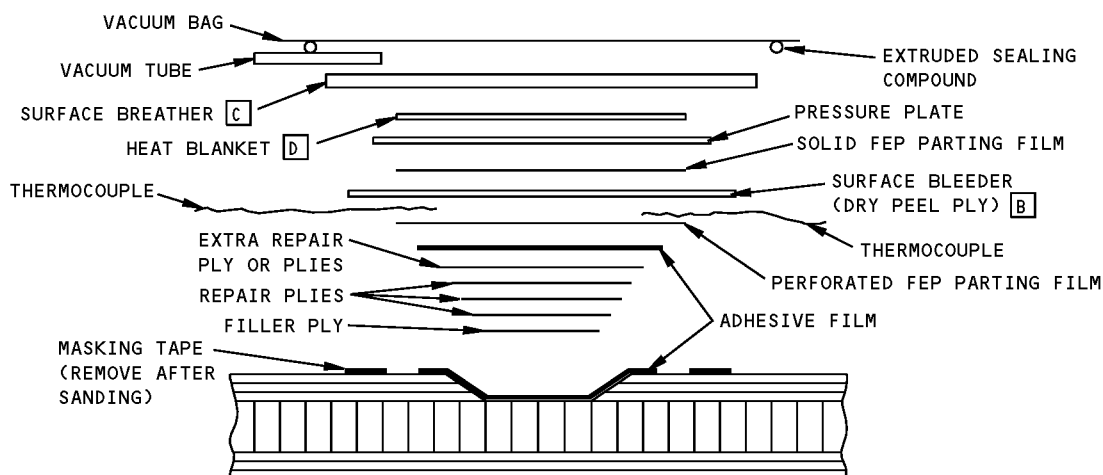
SECTION THRU REPAIR AREA -
PARTIAL DEPTH CORE REPLACEMENT
SECTION A-A



SECTION THRU REPAIR AREA -
FULL DEPTH CORE REPLACEMENT
SECTION B-B

Repair of Large Punctures Thru One Skin of a Sandwich Structure Including Core Damage (350 Degrees F (177 Degrees C) Cure)
Figure 2 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL**BAGGING SEQUENCE FOR SKIN PLY REPAIR****SECTION THRU SKIN PLY REPAIR****NOTES**

[A] ONE PLY OF ADHESIVE FILM (FOR FULL DEPTH CORE REPLACEMENT, WHERE DAMAGE DOES NOT EXTEND THROUGH BOTH SKINS). FOR PARTIAL CORE REPLACEMENT USE TWO PLIES OF ADHESIVE FILM WITH ONE PLY OF BMS 8-212, TYPE IV, CLASS 2 OR BMS 8-256 CLASS 2 GRAPHITE BETWEEN THEM

[B] DRY PEEL PLY MUST MAKE CONTACT WITH THE SURFACE BREATHER MATERIAL

[C] WHEN USING A HEATING BLANKET, USE 4 TO 6 LAYERS OF BREATHER MATERIAL TO PREVENT DAMAGE TO VACUUM BAG

[D] HEATING BLANKET MUST EXTEND A MINIMUM OF 2 INCHES (5 cm) BEYOND EDGE OF REPAIR PATCH

[E] IT IS PERMISSIBLE TO LEAVE A THERMOCOUPLE BONDED TO THE INSIDE OF A HONEYCOMB CORE CELL PROVIDED IT DOES NOT INTERFERE WITH SUBSEQUENT SKIN REPAIR

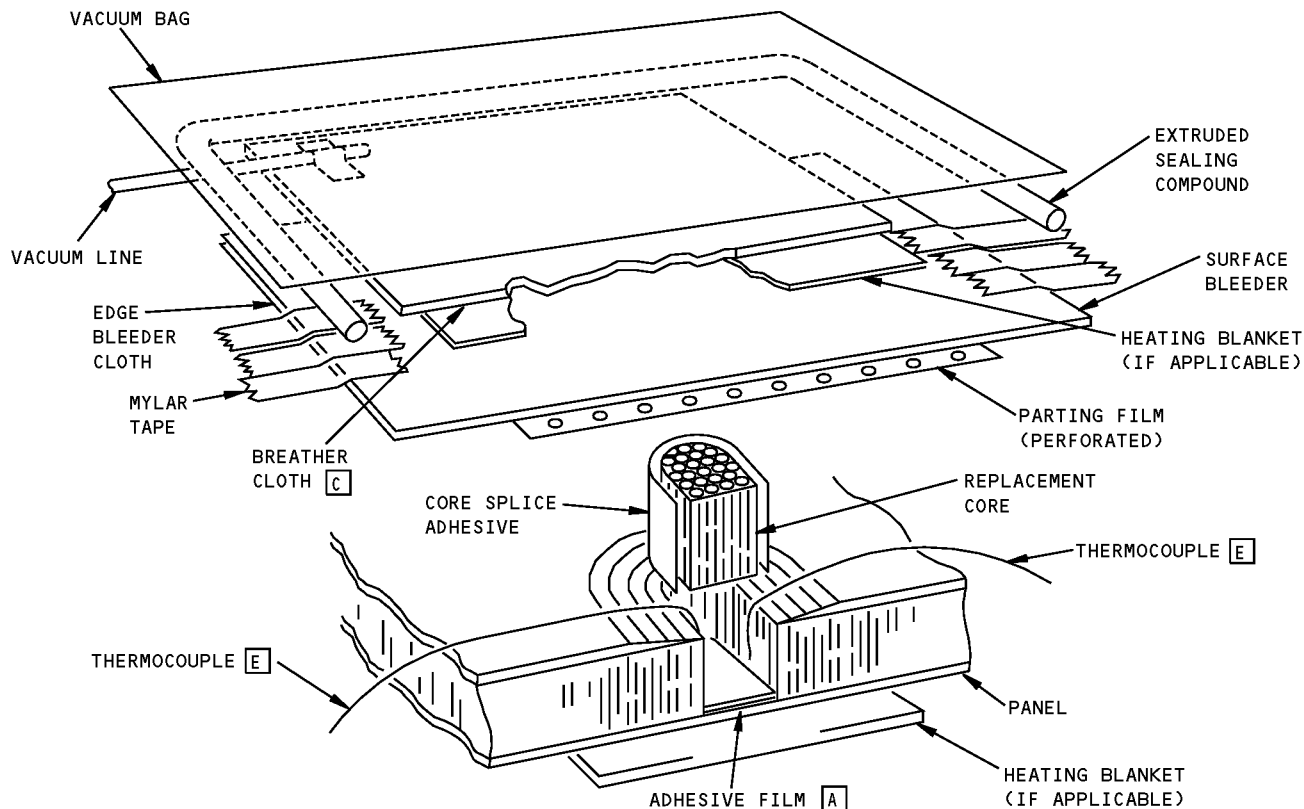
Application of Pressure During Cure (350 Degrees F (177 Degrees C) Cure)**Figure 3 (Sheet 1 of 2)**

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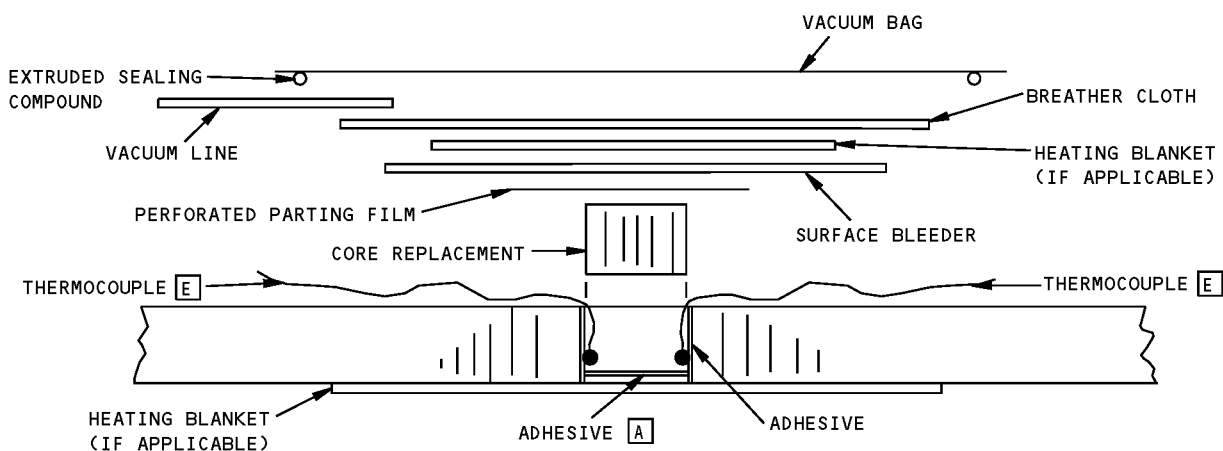
51-71-01

GENERAL
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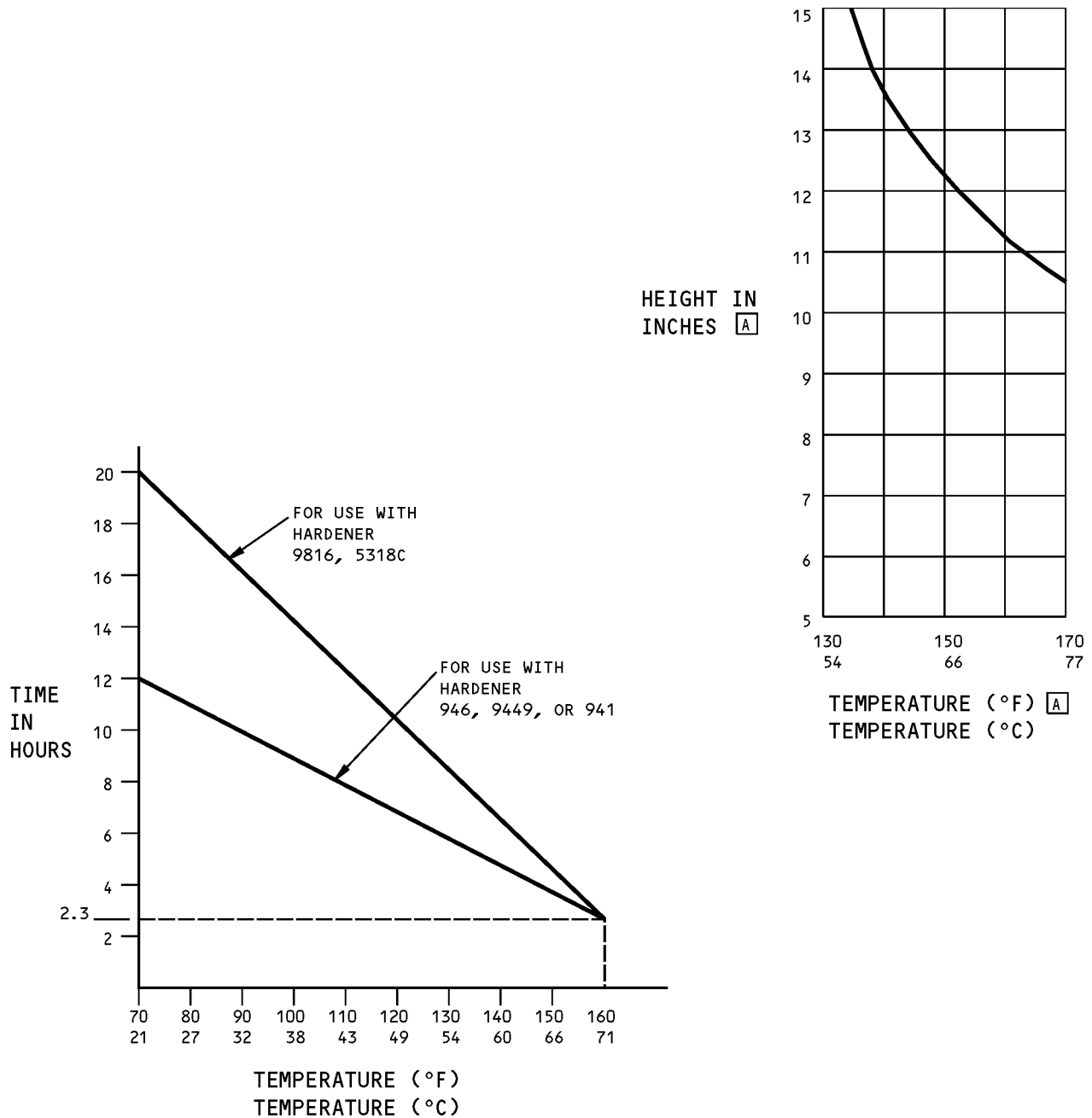
**BAGGING SEQUENCE FOR CORE REPLACEMENT
(350°F (177°C) CURE)1**



**SECTION THRU LAYUP FOR CORE REPLACEMENT
(350°F (177°C) LAYUP ONLY)**

**Application of Pressure During Cure (350 Degrees F (177 Degrees C) Cure)
Figure 3 (Sheet 2 of 2)**

757-200 STRUCTURAL REPAIR MANUAL



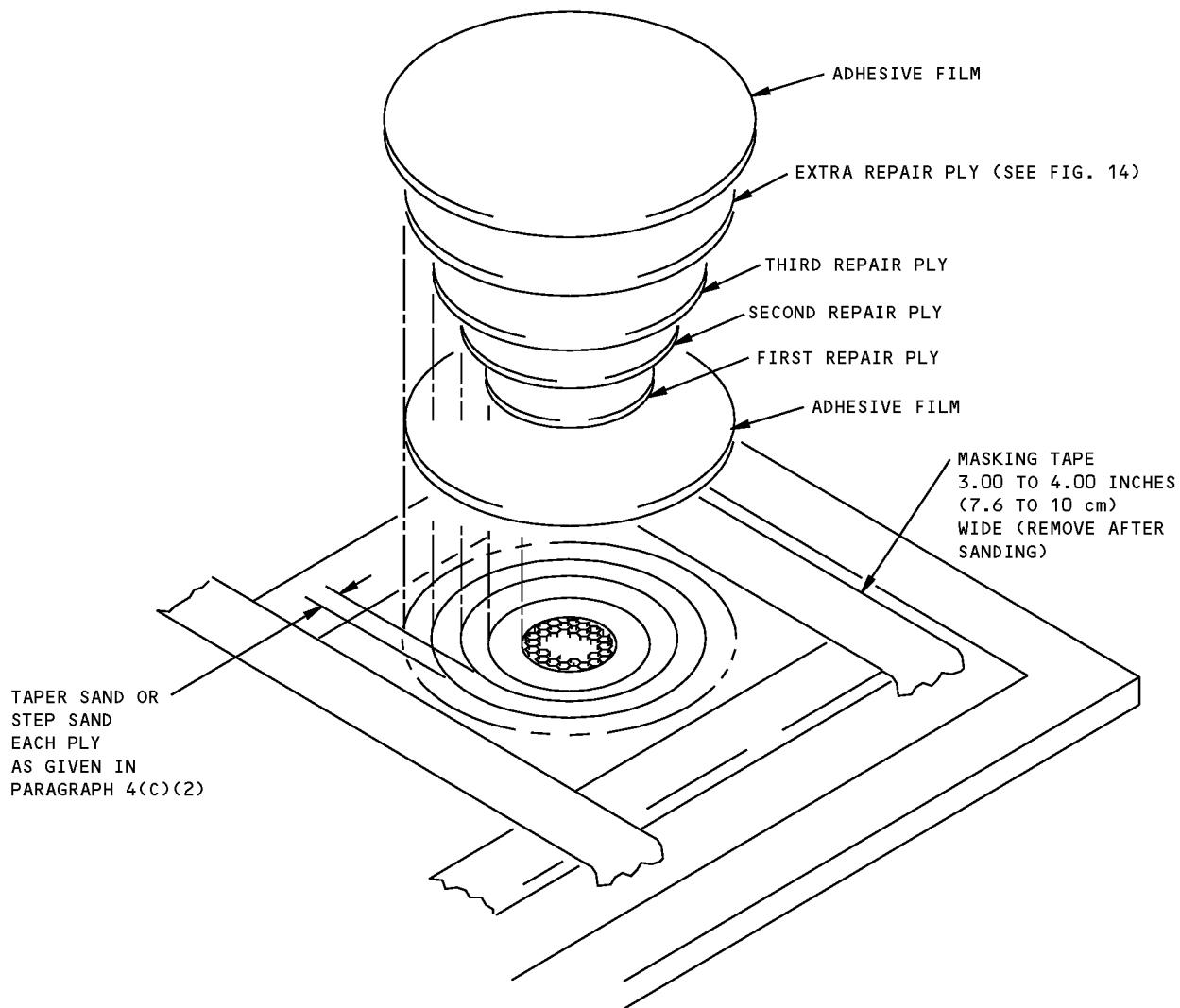
NOTES

- USE THERMOCOUPLES TO MONITOR TEMPERATURE

[A] THE HEIGHT IN INCHES OF 250 WATT HEAT LAMP FROM THE SURFACES OF THE PATCH VS TEMPERATURE AT SURFACE OF PART

**Potting and Laminating Resin Cure Temperature
Figure 4**

757-200 STRUCTURAL REPAIR MANUAL

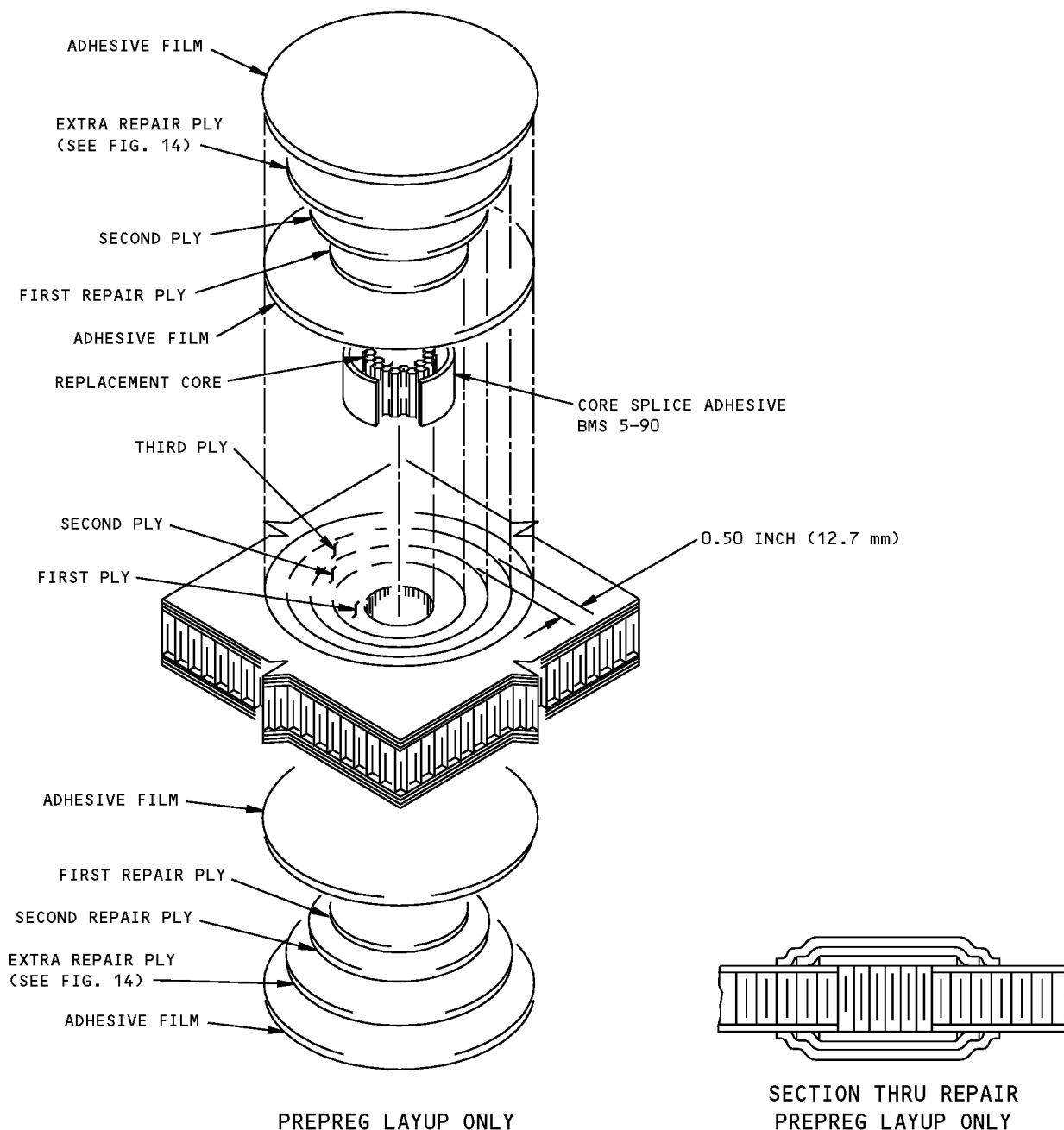


REPAIR PLY LAYUP ONLY

Repair of Damaged External or Internal Skins of a Sandwich Panel (350 Degrees F (177 Degrees C Cure) Figure 5

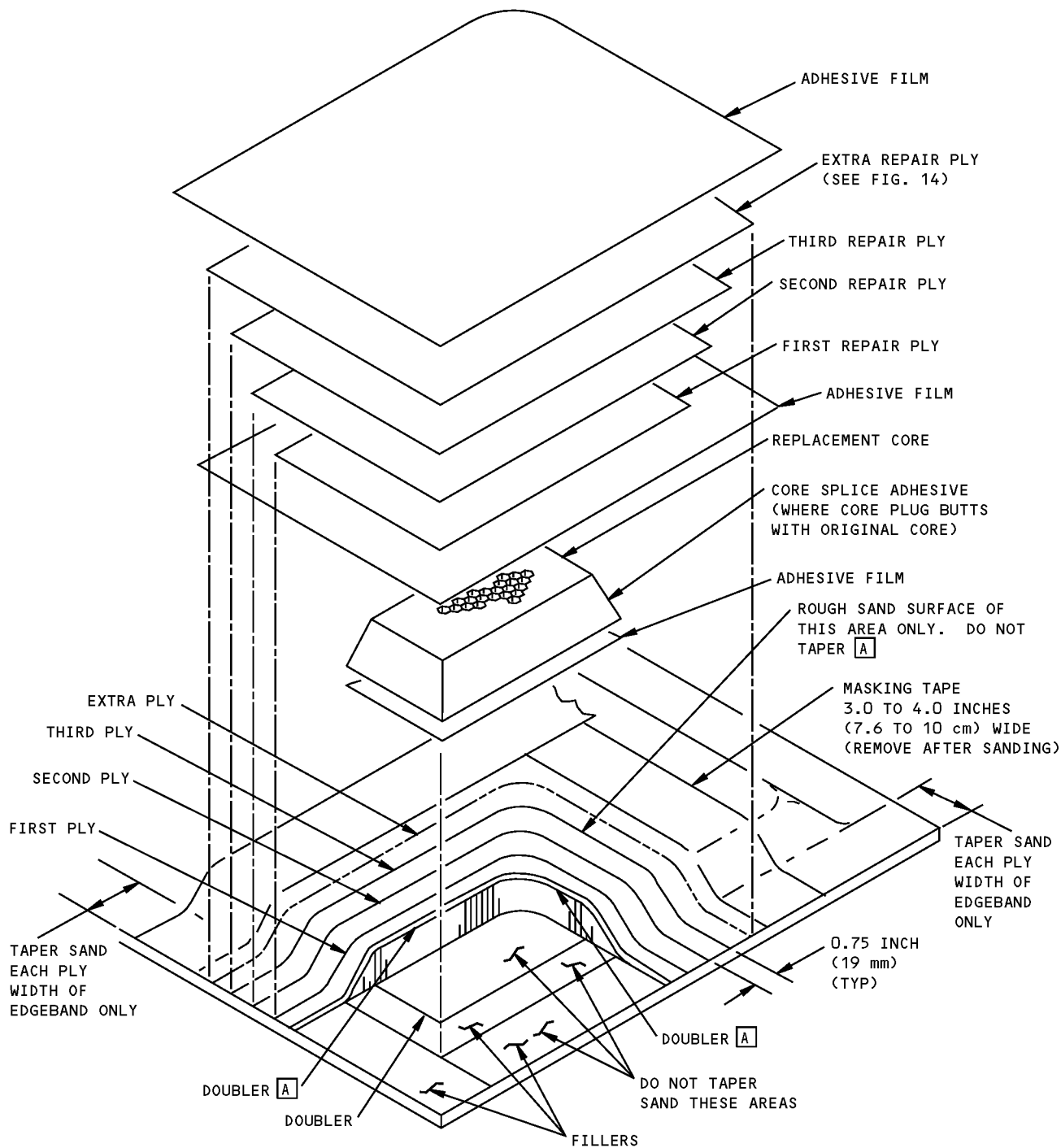
757-200

STRUCTURAL REPAIR MANUAL



**Repair of Large Punctures through Both Skins of a Sandwich Panel Including Core Damage (350 Degrees F
(177 Degrees C) Cure)**
Figure 6

757-200 STRUCTURAL REPAIR MANUAL

**NOTE**

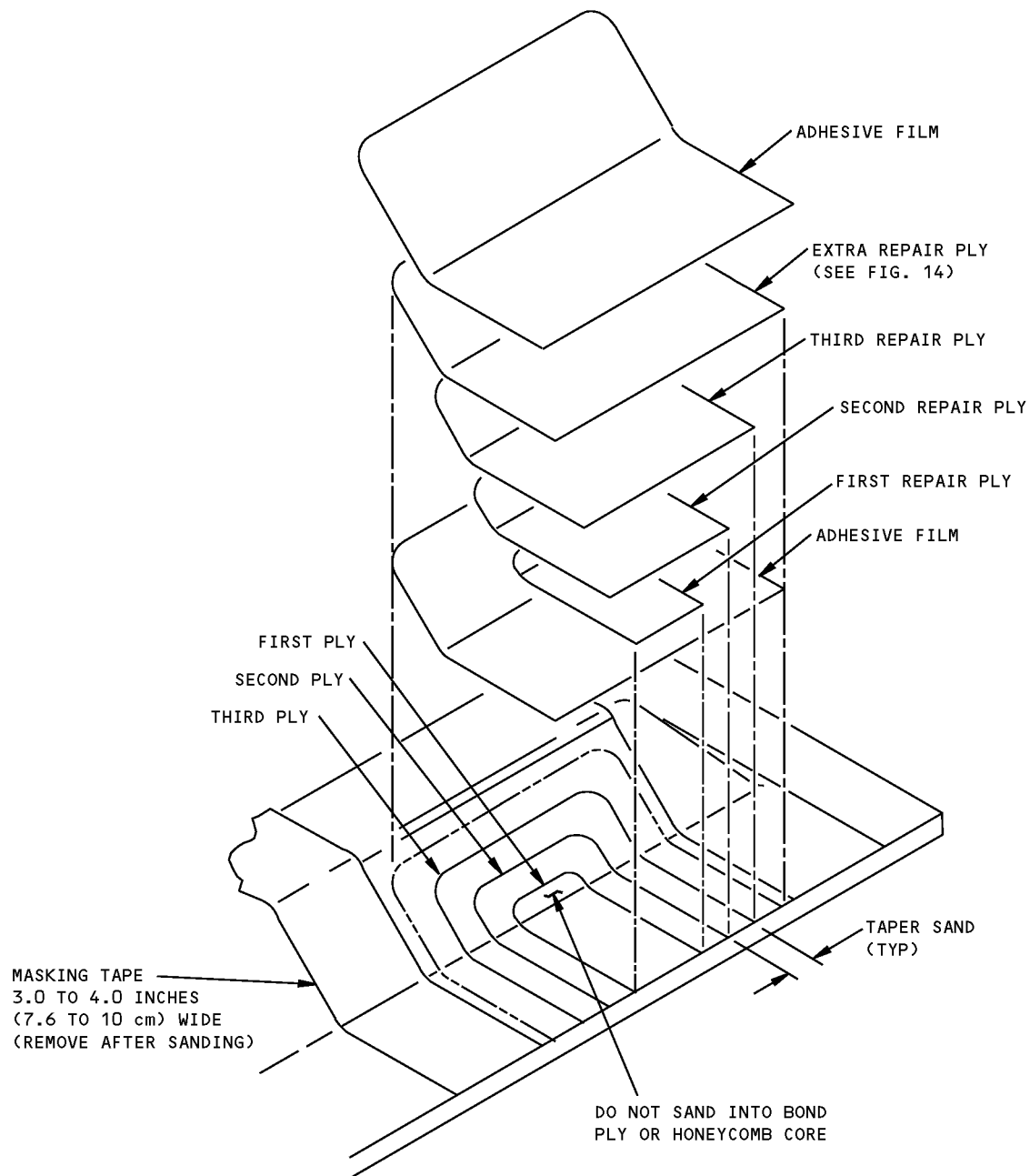
[A] DO NOT TAPER SAND SKIN OR DOUBLER PLIES OVER CORE

PREPREG LAYUP ONLY

Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel (350 Degrees F (177 Degrees C) Cure)
Figure 7

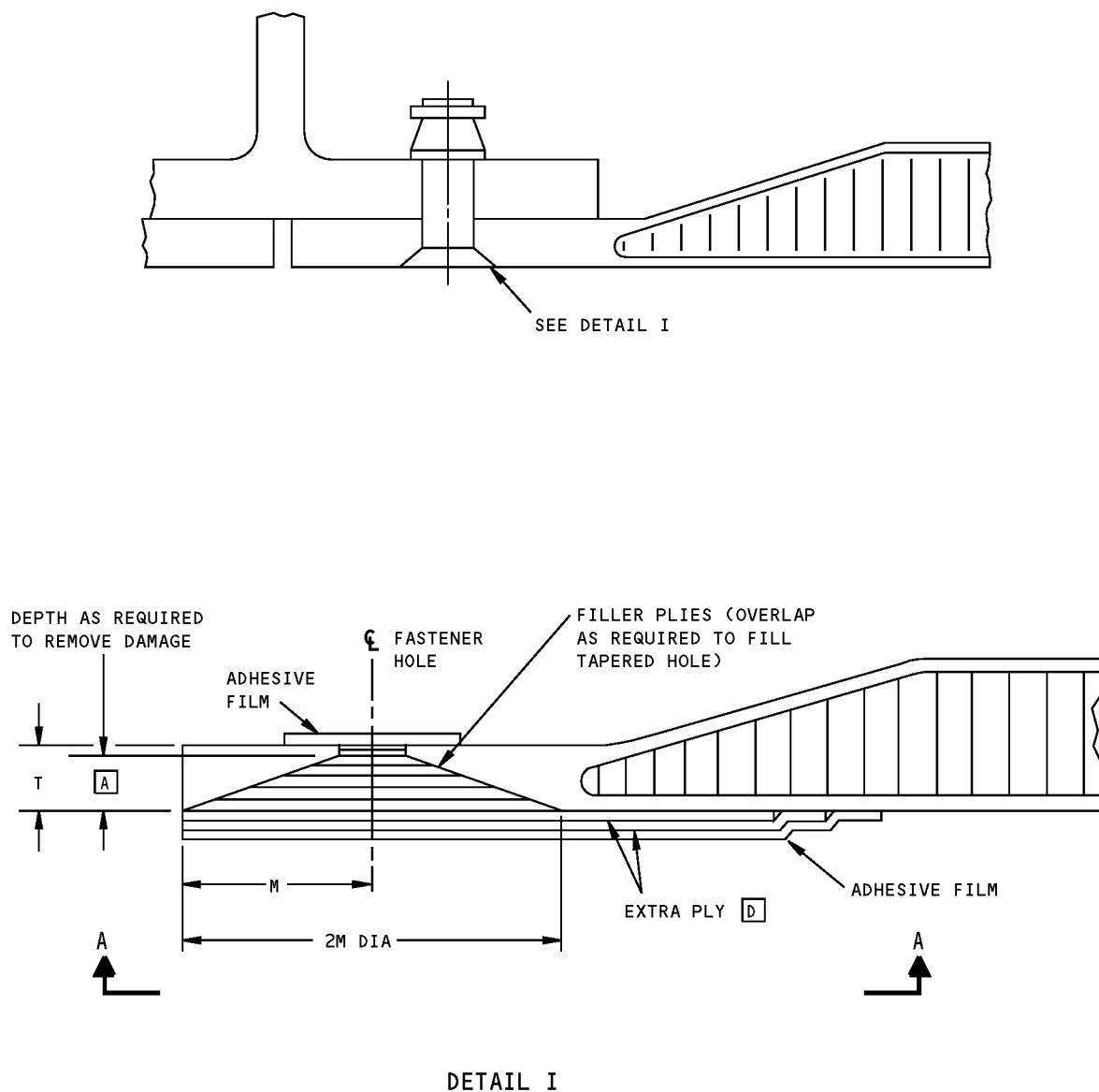
757-200

STRUCTURAL REPAIR MANUAL



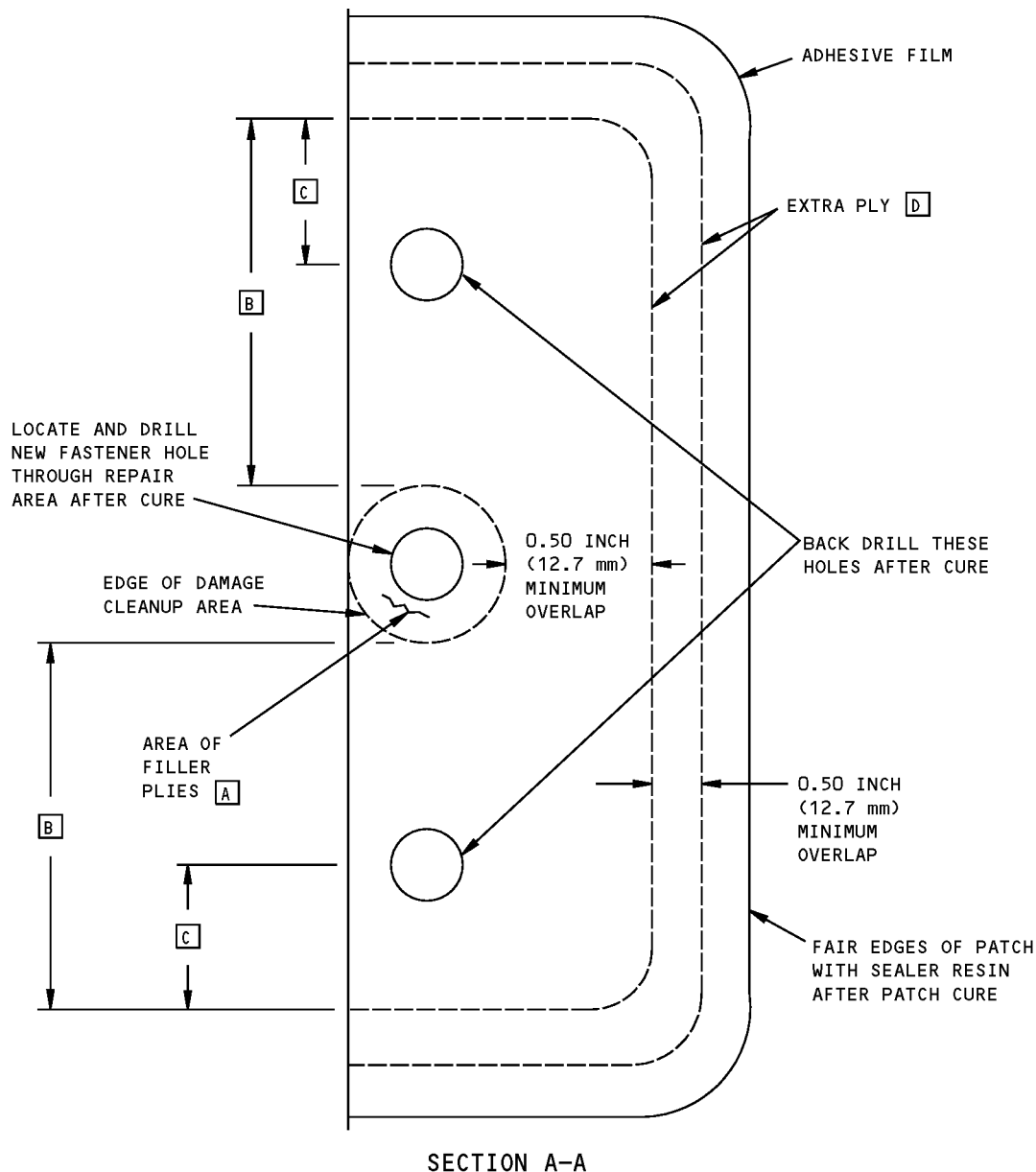
PREPREG LAYUP ONLY

Repair of Damaged Skin Plies on a Panel Edge (350 Degrees F (177 Degrees C) Cure)
Figure 8

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STRUCTURAL REPAIR MANUAL

Repair of Damaged Panel Attach Hole (350 Degrees F (177 Degrees C) Cure)
Figure 9 (Sheet 1 of 2)

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- D EQUALS FASTENER DIAMETER
- $M = 5T$ MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES

[A] APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA

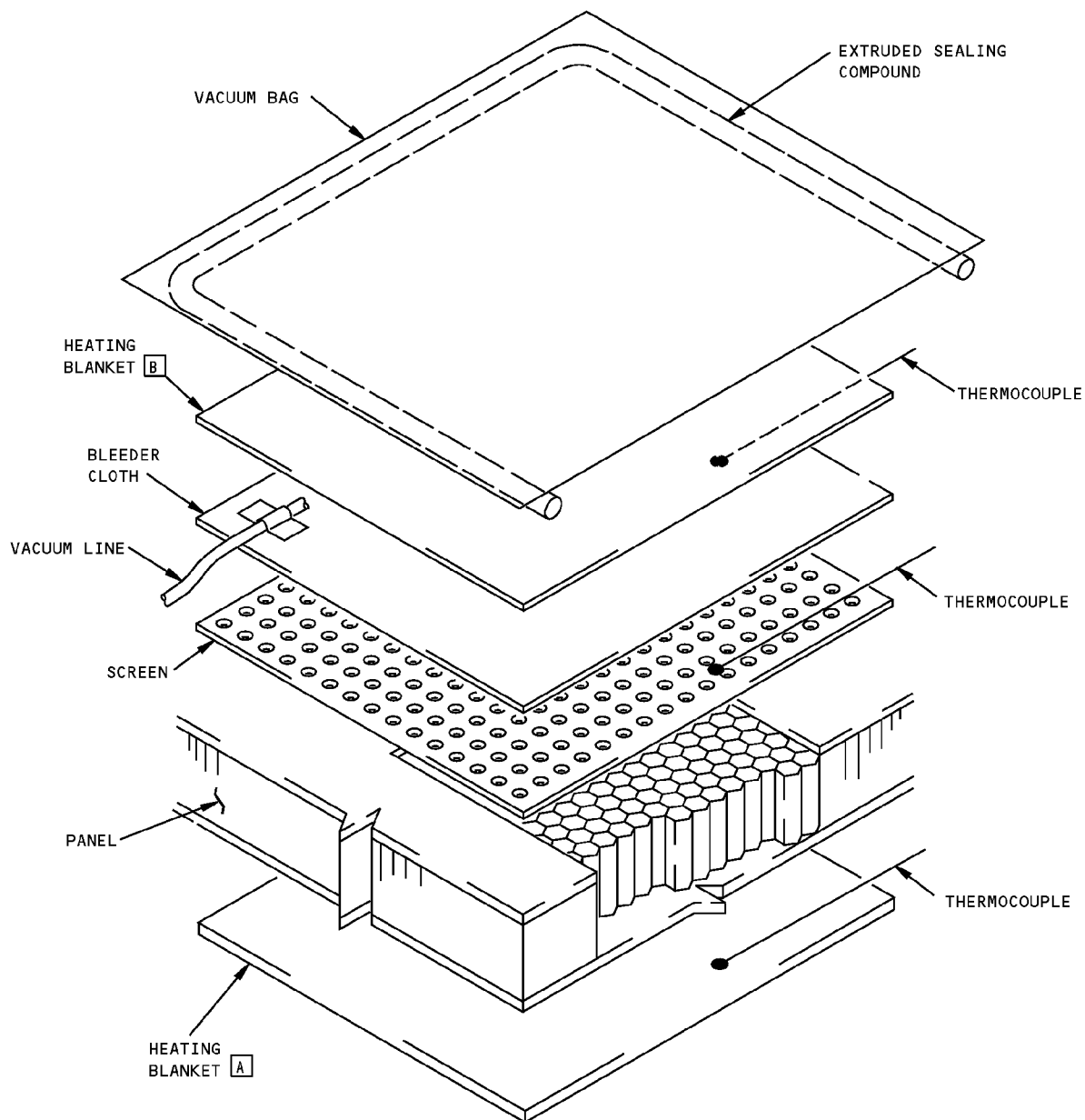
[B] EXTEND FIRST EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 0.50 INCH (12.7 mm) PAST EDGE OF DAMAGED AREA

[C] EXTEND FIRST EXTRA PLY FAR ENOUGH TO PROVIDE AT LEAST 2D EDGE MARGIN

[D] ORIENTATE EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER (SEE FIG. 15)

Repair of Damaged Panel Attach Hole (350 Degrees F (177 Degrees C) Cure)
Figure 9 (Sheet 2 of 2)

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STRUCTURAL REPAIR MANUAL

**NOTES**

- [A] PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B] ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

Water Removal from Honeycomb Sandwich
Figure 10

757-200 STRUCTURAL REPAIR MANUAL

BMS 8-139 STYLE	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS
120 A	BLACK	0.004-0.006	_____
1581 A	RED	0.008-0.012	BMS 8-139, STYLE 120 A

BMS 8-139 GLASS FABRIC PREPREG DATA

BMS 8-218 STYLE	SEPARATOR FILM COLOR	THICKNESS PER PLY, INCHES	PLY SUBSTITUTIONS
120 B	LT BLUE	0.0041	BMS 8-139, STYLE 120 B
285 B	GREEN	0.010	BMS 8-139, STYLE 1581 B

BMS 8-218 ARAMID FABRIC PREPREG DATA

CAUTION: GLASS FABRIC MUST NOT BE SUBSTITUTED FOR GRAPHITE PREPREG REPAIR PLIES.

NOTES

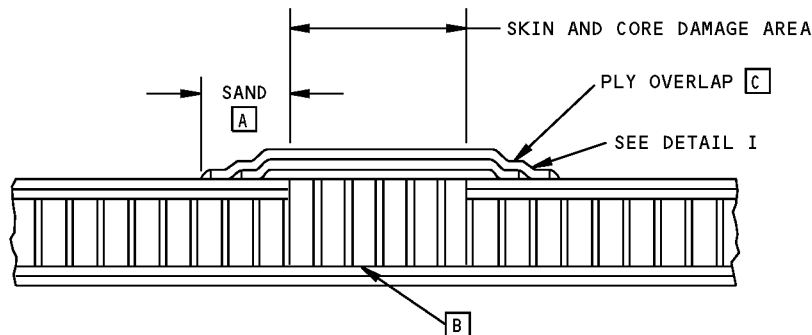
- A STYLE 1581 IS PREFERRED FOR USE AS REPAIR PLIES. THREE PLIES OF STYLE 120 MAY BE SUBSTITUTED FOR EACH PLY OF STYLE 1581.
- B BMS 8-218, STYLES 120 AND 285 ARE PREFERRED FOR USE AS REPAIR PLIES. ONE PLY OF BMS 8-139, STYLE 120 MAY BE SUBSTITUTED FOR EACH PLY OF BMS 8-218, STYLE 120 AND ONE PLY OF BMS 8-139, STYLE 1581 MAY BE SUBSTITUTED FOR EACH PLY OF BMS 8-218, STYLE 285.

BMS 8-212 OR BMS 8-256 CLASS 1	SUBSTITUTE PLIES ALLOWED BMS 8-212 OR BMS 8-256, CLASS 2 (FABRIC), STYLE:	
(TAPE) GRADE	3K-70-PW	3K-135-8H
95	1	NOT RECOMMENDED
145	2	1
190	2	1

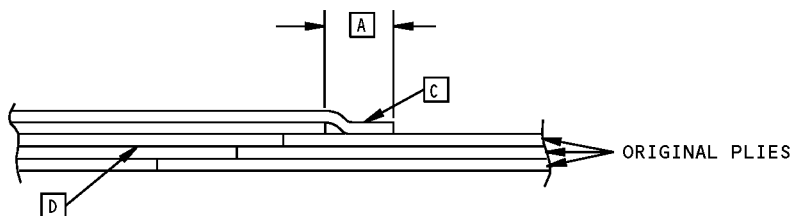
BMS 8-212 AND BMS 8-256 GRAPHITE TAPE/
FABRIC PREPREG DATA

Prepreg Fabric Ply Substitution Data
Figure 11

757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
SANDWICH STRUCTURE
(PREPREG LAYUP ONLY)



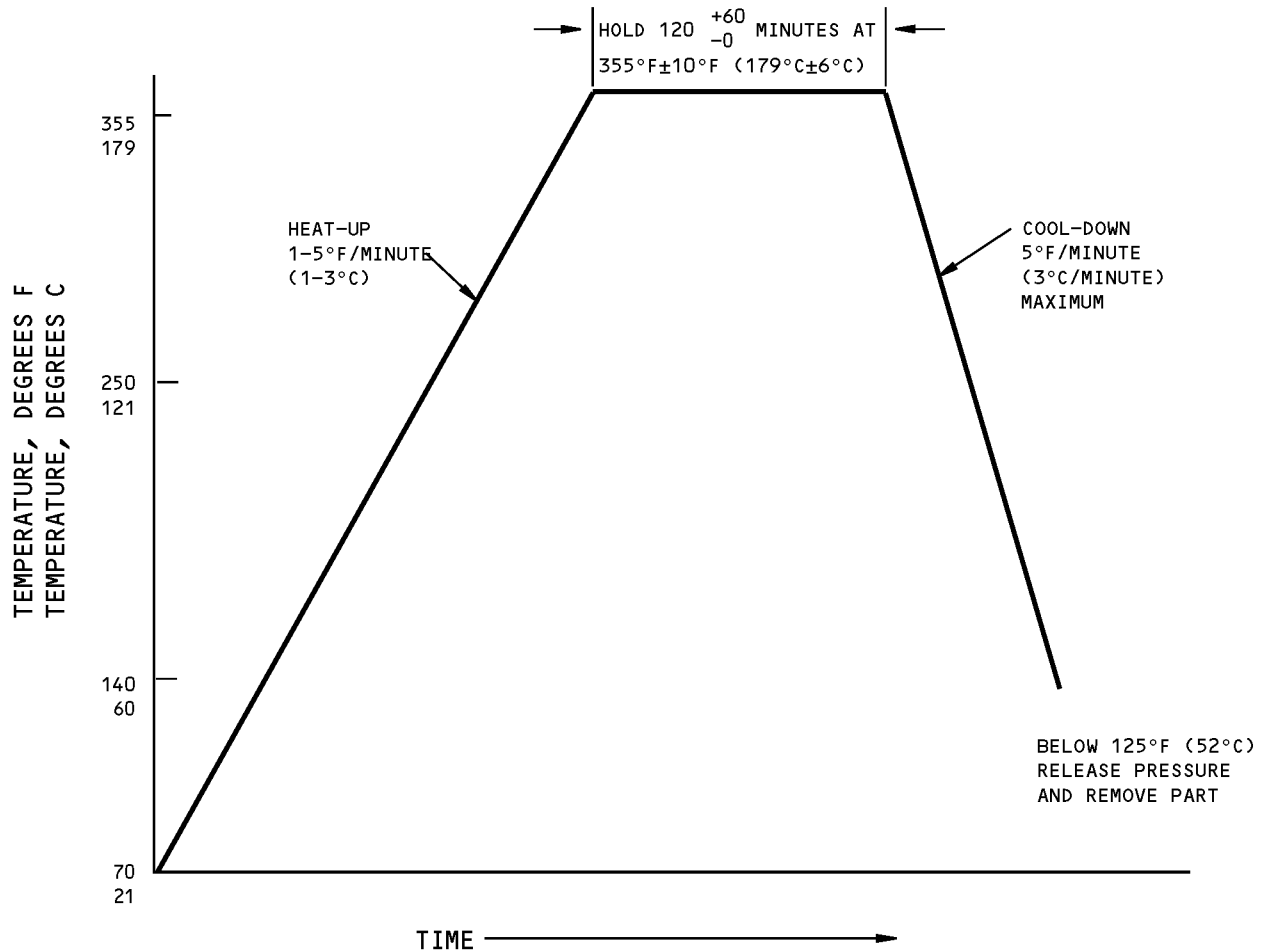
SECTION THROUGH SOLID LAMINATE PANEL
STEPPED SKIN
DETAIL I

NOTES

- | | |
|---|--|
| <p>[A] DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING</p> <p>[B] SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)</p> | <p>[C] EXTRA PLY MUST OVERLAP AT LEAST 0.75 INCH (19 mm). EACH SUCCEEDING PLY MUST OVERLAP AT LEAST 0.50 INCH (12.7 mm) PAST EDGE OF PRECEDING PLY</p> <p>[D] REMOVE DAMAGED PLIES IN STEPS OF 0.75 INCH (19 mm) FOR EACH EXISTING PLY</p> |
|---|--|

Sanding and Overlap Requirements Figure 12

757-200 STRUCTURAL REPAIR MANUAL



DURING CURE CYCLE APPLY 22 INCHES OF MERCURY (75 kPa) VACUUM MINIMUM

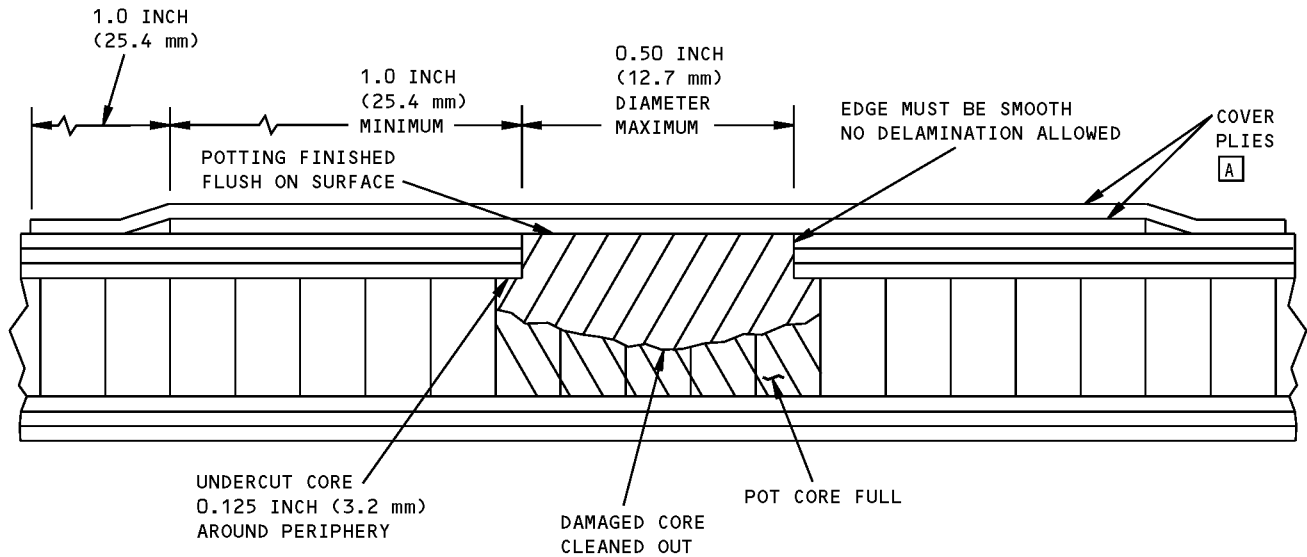
350 Degrees F (177 Degrees C) Cure Cycle for Advanced Composite Repairs
Figure 13

757-200
STRUCTURAL REPAIR MANUAL

COMPONENT MATERIAL	EXTRA PLY MATERIAL
GRAPHITE	GRAPHITE FABRIC, STYLE 3K-70-PW
ARAMID	ARAMID/EPOXY FABRIC, BMS 8-218, STYLE 285

Extra Repair Ply Materials
Figure 14

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STRUCTURAL REPAIR MANUAL



TYPICAL SECTION

NOTES

- OVERLAP COVER PLIES AS SHOWN IN FIG. 12. DO NOT TAPER SAND OR STEP SAND ANY PLIES

[A] ORIENTATE COVER PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER

Typical Puncture Repair, 0.50 Inch Diameter or Less
Figure 15

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STRUCTURAL REPAIR MANUAL

TOOL	MANUFACTURER'S DESIGNATION	MANUFACTURER	REMARKS
TEMPERATURE CONTROLLER, CONSOLE, PORTABLE SELF CONTAINED A	ATACS 8000 OR ATACS 8008	ATACS PRODUCTS, INC PO BOX 88237 SEATTLE, WA 98188	USE WITH HEAT BLANKETS, THERMOCOUPLES AND VACUUM UNIT FOR APPLICATION AND RECORDING OF HEAT AND PRESSURE

NOTE

- A** HOT BOND CONSOLES MUST HAVE THE FOLLOWING FEATURES:
- (1) CONTROL OF POWER INPUT TO HEAT BLANKETS
 - (2) PROVIDE FOR EVACUATION OF LAYUP
 - (3) CONTROL VACUUM
 - (4) CONTINUOUSLY RECORD TEMPERATURE INPUT FROM AT LEAST 1 THERMOCOUPLE
 - (5) PROVIDE MANUAL MONITORING OF AT LEAST 3 THERMOCOUPLES
 - (6) SETTING OF CURE TIME
 - (7) AUTOMATIC SHUTOFF AT END OF CURE TIME

Miscellaneous Equipment for Repair of Adhesive Bonded Components
Figure 16

STRUCTURAL REPAIR MANUAL**GENERAL - REPAIRS TO GRAPHITE OR ARAMID REINFORCED EPOXY LAMINATES AND ALUMINUM HONEYCOMB SANDWICH STRUCTURE - 200°F (93°C) TO 230°F (110°C) WET LAYUP REPAIR METHOD****1. General**

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of graphite tape or fabric or aramid fabric. The most common construction is a sandwich of two laminated skins separated by an aluminum honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands and at fitting locations. Repairs described herein use dry fabric material which is hand-impregnated with resin (wet layup) and cured at elevated temperatures. These repairs are permanent when applied using the repair manual procedures.

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR NEOPRENE GLOVES, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

WARNING: DO NOT BREATHE CARBON FIBER DUST. MAKE SURE THAT THERE IS A GOOD FLOW OF AIR WHERE YOU DO THE WORK. USE EQUIPMENT TO HELP YOU BREATHE WHEN YOU WORK IN A CONFINED SPACE. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY.

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

CAUTION: DO NOT LET CARBON FIBER DUST GO INTO ELECTRICAL EQUIPMENT. CARBON FIBER DUST IS ELECTRICALLY CONDUCTIVE AND IT CAN CAUSE SHORT CIRCUITS IF IT GOES INTO ELECTRICAL EQUIPMENT. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE ELECTRICAL EQUIPMENT.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE BARE OR ALUMINUM COATED TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY ALSO BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.

WHEN REINSTALLING ALUMINUM FITTINGS ON GRAPHITE COMPOSITE STRUCTURE, ENSURE THAT THE ORIGINAL CORROSION PROTECTIVE TREATMENT IS MAINTAINED.

- B. Use suitable holding fixtures as given in Paragraph 3.F./GENERAL to prevent distortion and delamination of the structure.

STRUCTURAL REPAIR MANUAL

- C. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- D. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts. Refer to Paragraph 3.D.(3)/GENERAL for protection when working with resin system.
- E. Store resin and/or adhesive material at 55° to 80°F (12° to 27°C) in sealed containers. An identification label must accompany the material inside the bag, with the following information: BMS type, class, grade, supplier name, batch number, and date of preparation.
- F. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials.
- G. Refer to 51-11-01, GENERAL for aerodynamic smoothness requirements.
- H. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- I. Refer to Figure 15/GENERAL for substitute repair ply material.
- J. Refer to 51-30-06, GENERAL for composite repair material ordering data.
- K. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 3./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 3.A./GENERAL	Determine Damage
Paragraph 3.B./GENERAL	Remove Water and Dry Out Damaged Area
Paragraph 3.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 3.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 3.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 3.F./GENERAL	Layup/Bagging Procedures
Paragraph 3.G./GENERAL	Cure the Repair
Paragraph 3.H./GENERAL	Refinish After Repair
Paragraph 3.I./GENERAL	Perform Post-Repair Requirements
Paragraph 4./GENERAL	Typical Repairs
Paragraph 4.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 4.B./GENERAL	Repair of Puncture, 0.50-inch Diameter or Less, in Honeycomb Panel
Paragraph 4.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50-inch Diameter

STRUCTURAL REPAIR MANUAL

Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 4.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 4.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 4.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 4.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 4.H./GENERAL	Repair of Damage and Punctures to Multiple Plies in Solid Laminate Panels
Paragraph 4.I./GENERAL	Repair of Punctures, 0.50-inch Diameter or Less, in Solid Laminate Panels
Paragraph 4.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 4.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels
Paragraph 4.L./GENERAL	Repair of Surface Dents

2. References

Reference	Title
51-11-01, GENERAL	Aerodynamic Smoothness - RB211-535 Engine Nacelle
51-30	REPAIR MATERIALS
51-30-06, GENERAL	Order Data for Composite Repair Materials
51-70-16, GENERAL	Hole Drilling and Machining of Composite Structure
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-03	Standard Overhaul Practices Manual
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

3. Repair Procedures Common to Various Repairs**A. Determine Damage.**

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT BEFORE MAKING DAMAGE EVALUATIONS.

- (1) Examine visually for extent of damage.
- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic methods. Remove contaminants. Refer to Paragraph 3.B./GENERAL for water removal instructions.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental NDI methods or by tap test. For tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bonded area. Refer to NDT Part 1, 51-05-01.

B. Remove Water and Dry Out Damaged Area.

STRUCTURAL REPAIR MANUAL

- (1) Remove water from honeycomb sandwich (Refer to Figure 5/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum and oil-free compressed air.
 - (b) Sand the core to remove the adhesive. Removal of adhesive fillets on core is not required.
 - (c) Apply a fiberglass or metallic fine mesh screen over exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) When opposite face is accessible, apply thermocouple to the opposite side of honeycomb sandwich panel.
 - (f) When opposite face is accessible, apply heating blanket to opposite side of honeycomb sandwich panel.

NOTE: When opposite face is accessible, it is acceptable to heat the area using a heating blanket only on the opposite face. An additional heating blanket and vacuum application may be used on the near face at the location shown in Figure 5/GENERAL. Additional heating blanket accelerates water removal. When opposite face is inaccessible, use of a heating blanket on the near side is required.

- (g) When opposite face is inaccessible or when using additional heating blanket, perform the following steps:
 - 1) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - 2) Apply a thermocouple to the center of the bleeder cloth. Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
 - 3) Place the heating blanket over the bleeder cloth.
 - (h) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
 - (i) Evacuate the layup to vacuum of 22 in/Hg (75 kPa) minimum.
 - (j) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
 - (k) Remove bagging materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
 - (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
 - (b) Heat the area for 1 hour minimum at 180°F (82°C) to 210°F (99°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.

C. Remove Damage and Prepare Damaged Area.

- (1) Damage removal.
 - (a) Trim out the damaged lamination to a smooth shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.
 - (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. The core area removed should extend at least 0.50 in. (12.7 mm) further than visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side.

STRUCTURAL REPAIR MANUAL

- (c) In areas where contamination cannot be removed by cleaning or drying as given in Paragraph 3.B./GENERAL, remove the contaminated structure along with the other damage.
- (d) When opposite inner skin is also damaged, trim out the damage to a smooth shape as described in Paragraph 3.C.(1)(a)/GENERAL.
- (e) When core is removed from inner surface of opposite skin, do not remove adhesive fillets from skin.
- (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

SANDING MUST NOT EXPOSE OR DAMAGE FILAMENTS IN EACH PLY WHEN STEP SANDING OR IN THE PLY BONDED TO THE CORE (FIGURE 8/GENERAL).

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

- (2) Preparation of damaged area (Refer to Figure 6/GENERAL).

- (a) Determine the number and orientation of plies that have been cut. Mask off area around the cutout allowing 0.75 in. (19 mm) minimum for each ply replacement and each extra ply.

NOTE: Where the number of plies is not apparent, refer to the applicable component structure identification or engineering drawing.

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
 - 1) Remove the paint finish or Tedlar film in the masked off area using No. 240 or finer Scotch-Brite abrasive, or No. 150 or finer sandpaper.
 - 2) Taper or step sand each ply or simply abrade by rough sanding around the cleaned up damage a minimum of 0.75 in. (19 mm) per ply. Refer to Paragraph 3.C.(2)(a)/GENERAL.
 - 3) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damage area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
- (c) External surface of panel (critical aerodynamic surfaces).

STRUCTURAL REPAIR MANUAL

- 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over a minimum distance of 0.75 in. (19 mm) for each existing ply of the laminate. Refer to Paragraph 3.C.(2)(a)/GENERAL to determine the required distance. Step sanding as given in Paragraph 3.C.(2)(b)2)/GENERAL may be done instead of taper sanding. Refer to 51-11-01, GENERAL for locations of areas of critical aerodynamic smoothness. Taper sanding must always be done on solid laminate structures.

NOTE: For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.

- 2) Remove exterior finishes, including enamel finish and conductive coating from the surface of the 0.75 in. (19 mm) border using No. 150 or finer sandpaper.

(d) Edgeband of panel.

- 1) Taper sand panel edgeband as given in Paragraph 3.C.(2)(c)/GENERAL.

NOTE: Edgeband is the solid laminate around the outer periphery of the honeycomb panel.

(e) Cleaning of repair area.

- 1) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.
- 3) Perform water break test on both sides of repair elements after removing peel plies. Apply deionized or distilled water with an atomizing spray to cover the area.

NOTE: An acceptable surface will momentarily support an unbroken film of water for approximately 30 seconds. If surface is not acceptable, repeat surface preparation and apply water break test.

- 4) Remove the majority of the water with clean cheesecloth.
- 5) Force dry at 180°F (82°C) to 200°F (93°C) for 60 to 90 minutes to remove all trace of moisture. The rate of temperature rise must not exceed 5°F (3°C) per minute.

D. Fabricate, Clean, and Install Honeycomb Replacement Core Plug.

(1) Fabricate core plug.

- (a) Fabricate core plug from core called out on engineering drawing. Refer to specific component structural identification section to determine type of core called out on engineering drawing.

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- (b) For butt splicing, the honeycomb core plug should fit flush with original core and with ribbon direction the same as in original core. The replacement core must overlap and make intimate contact with the cell walls of surrounding core material.
- (c) Trim core plug full depth using a 200-grit high speed sounding disk to original core as given in Paragraph 3.C.(1)(b)/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of extra plies of fabric cloth and adhesive between core plug and undamaged core or skin.

- (2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT EXCEED IMMERSION CRITERIA GIVEN IN PARAGRAPH 3.D.(2)(A)/GENERAL. DAMAGE TO CORE MATERIAL WILL OCCUR.

DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99) bath for 60 seconds, or vapor degrease core (Refer to SOPM 20-30-03) limiting immersion to 30 seconds per cycle for a maximum of 4 cycles.
 - (b) Locally contaminated areas can be wiped with solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99).
 - (c) The core must be completely dry, clean, and free of evidence of solvents before installation.
- (3) Install core plug (Refer to Figure 3/GENERAL, Figure 7/GENERAL, Figure 11/GENERAL, Figure 12/GENERAL, Figure 13/GENERAL, and Figure 14/GENERAL).

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WARNING: BREATHING VAPORS OR ALLOWING RESIN COMPONENTS TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR PROTECTIVE CLOTHING AND EYE GOGGLES. NEOPRENE GLOVES WITH COTTON LINERS SHOULD BE USED FOR HAND PROTECTION. GLOVES AND LINERS SHOULD BE USED FOR A MAXIMUM OF 2 HOURS AND DISCARDED. HANDS SHOULD BE WASHED WITH SOAP AND WATER IMMEDIATELY AFTER REMOVAL OF GLOVES AND LINERS. IF GLOVES NEED TO BE REMOVED DURING USE OR A PUNCTURE IS SUSPECTED THEY SHOULD BE REPLACED WITH NEW GLOVES AND COTTON LINERS. IF CHEMICAL CONTACT OCCURS WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

- (a) If one skin is undamaged and for full core depth replacement apply two plies of BMS 9-3, Type H-2 or H-3 fiberglass fabric or four plies of BMS 9-3, Type D fiberglass fabric saturated with Resin Mix 2 as given in Paragraph 3.E./GENERAL to the undamaged skin in the repair cavity.
- (b) If both skins of the panel are damaged, repair one surface of the panel and replacement core plug. Repair other surface with subsequent repair cycle. Refer to Paragraph 3.E./GENERAL.
- (c) For butt splicing, apply uniform coat of Resin Mix 1 around core plug.

NOTE: It is optional to apply the resin to the inside surface of the existing core instead of to the core plug.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (d) Apply Resin Mix 3 to lower face of the core plug.
- (e) Insert the core plug into the core cavity. Orient the ribbon direction to align with the original core ribbon.
- (f) Layup materials and equipment in place as given in Figure 4/GENERAL. If access is available and where damage extends through both face skins use heating blanket and vacuum bag both sides of the panel using the layup shown in Figure 3/GENERAL.

NOTE: A heat lamp may be used in lieu of a heating blanket to gel the core bonding and potting resin. Refer to heat lamp temperature cure, Figure 7/GENERAL.

- (g) Evacuate the repair area to a vacuum of 22 in/Hg (75 kPa) minimum.

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- (h) Cure to the specified cure temperature in the component repair chart and the cure cycle chart on Figure 1/GENERAL.

NOTE: Gelation of the potting resin will occur after 20 minutes at 150°F (66°C). After gelation period of 20 minutes, the heat may be turned off to allow core sanding and application of repair plies. The wet layup skin-to-core bonding plies can then be cured concurrently with the skin repair plies to the required repair cure temperature. Monitor bondline temperatures throughout the cure. Failure to reach the necessary cure temperature for the specified cure period is cause for rejection of the repair.

- (i) Allow the repair area to cool under vacuum until the temperature of the repair area is 140°F (60°C) or less. Then release restraints (if applicable) and remove layup materials and equipment.
- (j) Sand core plug approximately flush with surrounding material, making allowance for adhesive and slight core crush during cure.
- (k) Vacuum to remove sanding residue from core cells.

NOTE: The above procedure is based on the core plug installation being cured separately from the repair plies. As an option, core plug installation and repair plies may be cured at the same time. When this option is used, ensure that temperature on both sides of panel is equal by using thermocouples in both adhesive films.

E. Prepare and Apply Repair Plies.

NOTE: Refer to applicable paragraphs for preparation of graphite fabrics.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

(1) Prepare glass fabric repair plies (BMS 9-3).

- (a) Refer to the component structure identification to determine number, style, and orientation of glass fabric used in original structure. Refer to specific structural component repair section for extra repair ply requirements. Refer to Figure 15/GENERAL for substitution of glass fabric repair plies.
- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. Each repair ply must be of equivalent thickness and the same orientation as the original plies. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 18/GENERAL for extra repair ply material and orientation.

- (c) When replacing ply over core, a filler ply the size of the cutout is required to minimize surface depression.
- (d) Impregnate repair plies with resin as given in Paragraph 3.E.(3)/GENERAL.
- (2) Prepare graphite fabric repair plies (BMS 9-8).

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- (a) Refer to the specific structural component identification to determine number, style, and orientation of graphite fabric used in original structure. Refer to the structural component repair section for extra repair ply requirements. Refer to Figure 15/GENERAL for substitution of dry fabric plies for existing prepreg materials.

- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. Each repair ply must be of equivalent thickness and the same orientation as the original plies. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 16/GENERAL for extra repair ply material and orientation.

- (c) When replacing ply over core a filler ply the size of the cutout is required to minimize surface depression.

- (d) Impregnate repair plies with resin as given in Paragraph 3.E.(3)/GENERAL.

- (3) Impregnate repair plies with resin.

- (a) Cut two pieces of parting film approximately 3.0 in. (7.6 cm) larger all around than the fabric and tape down one piece to a smooth surface.

NOTE: Use Teflon film or other parting films.

- (b) Lay fabric (Refer to Figure 15/GENERAL) onto parting film.

NOTE: Cut a piece of fabric that is large enough for cutting the required number of plies for the repair patch.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (c) Pour Resin Mix 2 to adequately cover fabric and spread out to evenly coat the fabric.
- (d) Cover fabric with parting film.
- (e) Work resin thoroughly and evenly into fabric with squeegee or roller in order to impregnate the fabric and to remove entrapped air.
- (f) Work excess resin to edges of fabric such that fabric weave is barely visible.

NOTE: Resin content of the impregnated fabric should be 55 ± 5 percent by weight.

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- (g) Cut the impregnated fabric to the required sizes for each individual ply of the patch. The parting film on both sides of the fabric decreases fraying of the edges while cutting the fabric.

NOTE: The total number of repair plies is to be in accordance with Paragraph 3.E.(2)/GENERAL. Refer to Figure 6/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired. Where repair plies are to be applied over an exposed honeycomb core a filler ply the same size as the cutout is required to minimize surface depression. Extra repair plies must be installed as specified in individual structural component repair sections.

- (4) Apply repair plies

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with filler plies before application of the repair plies.

CAUTION: ENSURE THAT PARTING FILM IS REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Thoroughly coat face of exposed honeycomb core with Resin Mix 3 just prior to applying repair plies. Use of roller for resin application is recommended.
- (b) Remove parting film from one side of the smallest ply of the patch and place the exposed face against the repair area with orientation as in original structure.

NOTE: The filler ply applied over the honeycomb core is to have the same orientation as the first repair ply.

- (c) Use a squeegee over the parting film that covers the patch to remove wrinkles and entrapped air. Do not apply excessive pressure. Excessive pressure will produce a patch deficient in resin.
- (d) After removing parting film from the contact faces, place the next larger size ply of the impregnated patch over the ply on the repair area with proper orientation and with overlap all around as shown in Figure 6/GENERAL.
- (e) Place succeeding plies of the patch as described in Paragraph 3.E.(4)(c)/GENERAL and Paragraph 3.E.(4)(d)/GENERAL.
- (f) Proceed to layup/bagging procedure.

F. Layup/Bagging Procedure (Figure 3/GENERAL)

- (1) Place a layer of perforated FEP parting film (1 mil thick) over the repair. Cut the FEP so that the edges extend 3 in. (7.6 cm) beyond the edge of the repair patch.
- (2) Secure three thermocouples (spaced evenly around repair) to the panel at the edge of the repair and secure them to the appropriate recorders.

NOTE: Thermocouples should not exceed 0.0625 in. (1.59 mm) in total diameter.

- (3) Place a layer of dry peel ply or Style 120 glass fabric (BMS 9-3 Type D) or equivalent thickness glass fabric over the perforated FEP as a surface bleeder. Cut the surface bleeder so that the edges extend 2 in. (5 cm) beyond the edge of the perforated FEP.
- (4) Place a layer of solid FEP parting film (2 mil thick) over the surface bleeder. Cut the solid FEP so that the edges are even with the edge of the perforated FEP.

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- (5) Place a layer of Airweave SS or open weave glass fabric over the solid FEP as a surface breather. Cut the surface breather so that the edges extend to the edge of the surface bleeder along the edges.
- (6) Secure a vacuum line on the edge of the surface breather.

WARNING: USE HEAT CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE INJURY TO PERSONNEL.

- (7) If a heat blanket is used as a heat source, perform the following steps:

NOTE: A heat blanket or equivalent heat source may be used to cure the repair. Infrared heat lamps are not recommended for accelerated cures above 180°F (82°C).

If the repair is made on a structure too small to allow the heat blanket to be vacuum bagged, proceed to Paragraph 3.F.(8)/GENERAL and place heat blanket over the vacuum bag. A second vacuum bag may then be placed over the part to hold the heat blanket in place.

- (a) Place a heat blanket over the surface breather. The heat blanket must extend a minimum of 2 in. (5 cm) beyond the repair patch edges.

NOTE: When using a heat blanket larger than 12 in. (30 cm) on one side, an aluminum caul plate (0.016 in. (0.4 mm) thick) can be used under the heat blanket to minimize localized heating. Make the caul plate slightly smaller than the surface breather.

- (b) Place controlling thermocouple over the center of the heat blanket.
 - (c) Place 4 to 6 layers of glass fabric over the heat blanket. The glass fabric will insulate the heat blanket and prevent damage to the bagging film.
- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.
 - (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. It is optional to vacuum bag the entire part.

NOTE: The entire part must be vacuum bagged and restrained in place to prevent delamination and distortion when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts where sagging and distortion could occur due to the weight of the part.

- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 20 in/Hg (68 kPa) minimum during entire cure cycle.
- (11) Check the vacuum bag for leak paths.
- (12) Cure the repair as given in Paragraph 3.G./GENERAL.

STRUCTURAL REPAIR MANUAL**G. Cure the Repair**

NOTE: Determination of the temperature must be made by using thermocouples placed at edge of patch.

In honeycomb panels, for repairs to both skins or single skin and partial depth core replacement using a septum, thermocouples must be located in both repair surfaces to monitor cure temperatures.

When using a hot bond repair console, consult manufacturer's operating instructions.

WARNING: USE EXPLOSIONPROOF EQUIPMENT DURING CURE. NONCOMPLIANCE COULD CAUSE INJURY TO PERSONNEL.

CAUTION: SURFACE TEMPERATURE MUST NOT EXCEED CURE TEMPERATURE SPECIFIED IN THE COMPONENT REPAIR CHART. DAMAGE OR DISTORTION OF STRUCTURE MAY OCCUR IF TEMPERATURE EXCEEDS THAT SPECIFIED.

- (1) For Resin Mix 1 (Figure 1/GENERAL) raise the temperature at a maximum rate of 8°F (4.5°C) per minute to follow the cure cycle temperature-time profile shown in Figure 4/GENERAL. Determine cure temperature from thermocouple at the edge of the repair ply that has the lowest reading.
- (2) For Resin Mix 2 and 3 (Figure 1/GENERAL) heat the repair area to 180°F (82°C) to 210°F (99°C) and hold cure temperature for a minimum of 4 hours. Use thermocouples on both sides of repair to verify the cure temperature. Apply and maintain a minimum of 20 in/Hg (68 kPa) vacuum during the entire cure cycle.

NOTE: Cure time does not include the time required for the mold and part to heat up to temperature. Cure time is the period after the part has reached that temperature.

- (3) Cool down repair after cure period at a rate of 5°F (3°C) per minute maximum while still maintaining vacuum.
- (4) When the repaired area has cooled to less than 140°F (60°C), release vacuum pressure and remove vacuum bagging materials and other layup materials.

H. Refinish After Repair

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of top most repair ply as necessary to fair the edge. Sand surface of repair to produce a smooth finish without damaging fibers.

I. Perform Post-Repair Requirements

- (1) Inspect completed repairs for voids or bonding flaws using instrumented nondestructive inspection methods. Inspection should cover an area that includes a band 2 in. (5 cm) minimum around the area heated. If a defective repair is indicated by the inspection, remove and install the repair again.

NOTE: For NDI procedures, refer to 757 Nondestructive Test Manual, D634N301.

- (2) Where instrumented NDI methods are not available, tap testing may be used for interim inspection of the completed repair. Use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bonded area. Tap testing is not considered a reliable method for inspecting the finished repair. Instrumented NDI methods should be used to confirm repair integrity at the earliest opportunity.

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- (3) Check all repairs for clearance and noninterference with operation of control surfaces. Ensure adequate clearances for all repaired parts.

4. Typical Repairs

NOTE: These repairs apply to all graphite fabric reinforced honeycomb components, when called out in applicable repair index of specific structure.

CAUTION: ESTABLISH COMPONENT MATERIAL AND REPAIR LIMITS PRIOR TO PROCEEDING WITH ANY REPAIRS.

A. Repair of Delaminations Between Plies

- (1) Delamination of plies over core area of panel (Figure 8/GENERAL).
- (a) Determine damage as given in Paragraph 3.A./GENERAL. Ensure that water and other contamination are removed as given in Paragraph 3.B./GENERAL.
 - (b) Cut away delaminated plies as given in Paragraph 3.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area as given in Paragraph 3.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.
- (2) Repair of delaminations between plies of panel edgeband.
- (a) Determine damage as given in Paragraph 3.A./GENERAL.
 - (b) Remove all contaminants and water from damaged area. Area must be completely dried out as given in Paragraph 3.B./GENERAL.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (c) Force Resin Mix 2 (Figure 1/GENERAL) into delaminated area with a spatula or equivalent.
 - (d) Clamp plies together and remove excess resin.
 - (e) Cure according to Paragraph 3.G./GENERAL, maintaining pressure until cured. Vacuum pressure is not required for this repair.
 - (f) Refinish surface as given in Paragraph 3.H./GENERAL.
 - (g) Perform applicable post-repair requirements as given in Paragraph 3.I./GENERAL.
- B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or less, in Honeycomb Panel**
- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
 - (2) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper as given in Paragraph 3.C./GENERAL.

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- (3) Dry out structure around puncture as given in Paragraph 3.B./GENERAL.
- (4) Remove loose fragments and other contamination from the hole. Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
- (5) Clean repair area as given in Paragraph 3.C.(2)(e)/GENERAL.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (6) Prepare resin mix 1 as given in Figure 1/GENERAL.
- (7) Work resin into the hole filling as much as possible.
- (8) Cure as given in Paragraph 3.G./GENERAL.
- (9) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.254 mm).

NOTE: A 0.010 in. (0.254 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (10) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
 - (11) Clean repair area as given in Paragraph 3.C.(2)(e)/GENERAL.
 - (12) Prepare and apply two fabric cover plies with the same orientation as original surface ply as given in Paragraph 3.E./GENERAL. Refer to Figure 15/GENERAL for repair ply substitute materials.
 - (13) Complete repair as given in Paragraph 3.F./GENERAL through Paragraph 3.I./GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Refer to Figure 9/GENERAL)
- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
 - (2) Ensure that all contamination and water are removed from damaged area as given in Paragraph 3.B./GENERAL.
 - (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 3.D./GENERAL.
 - (5) Prepare and apply repair plies and complete repairs as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Refer to Figure 10/GENERAL)

NOTE: For repair where access to inner surface is limited, refer to Paragraph 4.F./GENERAL.

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove all contamination and water from damaged area. Refer to Paragraph 3.B./GENERAL.
- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.

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- (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 3.D./GENERAL, except it is not necessary to vacuum bag the core plug installation at this time.
- (5) Prepare and apply repair plies to one surface of the panel as given in Paragraph 3.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
- (6) Bag repair and cure as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
- (7) Sand core plug approximately flush with surrounding material, making allowance for slight core crush during cure.
- (8) Prepare and apply repair plies to the other surface of the panel as given in Paragraph 3.E./GENERAL.
- (9) Bag repair and cure as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL.
- (10) Refinish the repair as given in Paragraph 3.H./GENERAL.
- (11) Perform applicable post-repair requirements as given in Paragraph 3.I./GENERAL before returning the repaired component to flight service.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

E. Replacement of Honeycomb Core on Damaged Edge of Panel (Refer to Figure 11/GENERAL)

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL.
- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
- (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 3.D./GENERAL.
- (5) Clean surfaces as given in Paragraph 3.C.(2)(e)/GENERAL.
- (6) Prepare and apply repair plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.

F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side Only (Refer to Figure 12/GENERAL)

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side. Refer to Figure 12/GENERAL when making this repair.

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Ensure that all contamination and water are removed from damaged area. Refer to Paragraph 3.B./GENERAL.
- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL and do the following:

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- (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + 1.5 \times [N \times (1.0 \text{ in. (25.4 mm) for each ply}]$

d = major diameter of oval hole in inner skin and is limited to 1.5 in. (38 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval shaped hole, refer to Figure 12 (Sheet 1), Detail I.
- (c) Sand the outer skin plies as given in Paragraph 3.C.(2)/GENERAL.
- (4) Fabricate an airtight patch, (Figure 12/GENERAL, Details I through IV) to cover the oval hole from the inaccessible side as follows:
- (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
- (b) Cover the mold with parting film or release agent.
- (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 3.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D diameter.
- (d) Bag and cure the patch as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL. Place thermocouples at the edge of the patch before cure.
- (e) Remove the patch from the mold.
- (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.
- (g) Drill a 1/8 inch (3.2 mm) diameter hole in the center of the patch for a Cleco fastener.
- (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
- (i) Fabricate a strip of spring steel 1.0 x 10.0 inches (2.5 x 25 cm) and drill a 1/8 inch (3.2 mm) diameter hole in the center for the Cleco fastener.

NOTE: This repair illustrates the use of a spring steel clamp. However, any suitable retaining method may be used.

- (j) Assemble the patch and spring steel together with a 1/8 inch (3.2 mm) diameter Cleco fastener, refer to Figure 12 (Sheet 2), Detail II.
- (5) Abrade the underside of the inner skin to a distance of 0.75 in. (19 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean out the repair area with oil-free compressed air. Wipe the surface with a clean cloth moistened with solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99). Wipe dry with clean cotton cloth before solvent evaporates.

STRUCTURAL REPAIR MANUAL

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (7) Bend up both ends of the spring steel and apply Resin Mix 2 (Refer to Figure 1/GENERAL) to the upper side of the patch as shown in Figure 12 (Sheet 2), Detail III.
 - (8) Holding the spring steel up - insert the patch into the oval hole, and orientate so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin. (Refer to Figure 12 (Sheet 2), Details III and IV).
 - (9) Cure the adhesive as given in Paragraph 3.G./GENERAL. When cure is complete, remove the Cleco fastener and spring. Fill hole for the Cleco fastener with Resin Mix 1, BMS 5-25 or BMS 5-92. Allow this to cure at 150°F (66°C) for 20 minutes.
 - (10) Clean out the repair area as given in Paragraph 4.F.(6)/GENERAL.
 - (11) Prepare repair plies as given in Paragraph 3.E./GENERAL.
 - (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin (Refer to Figure 12 (Sheet 3)).
 - (13) Fabricate, clean, and install core plug as given in Paragraph 3.D./GENERAL.
 - (14) Prepare and apply repair plies to the outer skin surface of the panel and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Refer to Figure 13/GENERAL)
- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
 - (2) Remove all contamination and water from damaged area. Area must be completely dried out. Refer to Paragraph 3.B./GENERAL.
- CAUTION:** DO NOT SAND INTO BOND PLY OR CORE (FIGURE 13/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR. BOND PLY IS ADJACENT TO CORE.
- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
- CAUTION:** ON HYBRID PANELS, ENSURE THAT GRAPHITE REPAIR PLIES DO NOT EXTEND INTO AREAS OF FASTENER HOLES. ELECTROLYSIS BETWEEN METAL FASTENERS, SUPPORT STRUCTURE AND GRAPHITE MAY OCCUR CAUSING CORROSION TO ALUMINUM STRUCTURES.
- (4) Prepare and apply repair plies and complete repairs as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.
- H. Repair of Damage and Punctures in Solid Laminate Panels (Refer to Figure 19/GENERAL)
- NOTE:** This repair applies to components made from laminated fabric and/or tape plies and epoxy resin without a honeycomb core.
- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.

STRUCTURAL REPAIR MANUAL

- (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.

- (3) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.

NOTE: Taper sand edges of plies around repair on damaged side of panel.

- (4) Prepare and apply repair plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.

I. Repair of Punctures, 0.50 in. (12.7 mm) Diameter or Less, in Solid Laminate Panels (Figure 18/GENERAL)

- (1) Determine extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper as given in Paragraph 3.C./GENERAL.
- (3) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL. Area must be completely dried out.
- (4) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape as given in Paragraph 3.C./GENERAL.
- (5) Clean repair area as given in Paragraph 3.C.(2)(e)/GENERAL.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (6) Prepare Resin Mix 2, including 42 percent ± 3 percent milled glass fiber, as given in Figure 1/GENERAL.
- (7) Work resin into the hole filling as much as possible.
- (8) Cure as given in Paragraph 3.G./GENERAL.
- (9) Carefully sand any projecting material to fair with surrounding surface within ± 0.010 in. (0.254 mm).

NOTE: A 0.010 in. (0.254 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (10) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
- (11) Clean repair area as given in Paragraph 3.C.(2)(e)/GENERAL.

STRUCTURAL REPAIR MANUAL

- (12) Prepare and apply two fabric cover plies and complete repair as given in Paragraph 3.E./GENERAL through Paragraph 3.I./GENERAL.

NOTE: Refer to specific component structure identification for laminate material and orientation as the original surface plies.

For aramid, fiberglass or hybrid laminates, use fiberglass repair plies with the same orientation as the original surface plies.

Refer to Figure 15/GENERAL for repair ply substitutions.

J. Repair of Delaminations Between Plies in Solid Laminate Panels

NOTE: This repair applies to components made from laminate aramid or graphite fabric or tape plies and epoxy resin without a honeycomb core.

- (1) Repair delaminations using methods described in Paragraph 4.H./GENERAL.

K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels (Refer to Figure 14/GENERAL)

- (1) Determine the extent of damage as given in Paragraph 3.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 3.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage as given in Figure 14/GENERAL and Paragraph 3.C.(2)(b)/GENERAL and Paragraph 3.C.(2)(c)/GENERAL.
- (4) Clean area as given in Paragraph 3.C.(2)(e)/GENERAL.
- (5) Prepare and apply repair plies as given in Paragraph 3.E./GENERAL and shown in Figure 14/GENERAL.
- (6) Bag repair and cure as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL.
- (7) Refinish the repair as given in Paragraph 3.H./GENERAL.
- (8) Drill and countersink fastener holes. Refer to 51-70-16, GENERAL for drilling composite structure.
- (9) Perform applicable post-repair requirements as given in Paragraph 3.I./GENERAL before returning the repaired component to flight service.

L. Repair of Surface Dents

- (1) Check for delamination and broken fibers as given in Paragraph 3.A./GENERAL.
- (2) If delamination is found, repair as given in Paragraph 4.A./GENERAL.
- (3) If broken fibers are found, repair as given in Paragraph 4.B./GENERAL or Paragraph 4.C./GENERAL.
- (4) If no delamination or broken fibers are found, mark off damaged area allowing 1.0 in. (25.4 mm) of overlap for the repair ply.
- (5) Remove damage and prepare area as given in Paragraph 3.C./GENERAL.
- (6) Mask area for repair with masking tape.
- (7) Remove finish using methods described in Paragraph 3.C.(2)(a)/GENERAL and Paragraph 3.C.(2)(b)/GENERAL.

STRUCTURAL REPAIR MANUAL

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

(8) Pot dent flush or slightly higher than surrounding surface with Resin Mix 1 potting compound (Refer to Figure 1/GENERAL).

(9) Cure as given in Paragraph 3.G./GENERAL.

CAUTION: DO NOT SAND INTO FIBERS IN THE AREA SURROUNDING DENT.

(10) Sand flush using 150-grit or finer sandpaper.

(11) Cure as given in Paragraph 3.G./GENERAL.

(12) Prepare and apply one ply with the same orientation as the original surface ply, except replace aramid with a glass fabric ply according to Paragraph 3.E./GENERAL. The ply layer is to overlap the potted area 1 in. (25 mm) all around. Refer to Figure 15/GENERAL for substitute repair ply material.

(13) Bag repair and cure as given in Paragraph 3.F./GENERAL and Paragraph 3.G./GENERAL.

(14) Refinish as given in Paragraph 3.H./GENERAL.

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RESIN, PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURING TIME
RESIN MIX 1 (POTTING RESIN) (BMS 5-28 TYPE 7)	FR 7162A RESIN FR 7162B HARDENER MICROBALLOONS [C]	100 ±5 40 ±2 5	60 MINUTES AT 70°F (21°C)	16 HRS AT 77°F (25°C) 2-4 HRS AT 122°F (50°C) [A]
RESIN MIX 2 (LAMINATING RESIN) (BMS 8-301, CLASS I)	HYSOL EA9390 BASE HYSOL EA9390 HARDENER [D]	100 ±0.5 56 ±0.5	2 HOURS AT 77°F (25°C)	4 HRS AT 180°F TO 210°F (82°C) TO (99°C)
RESIN MIX 3 (LAMINATING RESIN)	RESIN MIX 2 CAB-O-SIL (FUMED SILICA)	100 4 ±0.5	SAME AS RESIN MIX 2	SAME AS RESIN MIX 2

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER OR SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

	MIXING PROCEDURE
RESIN MIX 1	1. ADD PHENOLIC MICROBALLOONS TO RESIN AND MIX THOROUGHLY 2. ADD HARDENER AND MIX THOROUGHLY
RESIN MIX 2	ADD HARDENER TO RESIN AND MIX THOROUGHLY [B]
RESIN MIX 3	ADD CAB-O-SIL TO RESIN MIX 2 AND MIX THOROUGHLY

NOTE

- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

[A] FR 7162 FILLED PANELS CAN BE CUT OR DRILLED AFTER 16 HOUR CURE AT 77°F (25°C). AN OVEN CURE AT ABOUT 122°F (50°C) PERMITS HANDLING IN 2-4 HOURS. THICK SECTIONS (OVER 1 INCH) SHOULD BE MADE IN MULTIPLE POURS, ALLOWING THE PREVIOUS PORTION TO GEL BEFORE REPOURING.

[B] BE SURE TO STIR THE ENTIRE CONTAINER OF FR 7162-A. IT CONTAINS HOLLOW GLASS SPHERES WHICH RISE TO THE SURFACE OF THE LIQUID RESIN. THE CONTENTS MUST BE OF UNIFORM CONSISTENCY BEFORE ADDING HARDENER.

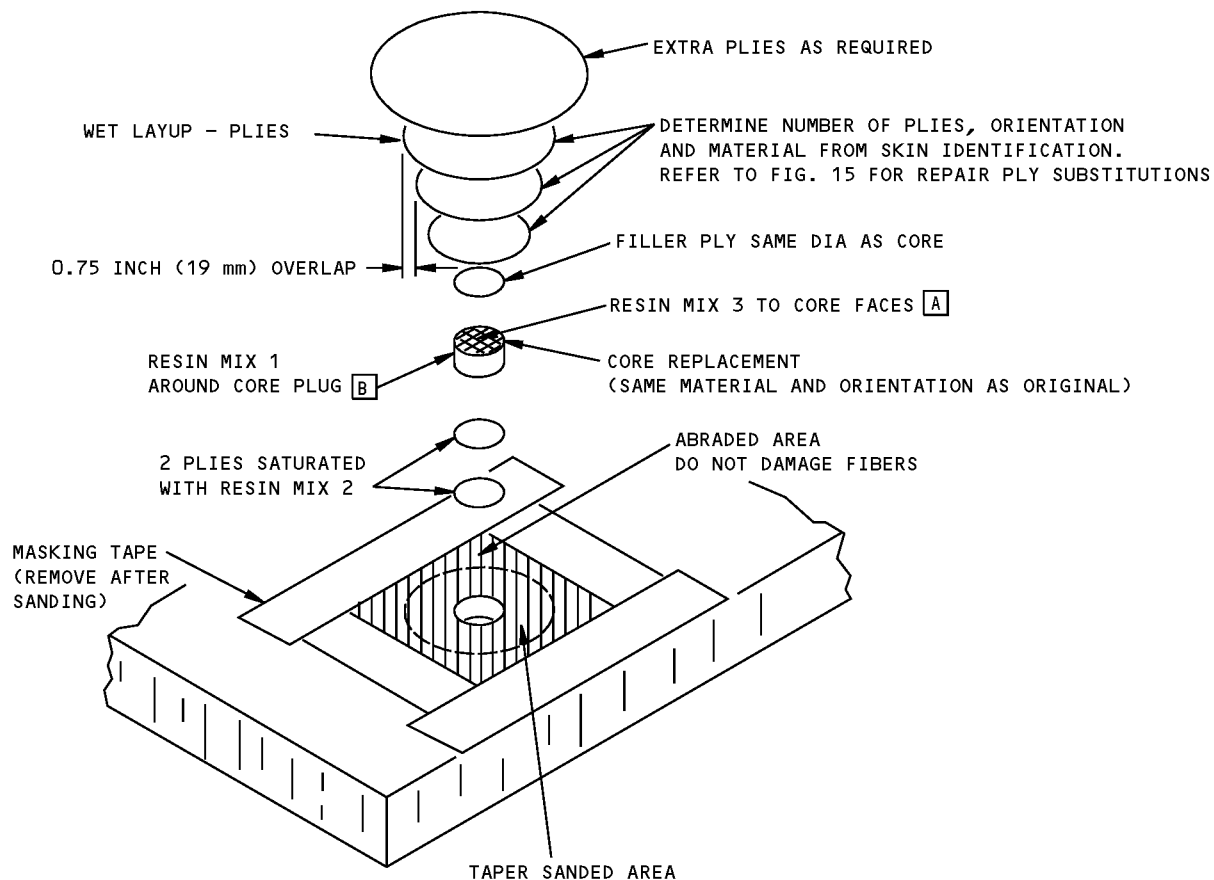
TO 100 PARTS-BY-WEIGHT OF FR 7162-A, ADD 40 PARTS-BY-WEIGHT OF HARDENER 7162-B. STIR THOROUGHLY WITH A SLOW SPEED MIXER, TO AVOID BREAKING THE GLASS MICROBALLOONS.

[C] SOURCE: FIBER-RESIN CORP.
170 WEST PROVIDENCIA AVE.
BURBANK, CA 91503

[D] SOURCE: DEXTER HYSOL
2850 WILLOW PASS ROAD
PITTSBURG, CA 94565

**Resin Specification and Mixing Procedure
Figure 1**

757-200 STRUCTURAL REPAIR MANUAL

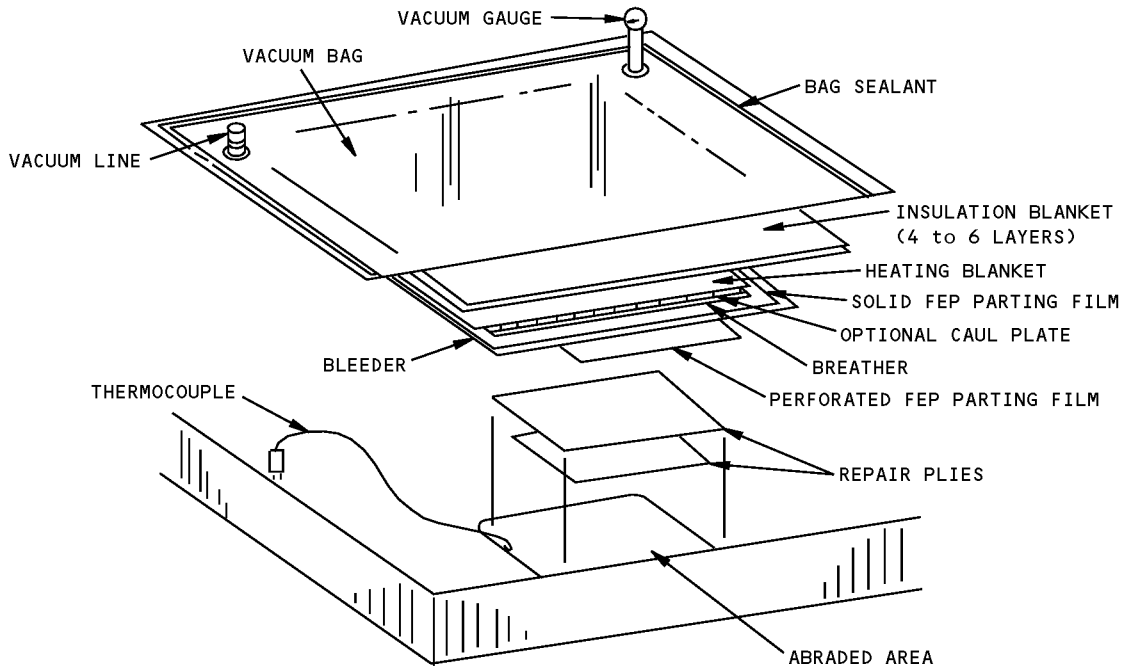


NOTES:

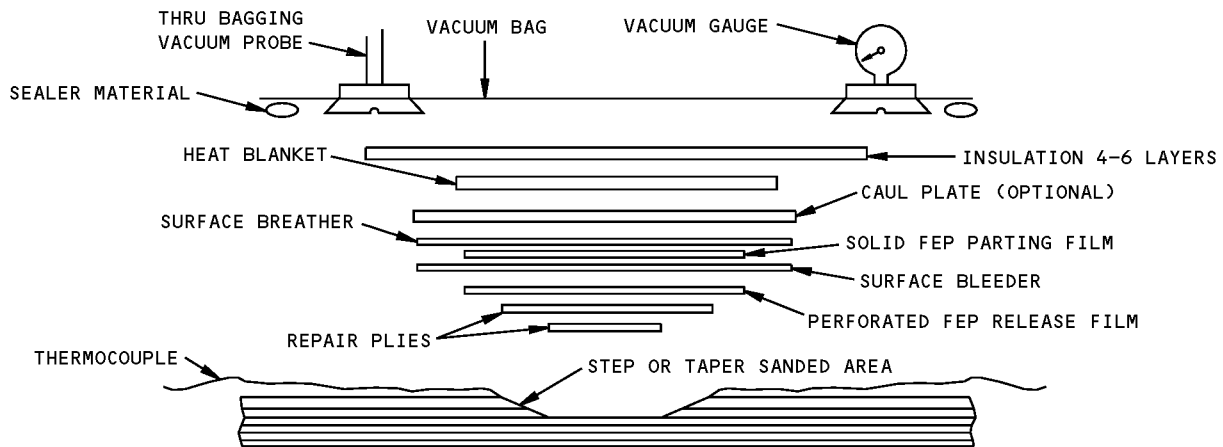
- [A] APPLY RESIN MIX 3 TO LOWER FACE JUST PRIOR TO CORE PLUG INSERTION AND TO UPPER FACE JUST PRIOR TO REPAIR PLY APPLICATION
- [B] RESIN MIX 1 MAY BE APPLIED TO PERIPHERY OF EXISTING CORE INSTEAD OF ON CORE PLUG

Typical Repair for Hole Damage through One Skin and Core
Figure 2

757-200

STRUCTURAL REPAIR MANUAL

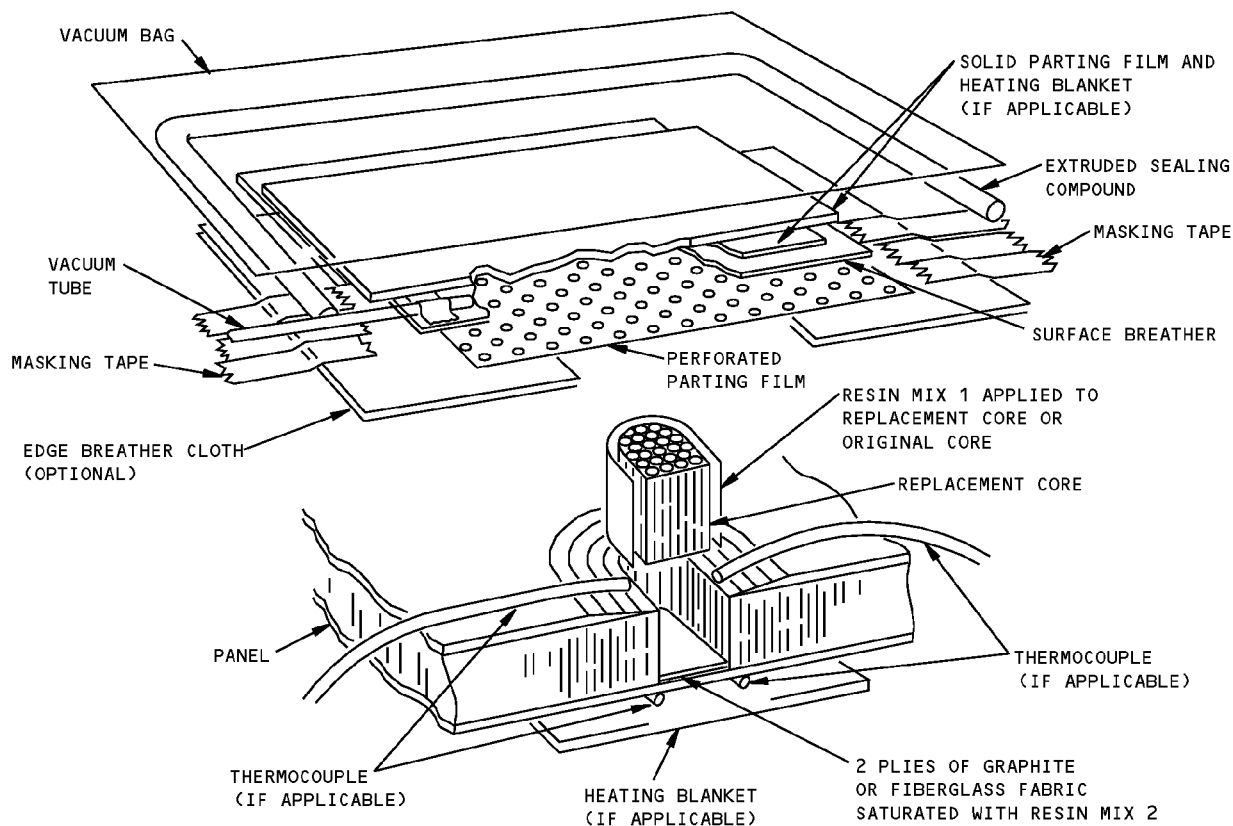
**SKIN PLY REPAIR
(WET LAYUP)**



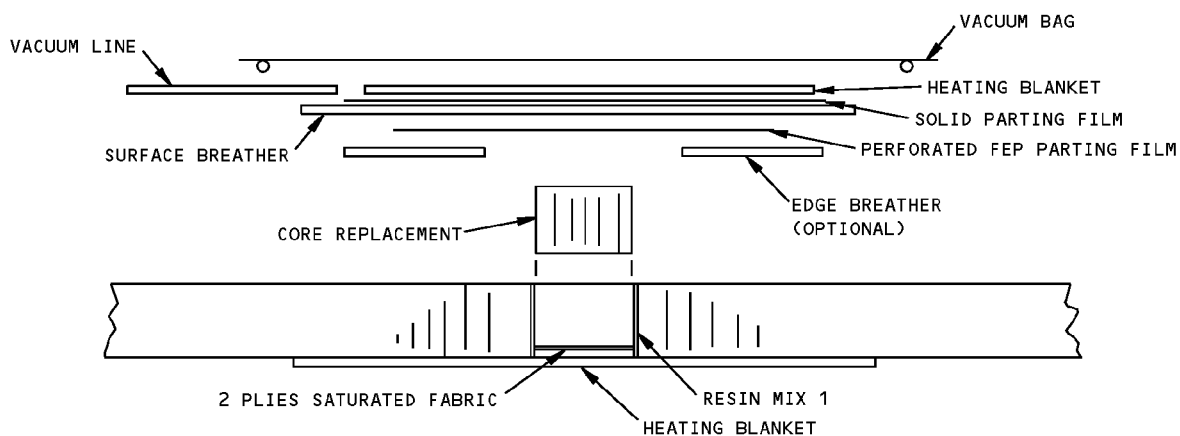
**SECTION THRU LAYUP FOR SKIN PLY REPAIR
(WET LAYUP)**

**Application of Pressure During Cure - Wet Layup
Figure 3 (Sheet 1 of 2)**

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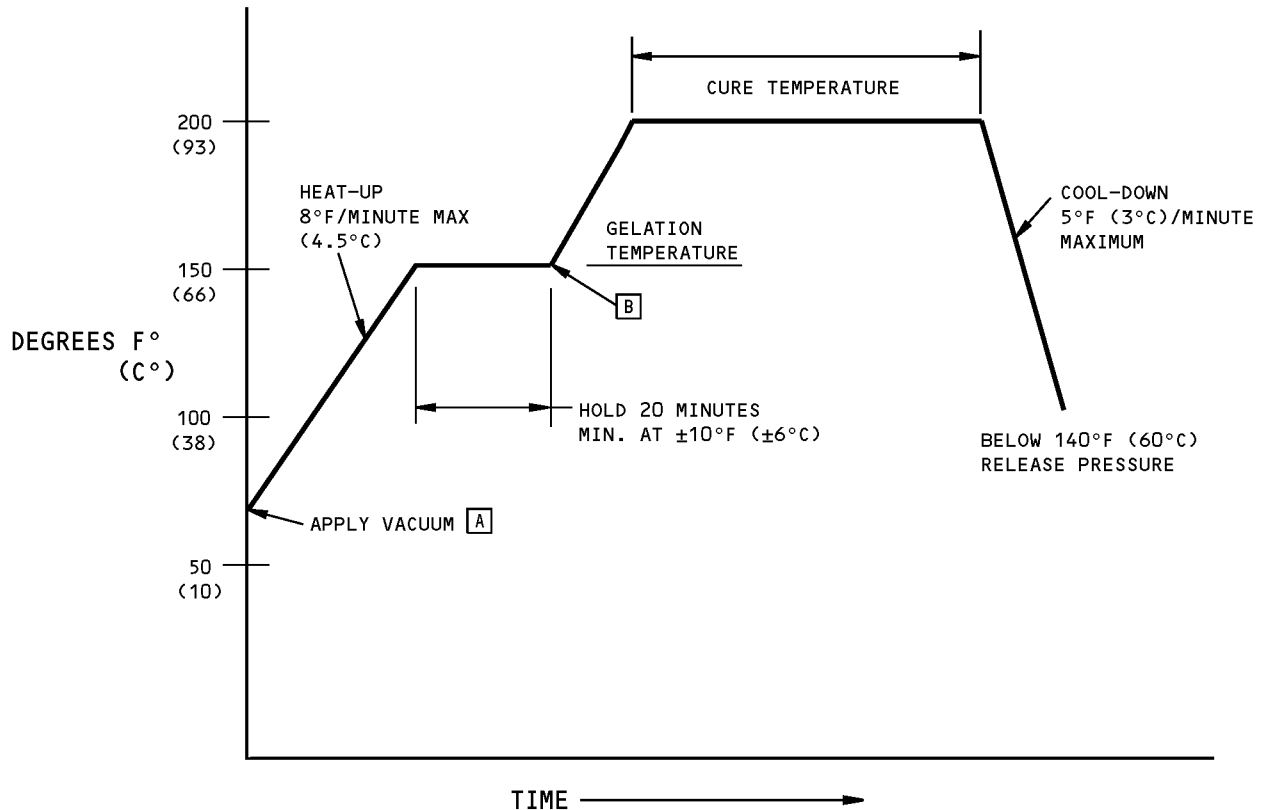
**BAGGING SEQUENCE FOR CORE REPLACEMENT
(WET LAYUP ONLY)**



**SECTION THRU LAYUP FOR CORE REPLACEMENT
(WET LAYUP ONLY)**

**Application of Pressure During Cure - Wet Layup
Figure 3 (Sheet 2 of 2)**

757-200 STRUCTURAL REPAIR MANUAL

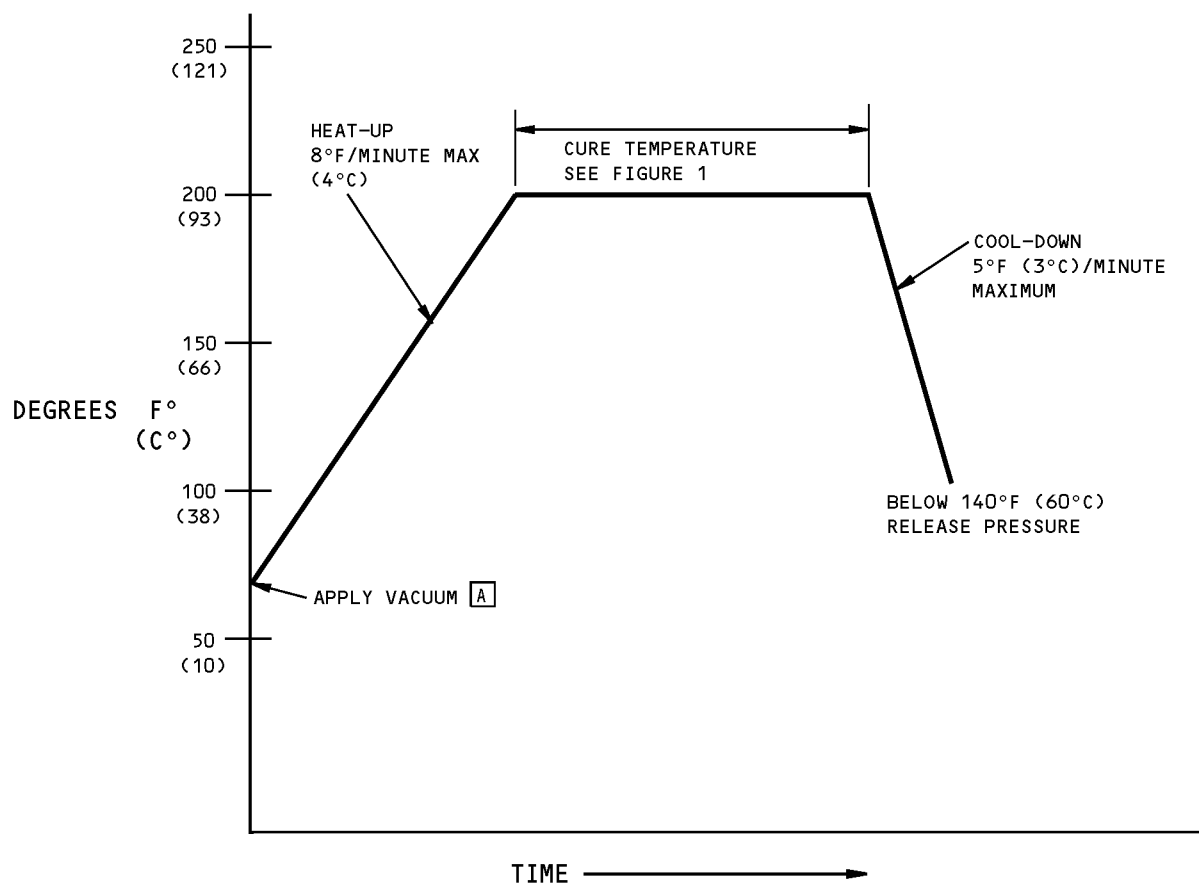


CURE CYCLE FOR HONEYCOMB CORE (RESIN MIX 1)
DETAIL I

NOTES:

- [A] MAINTAIN 20 INCHES OF MERCURY (68 kPa) VACUUM MINIMUM DURING ENTIRE CURE CYCLE
- [B] HEAT MAY BE TURNED OFF AT THIS POINT; CORE SANDED AND SKIN REPAIR PLIES APPLIED AND COURED TO THE REQUIRED CURE TEMPERATURE. SEE DETAIL II FOR CURE CYCLE FOR REPAIR PLIES

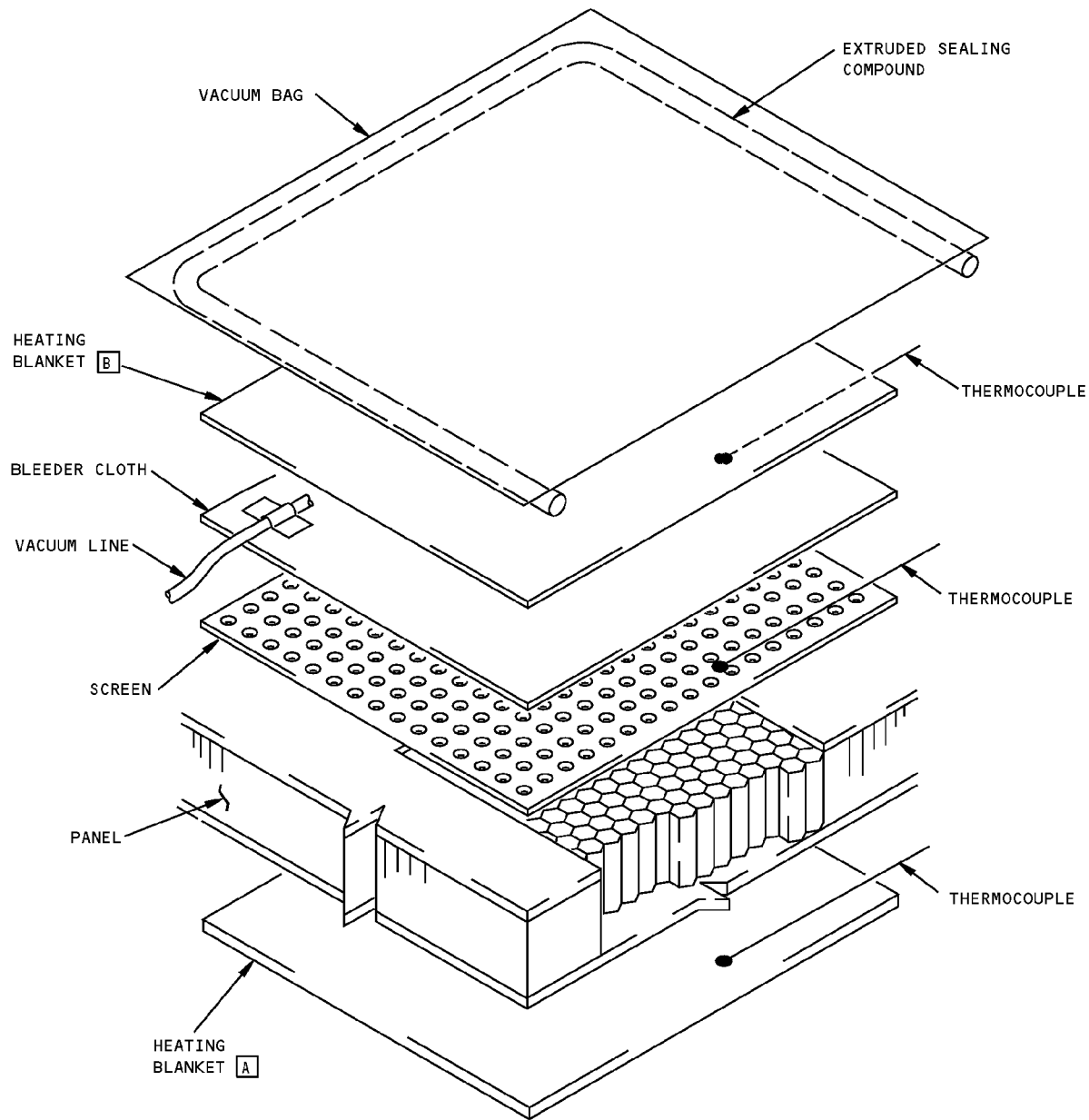
Cure Cycle
Figure 4 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**

CURE CYCLE FOR REPAIR PLIES (RESIN MIX 2 AND 3)
DETAIL II

Cure Cycle
Figure 4 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

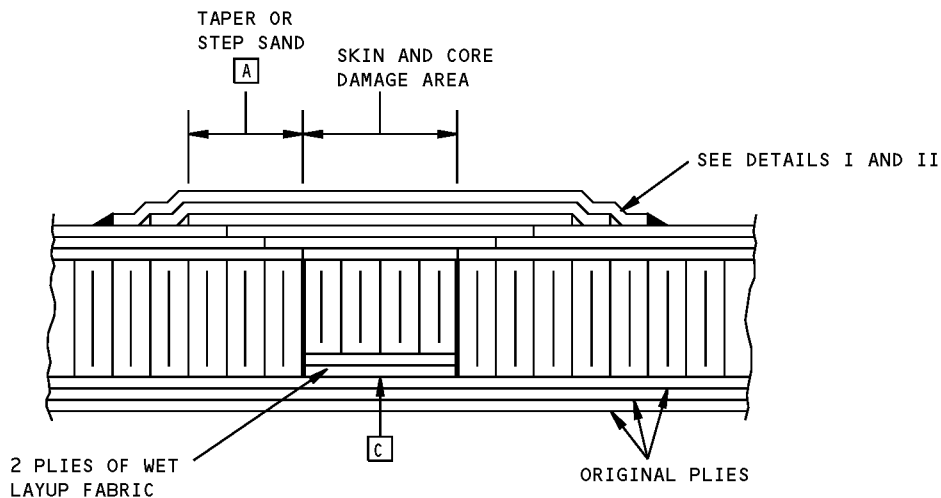


NOTES

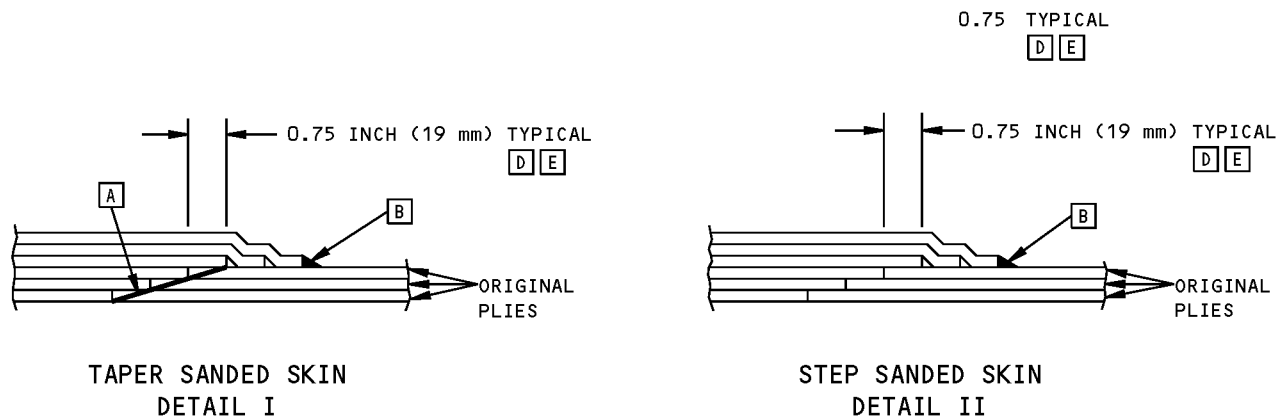
- [A] PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B] ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

**Water Removal from Honeycomb Sandwich
Figure 5**

757-200

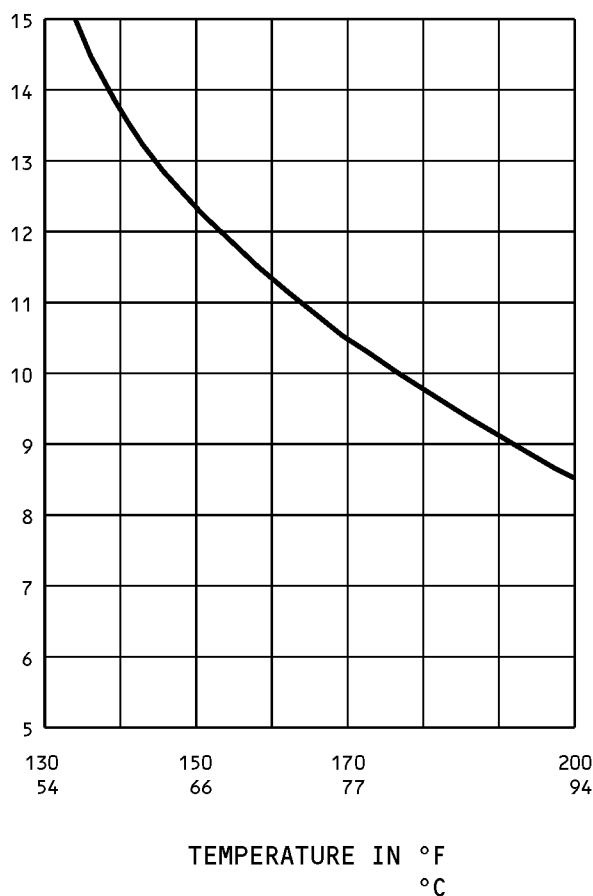
STRUCTURAL REPAIR MANUAL

SECTION THROUGH TYPICAL REPAIR
(WET LAYUP ONLY)

**NOTES:**

- [A] SAND AROUND REPAIR AREA OVER DISTANCE 0.75 MIN INCH (19 mm) FOR EACH EXISTING PLY
- [B] DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING
- [C] SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)
- [D] EACH PLY MUST OVERLAP AT LEAST 0.75 INCH (19 mm) PAST EDGE OF PRECEEDING PLY [E]
- [E] THE MINIMUM OVERLAP REQUIREMENT OF 0.75 INCH (19 mm) IS TYPICAL FOR MOST REPAIRS.

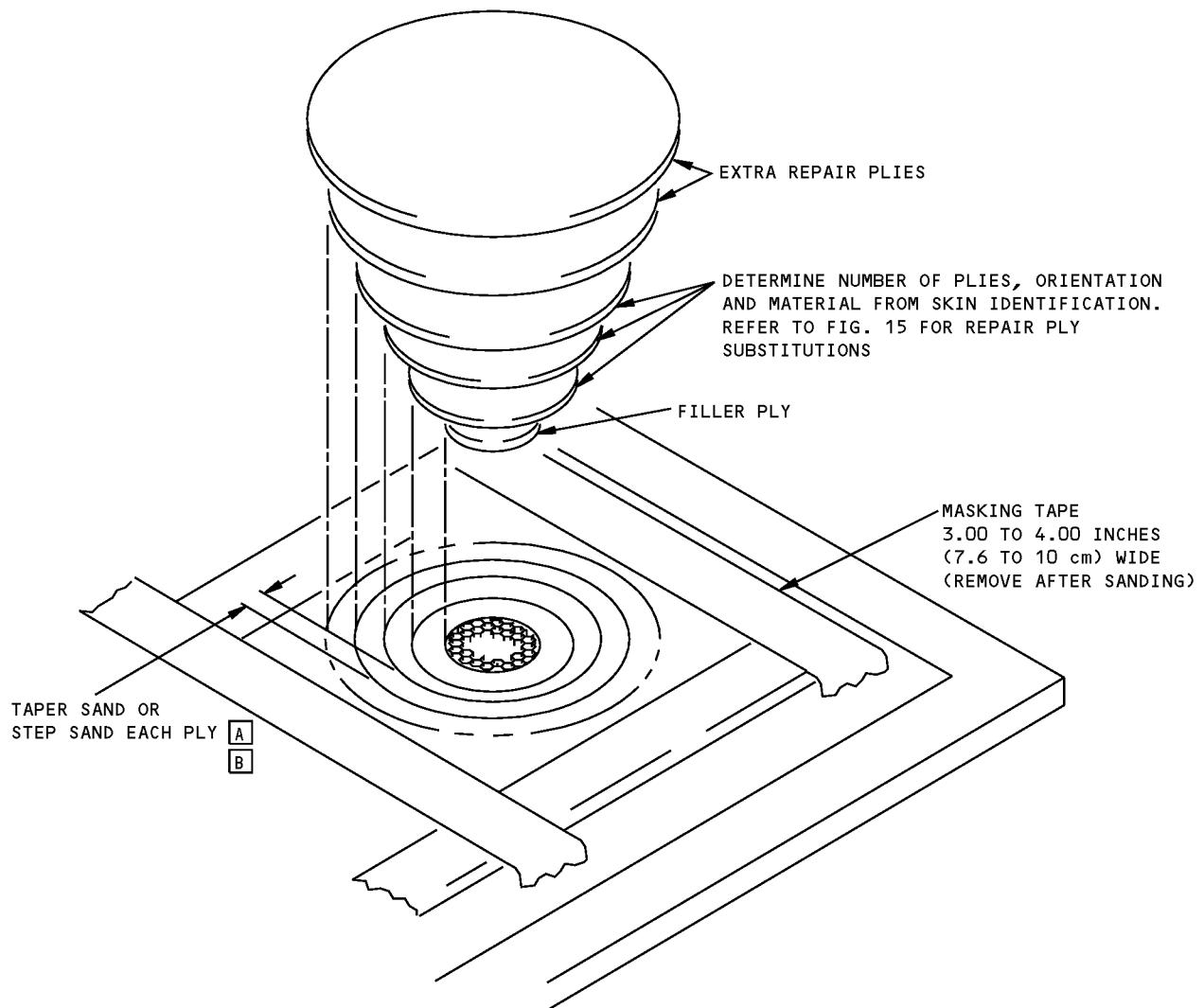
Sanding and Overlap Requirements
Figure 6

757-200
STRUCTURAL REPAIR MANUALHEAT LAMP –
HEIGHT (INCHES)

NOTE: THE HEIGHT IN INCHES OF 250-WATT HEAT LAMP
FROM SURFACE OF THE PATCH VS TEMPERATURE AT
SURFACE OF PART

Heat Lamp Temperature Cure
Figure 7

757-200 STRUCTURAL REPAIR MANUAL



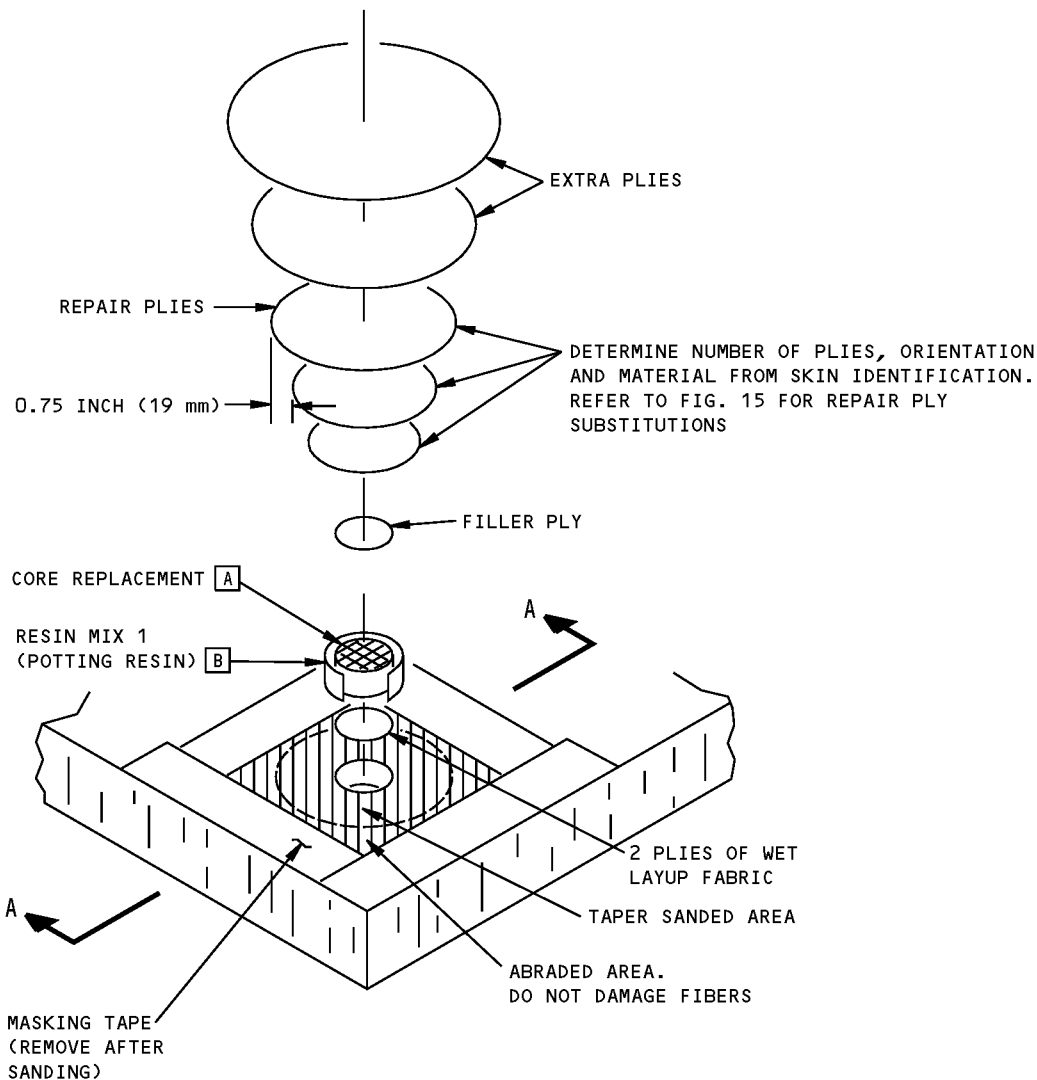
REPAIR PLY WET LAYUP ONLY

NOTES:

- A TAPER SANDING OF EACH PLY OF EXTERNAL SKIN IS RECOMMENDED
- B REFER TO PARAGRAPH 3.C.(2)(B) FOR OPTIONAL SANDING/LAYUP PROCEDURES

Repair of Damaged External or Internal Skins of a Sandwich Panel
Figure 8

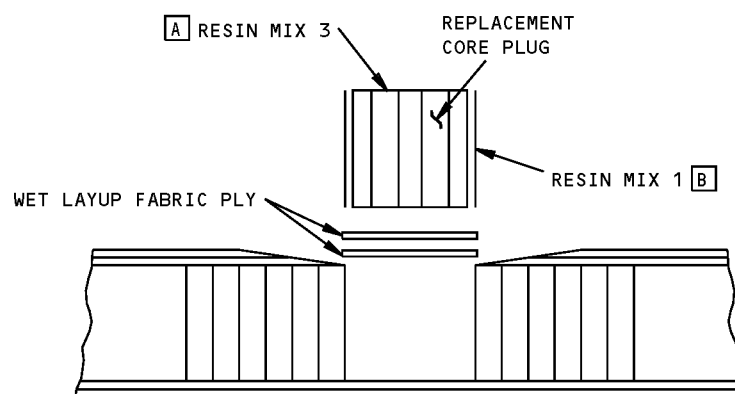
757-200 STRUCTURAL REPAIR MANUAL



NOTES:

- [A] APPLY RESIN MIX 3 TO LOWER FACE JUST PRIOR TO CORE INSERTION AND TO UPPER FACE JUST PRIOR TO REPAIR PLY APPLICATION
- [B] RESIN MIX 1 MAY BE APPLIED TO PERIPHERY OF EXISTING CORE INSTEAD OF ON CORE PLUG

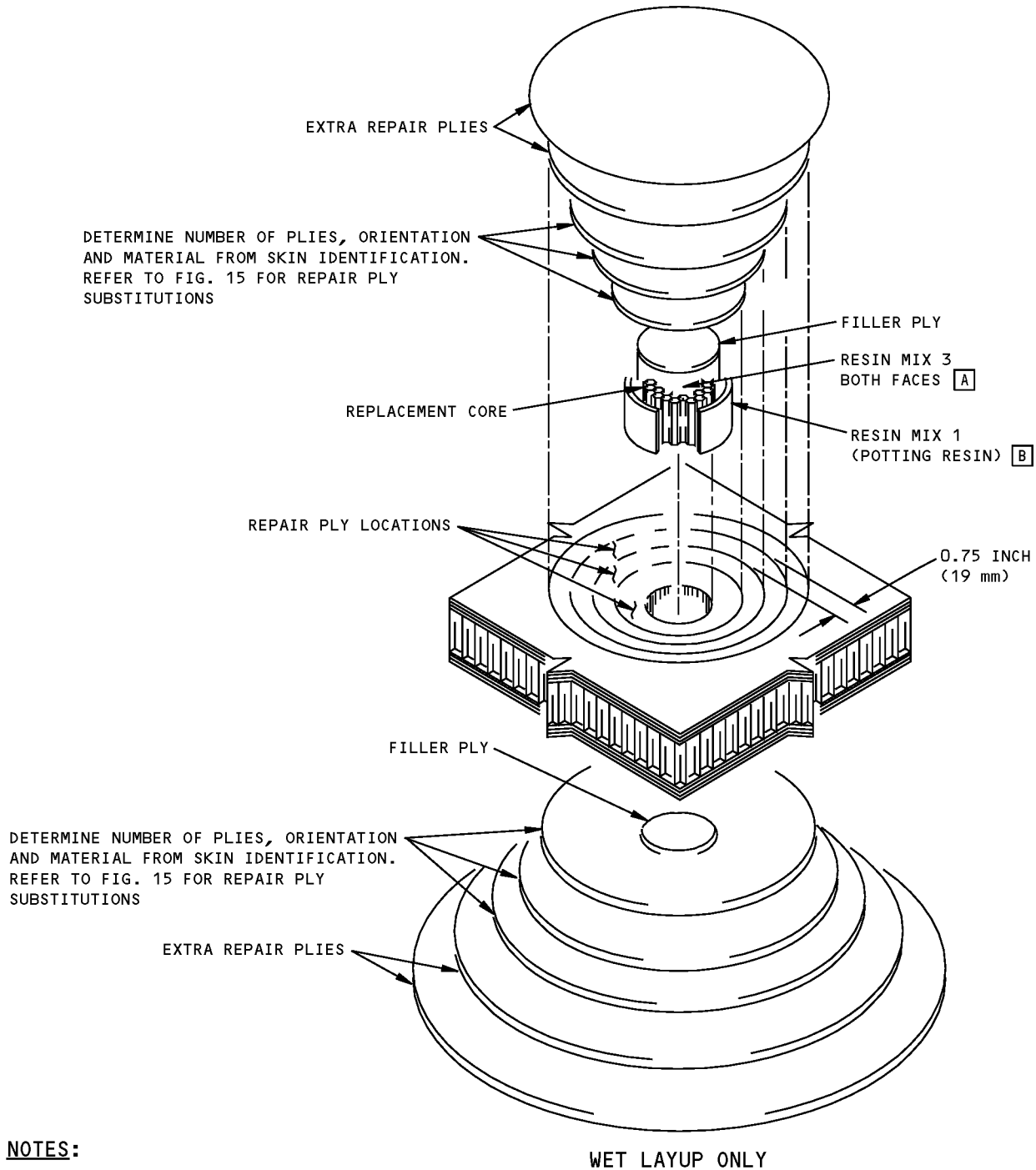
Repair of Large Punctures through One Skin of a Sandwich Structure Including Core Damage
Figure 9 (Sheet 1 of 2)

**757-200
STRUCTURAL REPAIR MANUAL**

SECTION THRU REPAIR AREA -
FULL DEPTH CORE REPLACEMENT
SECTION A-A

**Repair of Large Punctures through One Skin of a Sandwich Structure Including Core Damage
Figure 9 (Sheet 2 of 2)**

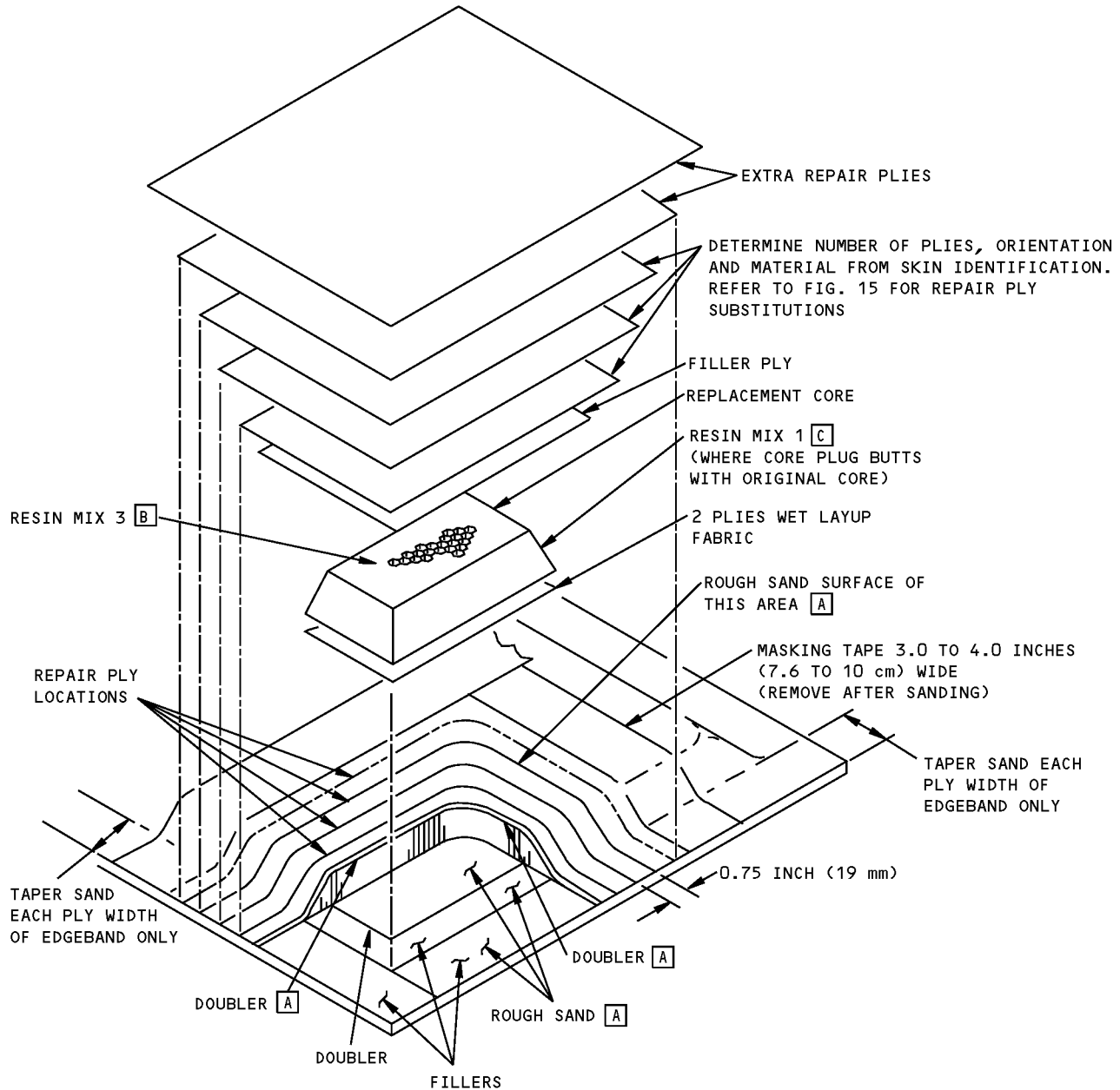
757-200

STRUCTURAL REPAIR MANUAL**NOTES:**

- [A] APPLY RESIN MIX 3 TO HONEYCOMB CORE FACES JUST PRIOR TO REPAIR PLY APPLICATION
- [B] RESIN MIX 1 MAY BE APPLIED TO PERIPHERY OF EXISTING CORE INSTEAD OF ON CORE PLUG

Repair of Large Punctures through Both Skins of a Sandwich Panel Including Core Damage
Figure 10

757-200
STRUCTURAL REPAIR MANUAL



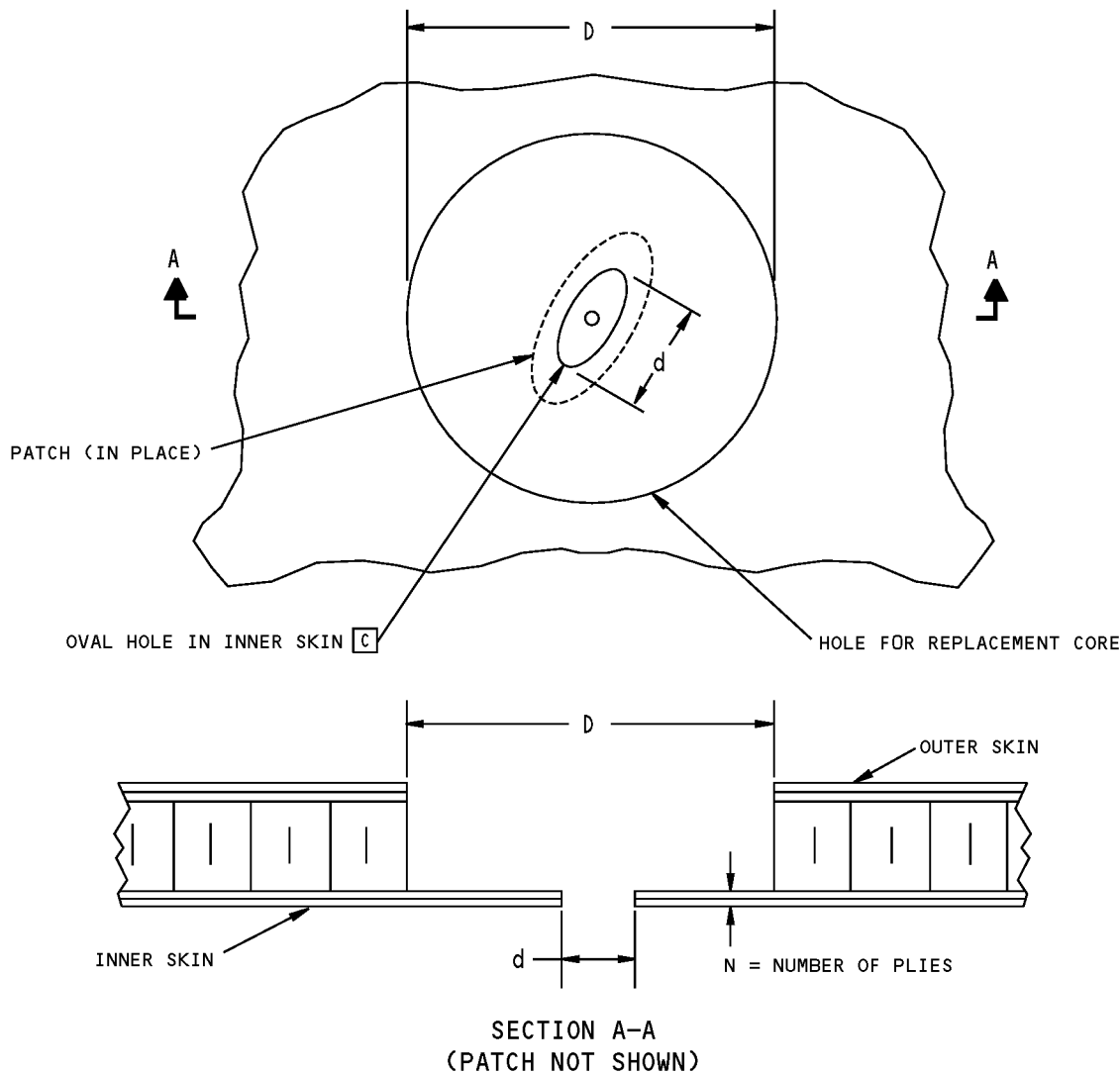
NOTES:

WET LAYUP ONLY

- A** DO NOT TAPER SAND SKIN OR DOUBLER
PLIES OVER CORE
- B** APPLY RESIN MIX 3 TO LOWER FACE JUST PRIOR
TO CORE PWG INSERTION AND TO UPPER FACE
JUST PRIOR TO REPAIR PLY APPLICATION
- C** RESIN MIX 1 MAY BE APPLIED TO PERIPHERY
OF EXISTING CORE INSTEAD OF ON CORE PLUG

Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel

757-200 STRUCTURAL REPAIR MANUAL



DETAIL I

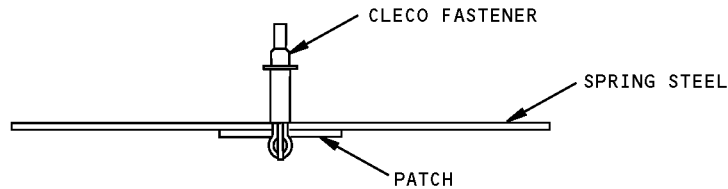
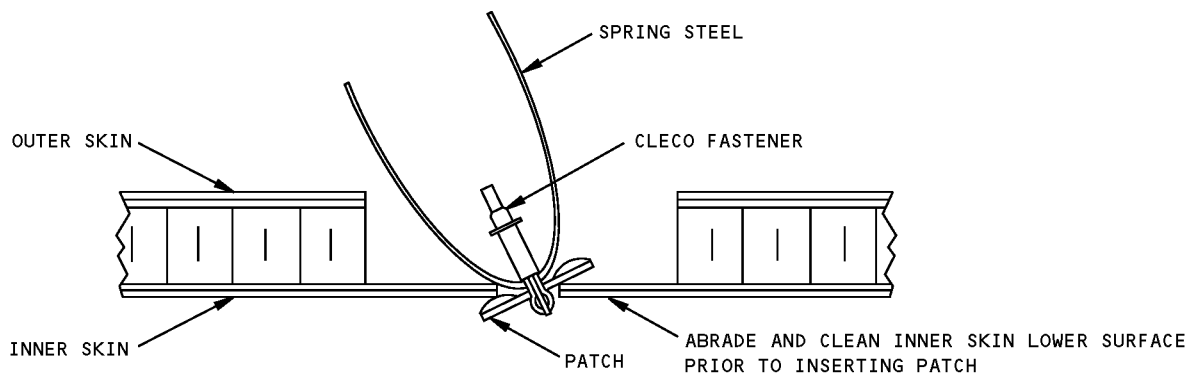
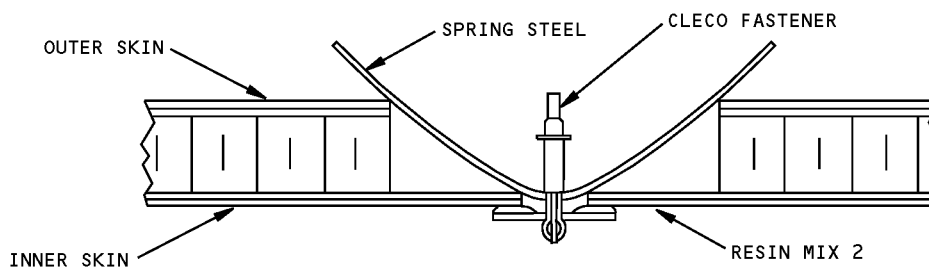
NOTES:

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
 - $D = d + 1.5 \times [N \times (1.0 \text{ INCH (25.4 mm) FOR EACH PLY})]$
 d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN
 N = NUMBER OF PLIES
- FOR EXAMPLE:
 IF $d = 0.50 \text{ INCH (12.7 mm)}$
 $N = 2$
 THEN, $D = 0.50 \text{ INCH (12.7 mm)} + 1.5 \times [2 \times 1.0 \text{ INCH (25.4 mm)}]$
 $D = 3.50 \text{ INCH (88.9 mm) DIAMETER}$
- [A] RESIN MIX 3 APPLIED TO CORE PLUG OR ORIGINAL CORE

[B] MAKE TAPER AND OVERLAP PER FIGURE 6

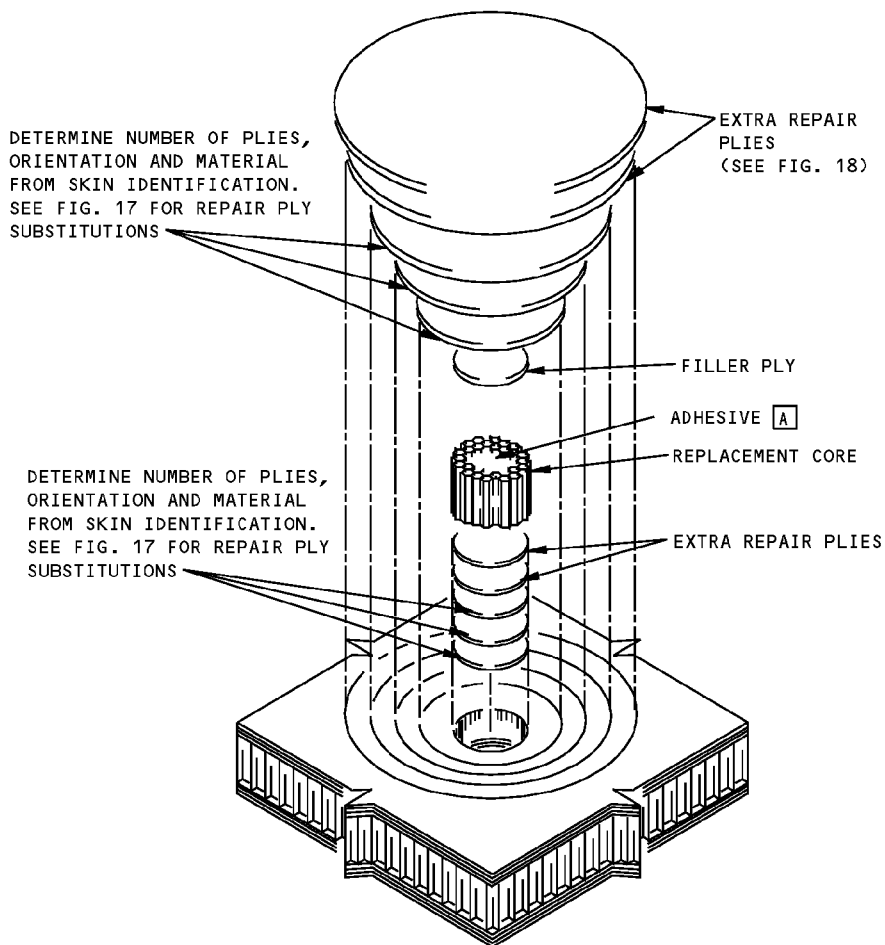
[C] MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCH (38 mm) FOR THIS REPAIR

Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 12 (Sheet 1 of 3)

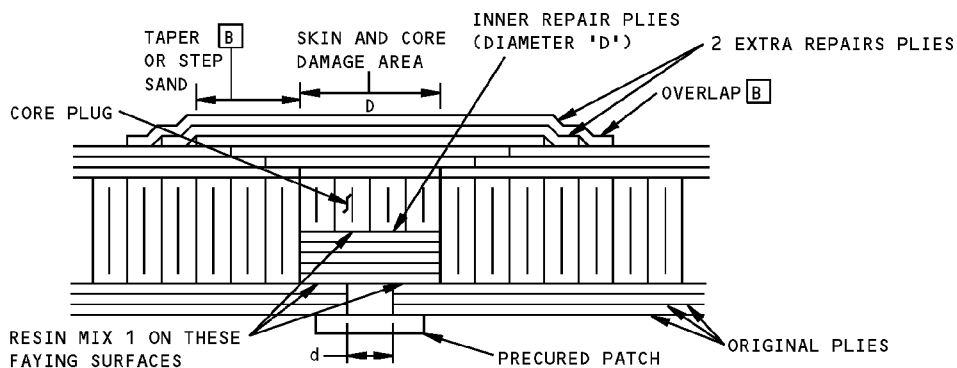
**757-200
STRUCTURAL REPAIR MANUAL****ASSEMBLE PATCH AND SPRING STEEL
DETAIL II****INSERT PATCH INTO OVAL HOLE
DETAIL III****HOLD PATCH IN PLACE WHILE CURING
DETAIL IV**

Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 12 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



WET LAYUP ONLY

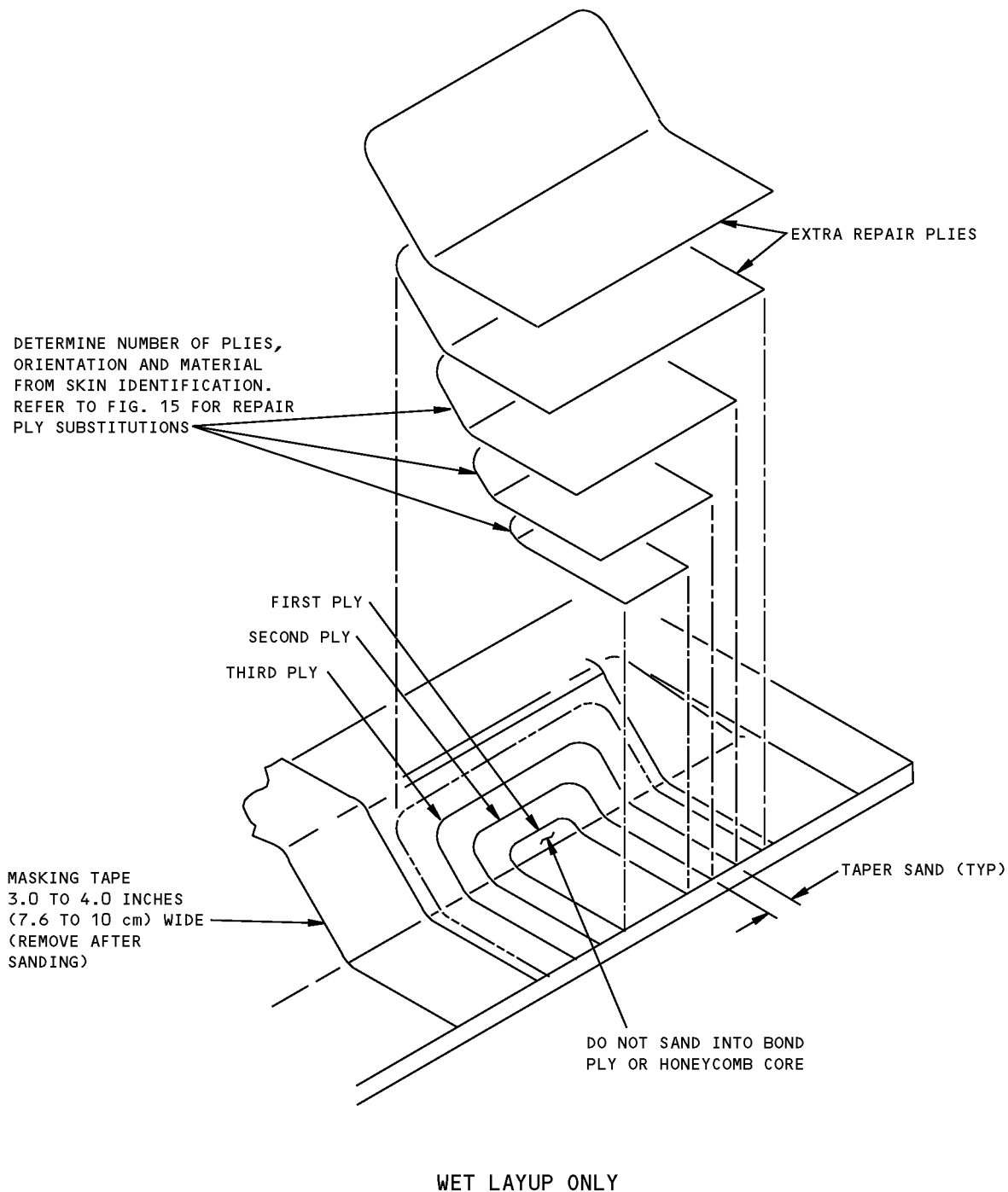


SECTION THROUGH REPAIR
(WET LAYUP ONLY)
DETAIL V

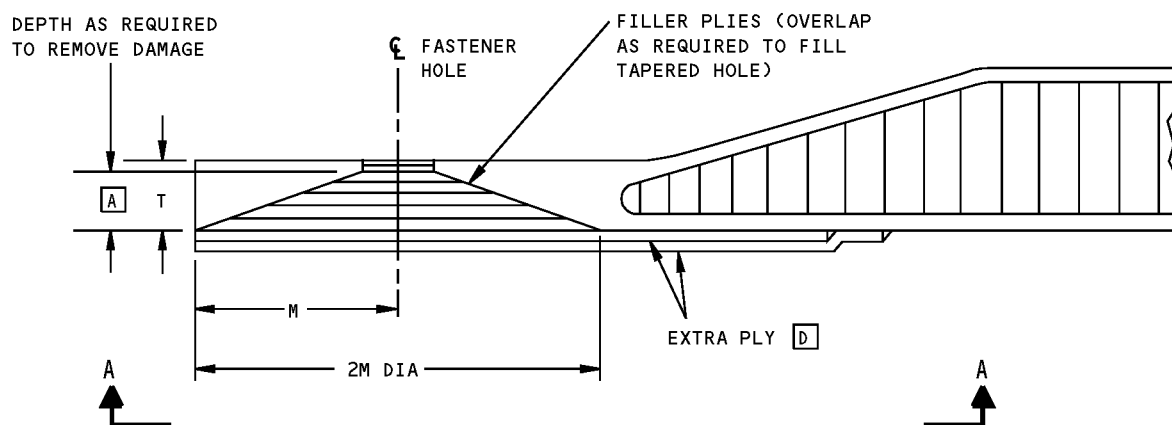
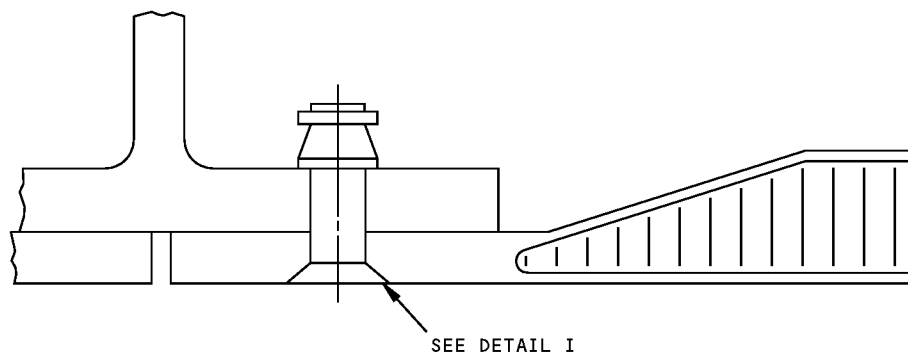
Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 12 (Sheet 3 of 3)

757-200

STRUCTURAL REPAIR MANUAL



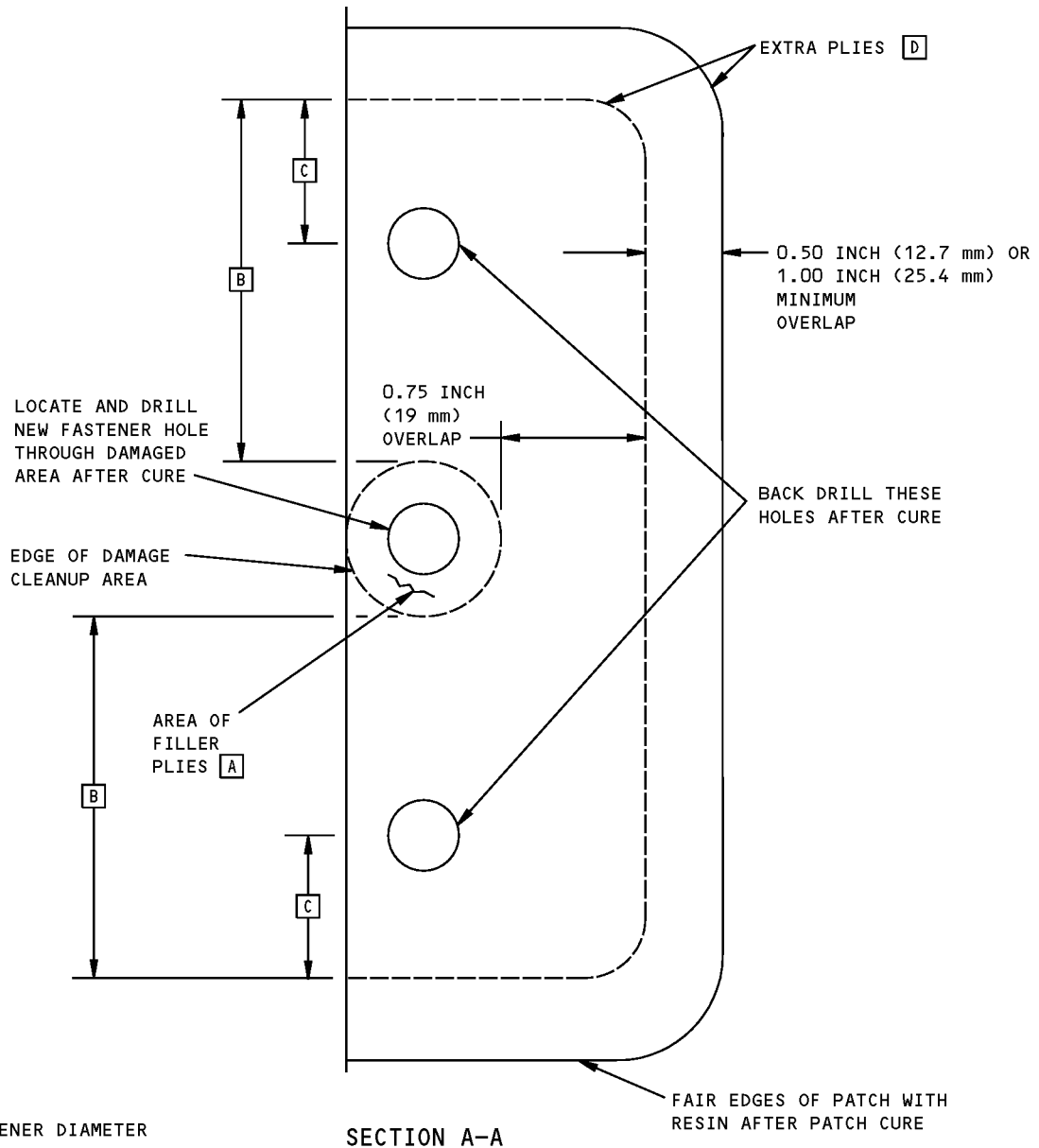
Repair of Damaged Skin Plies on a Panel Edge
Figure 13

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STRUCTURAL REPAIR MANUAL

DETAIL I

Repair of Damaged Panel Attach Hole
Figure 14 (Sheet 1 of 2)

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NOTES:

- D EQUALS FASTENER DIAMETER
- M = 5T MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES

- [A] APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA
- [B] EXTEND FIRST EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 1.00 INCH (25.4 mm) PAST EDGE OF DAMAGED AREA

- [C] EXTEND FIRST EXTRA PLY FAR ENOUGH TO PROVIDE AT LEAST 2D EDGE MARGIN
- [D] ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER (REFER TO FIG. 15)

**Repair of Damaged Panel Attach Hole
Figure 14 (Sheet 2 of 2)**

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STRUCTURAL REPAIR MANUAL

ORIGINAL PLY MATERIAL		REPAIR PLY MATERIAL	REPAIR PLY SUBSTITUTE MATERIAL
ARAMID FABRIC	KEVLAR 49-285 F161-188	BMS 9-3, TYPE H-2 OR H-3 (GLASS FABRIC)	A B C D
GRAPHITE TAPE	3501-5A-AS4	5HSW-AS4-6K STYLE ES-1506 (GRAPHITE FABRIC)	E F
GRAPHITE FABRIC	A370-5H/3501-5A	5HSW-AS4-6K STYLE ES-1506 (GRAPHITE FABRIC)	E F
	AS4 CYCOM985-1		
	AS4 EM7198 CELION 6K-ST		

NOTES

- A ALL CLASSES EXCEPT CLASS 7 MAY BE USED
- B USE ONE PLY OF TYPE H-2 OR H-3 IN PLACE OF TWO PLIES OF TYPE D
- C USE THREE PLIES OF TYPE D IN PLACE OF ONE PLY OF TYPE H-2 OR H-3
- D USE ONE PLY OF TYPE H-3 IN PLACE OF ONE PLY OF TYPE H-2

- E TWO CONSECUTIVE PLIES OF GRAPHITE FABRIC ARE REQUIRED FOR EACH PLY OF GRAPHITE TAPE. ALIGN THE FABRIC WARP FIBERS IN THE SAME DIRECTION AS THE TAPE FIBERS
- F SOURCE: HERCULES INC.
WOVEN STRUCTURES
1600 W. 135TH ST.
GARDENA, CA, USA 90249

Repair Ply Substitutions
Figure 15

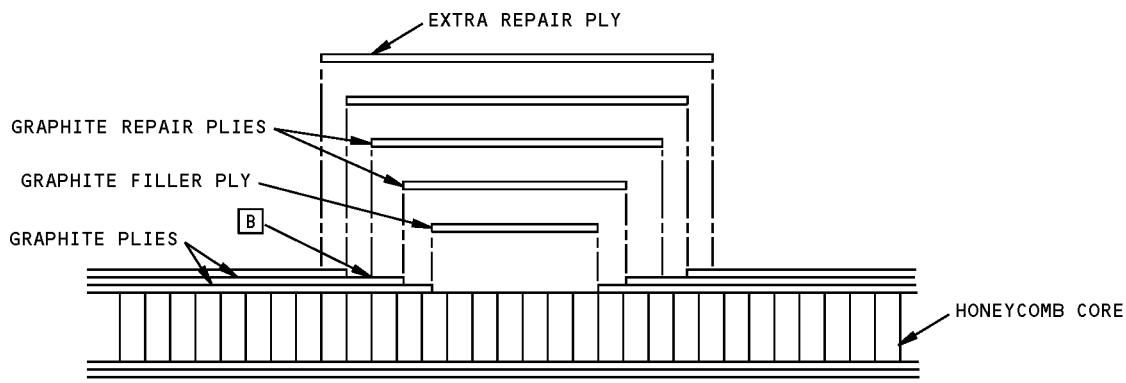
STRUCTURAL REPAIR MANUAL

COMPONENT MATERIAL	EXTRA PLY MATERIAL
GRAPHITE FABRIC	GRAPHITE FABRIC, 5HSW-AS4-6K (MFG. STYLE ES-1506)(FIG 15) A
ARAMID FABRIC	GLASS FABRIC, BMS 9-3 TYPE H-2 OR H-3 (MFG. STYLE 181-150 OR 181-77)(FIG 1) A

NOTES:

A THE ORIENTATIONS OF THE EXTRA REPAIR PLIES MUST REPEAT THE ORIENTATIONS OF THE EXISTING PLIES IN THE ORIGINAL LAMINATE STARTING WITH THE OUTERMOST PLY

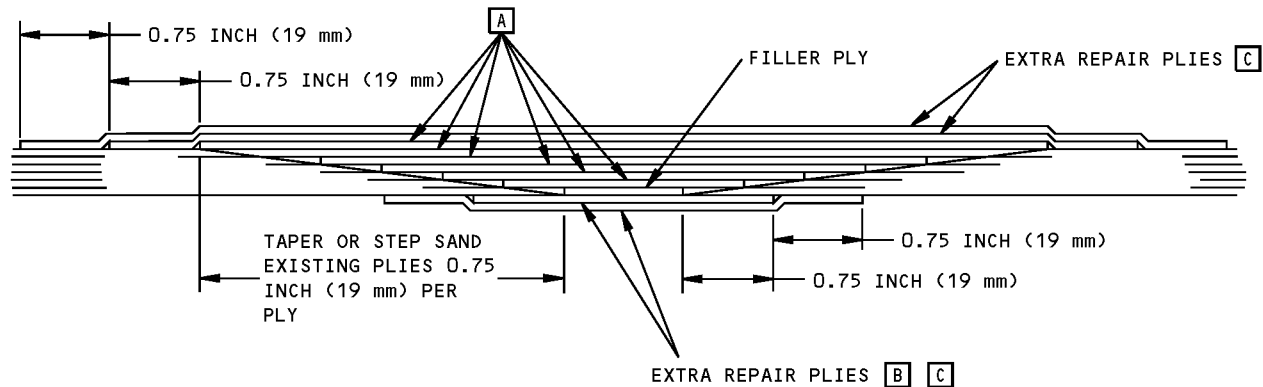
B WHEN EXTRA GRAPHITE REPAIR PLY OR PLIES ARE REQUIRED, THE EXISTING OUTER PLY MUST BE SANDED TO ALLOW AN OVERLAP OF 0.75 INCH (19 mm) FOR EACH EXTRA REPAIR PLY



SECTION THRU HYBRID HONEYCOMB SANDWICH
DETAIL I

Extra Repair Ply Materials
Figure 16

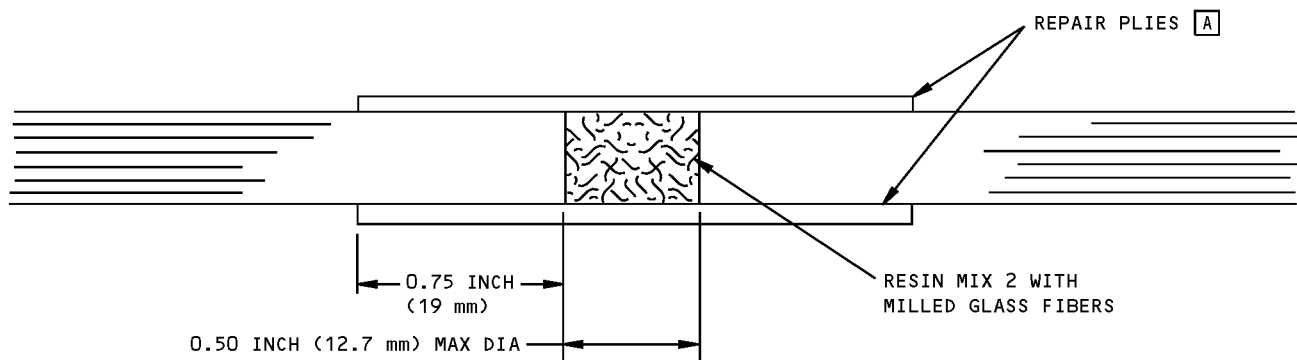
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STRUCTURAL REPAIR MANUAL

**NOTES:**

- [A] DETERMINE NUMBER OF PLIES, ORIENTATION, AND MATERIAL FROM SPECIFIC COMPONENT STRUCTURE IDENTIFICATION
- [B] EXTRA REPAIR PLIES AT THIS LOCATION ARE REQUIRED ONLY IF THE DAMAGE PENETRATES THIS SURFACE

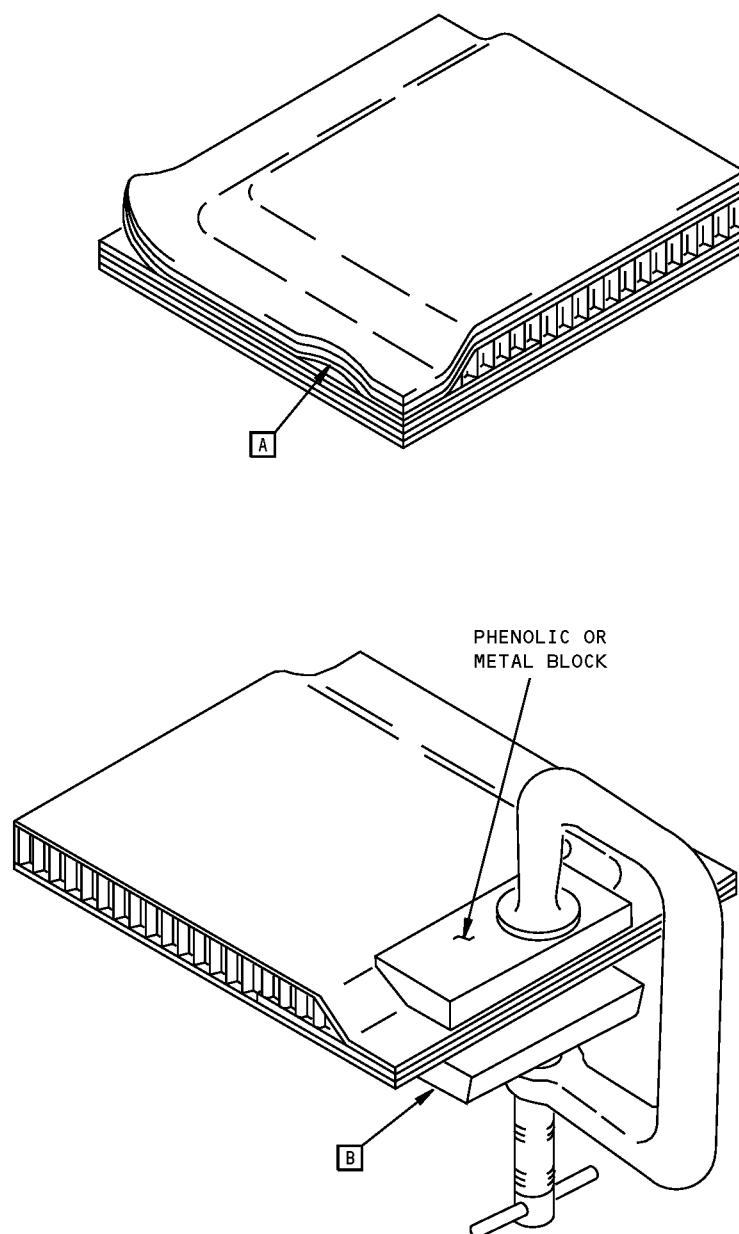
- [C] THE ORIENTATION OF THE EXTRA REPAIR PLY IS TO BE THE SAME AS THE OUTER PLY OF THE ORIGINAL LAMINATE

Solid Laminate Repair - 200 Degrees F (94 Degrees C) to 350 Degrees F (177 Degrees C)
Figure 17

**757-200
STRUCTURAL REPAIR MANUAL****NOTES:**

- [A] REPAIR PLIES ARE TO HAVE THE SAME ORIENTATION AS THE ORIGINAL SURFACE PLIES

**Repair of Punctures, 0.50 Inch Diameter or Less, in Solid Laminate Panels
Figure 18**

**757-200
STRUCTURAL REPAIR MANUAL****NOTES:**

- REFER TO PARAGRAPH 4.H. FOR COMPLETE REPAIR INSTRUCTIONS

A FORCE RESIN MIX 2 INTO DELAMINATED AREA

B CLAMP PLIES TOGETHER AND CURE

**Repair of Delaminated Skin Plies on a Panel Edge - Wet Layup
Figure 19**

STRUCTURAL REPAIR MANUAL**GENERAL - REPAIRS TO GRAPHITE OR ARAMID REINFORCED EPOXY LAMINATES AND ALUMINUM HONEYCOMB SANDWICH STRUCTURE - 150°F (66°C) CURE WET LAYUP REPAIR METHOD****1. Applicability**

WARNING: DO NOT BREATHE CARBON FIBER DUST. MAKE SURE THAT THERE IS A GOOD FLOW OF AIR WHERE YOU DO THE WORK. USE EQUIPMENT TO HELP YOU BREATHE WHEN YOU WORK IN A CONFINED SPACE. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE INJURY.

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR FOR THE REPAIR LIMITS AND MATERIAL OF THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

150°F (66°C) CURE REPAIRS WILL NOT RESTORE EITHER THE STRENGTH OR THE DURABILITY OF THE ORIGINAL 250°F (121°C) OR 350°F (177°C) CURE COMPONENTS. FOR SIZE AND LIMITS OF SUCH REPAIRS, SEE APPLICABLE REPAIR SECTION.

150°F (66°C) REPAIRS MUST NOT BE USED IN STRESS CRITICAL AREAS OF PRIMARY STRUCTURE COMPONENTS. FAILURE TO COMPLY COULD RESULT IN AN INADEQUATE REPAIR.

CAUTION: DO NOT LET CARBON FIBER DUST GO INTO ELECTRICAL EQUIPMENT. CARBON FIBER DUST IS ELECTRICALLY CONDUCTIVE AND IT CAN CAUSE SHORT CIRCUITS IF IT GOES INTO ELECTRICAL EQUIPMENT. USE A VACUUM NEAR THE SOURCE OF THE DUST TO REMOVE THE DUST FROM THE AIR. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE ELECTRICAL EQUIPMENT.

- A. This section contains repairs to components made from epoxy resin reinforced with several layers of graphite or aramid fabrics. The most common construction is a sandwich of two laminated skins separated by an aluminum honeycomb core. Solid laminate is used for small components, honeycomb panel edgebands, inlet cowl and at fitting locations. Glass fabric is also known as fiberglass cloth. This section describes repairs made using 150°F (66°C) cure materials in wet layup methods.

NOTE: The repairs called for in this section are wet layup repairs. These repairs require rapid use of catalyzed resin materials. These materials will not return the structure to its original strength or durability. A periodic inspection plan for the repaired area may be required. For size and limits of such repairs, see applicable repair section.

The repairs in this section are 150°F (66°C) repairs, the cure of which may be accelerated by the application of heat as specified herein. To obtain maximum properties, cure repair at 150°F (66°C).

- B. Refer to Table 1/GENERAL for an index of common repair procedures and typical repairs.

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Table 1: Index of Common Repair Procedures and Typical Repairs

Paragraph	Subject
Paragraph 4./GENERAL	Repair Procedures Common to Various Repairs
Paragraph 4.A./GENERAL	Determine Damage
Paragraph 4.B./GENERAL	Remove Water and Dry Out Damaged Area
Paragraph 4.C./GENERAL	Remove Damage and Prepare Damaged Area
Paragraph 4.D./GENERAL	Fabricate, Clean, and Install Honeycomb Replacement Core Plug
Paragraph 4.E./GENERAL	Prepare and Apply Repair Plies
Paragraph 4.F./GENERAL	Layup/Bagging Procedures
Paragraph 4.G./GENERAL	Cure the Repair
Paragraph 4.H./GENERAL	Refinish After Repair
Paragraph 4.I./GENERAL	Perform Post-Repair Requirements
Paragraph 5./GENERAL	Typical Repairs
Paragraph 5.A./GENERAL	Repair of Delaminations Between Plies
Paragraph 5.B./GENERAL	Repair of Puncture, 0.50-inch Diameter or Less, in Honeycomb Panel
Paragraph 5.C./GENERAL	Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50-inch Diameter
Paragraph 5.D./GENERAL	Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage
Paragraph 5.E./GENERAL	Replacement of Honeycomb Core on Damaged Edge of Panel
Paragraph 5.F./GENERAL	Repairs Where Access is Limited to One Side of Panel
Paragraph 5.G./GENERAL	Repair of Damaged Skin Plies in Panel Edgeband
Paragraph 5.H./GENERAL	Repair of Damage and Punctures to Multiple Plies in Solid Laminate Panels
Paragraph 5.I./GENERAL	Repair of Punctures, 0.50-inch Diameter or Less, in Solid Laminate Panels
Paragraph 5.J./GENERAL	Repair of Delamination Between Plies in Solid Laminate Panels
Paragraph 5.K./GENERAL	Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Solid Laminate Panels
Paragraph 5.L./GENERAL	Repair of Surface Dents

STRUCTURAL REPAIR MANUAL

Table 1: Index of Common Repair Procedures and Typical Repairs (Continued)

Paragraph	Subject
Paragraph 5.M./GENERAL	Repair of Lightning Strike Damage
Paragraph 5.N./GENERAL	Repair of Small Damage to One Skin
Paragraph 5.O./GENERAL	Repair of Erosion Damage of Panel Edges

2. General

WARNING: HEAT, FIRE, OR SPARKS CAN CAUSE AN EXPLOSION. USE EXPLOSIONPROOF EQUIPMENT WHEN PERFORMING THESE REPAIRS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. WEAR NEOPRENE GLOVES WITH COTTON LINERS, PROTECTIVE CLOTHING, AND EYE GOGGLES. IF CHEMICAL CONTACT OCCURS, WASH THOROUGHLY WITH WATER. IF CHEMICAL SHOULD SPLASH INTO EYES, FLUSH EYES WITH LARGE QUANTITIES OF WATER AND SEEK MEDICAL AID. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA.

CAUTION: FASTENERS INSTALLED IN GRAPHITE COMPOSITE STRUCTURE MUST BE TITANIUM OR CORROSION RESISTANT STEEL. CADMIUM PLATED CORROSION RESISTANT STEEL MAY NOT BE USED. ALUMINUM OR ALLOY STEEL FASTENERS ARE NOT ALLOWED IN GRAPHITE COMPOSITE STRUCTURES.

- A. Specific allowable damage, repair limitation, and repair data, can be found in the chapter/section/subject associated with each structural component.
- B. Use suitable holding fixtures for large repairs to prevent distortion of the structure.
- C. Perform the repair procedures specified herein only in areas of reasonable cleanliness. Areas containing oil mist, exhaust fumes, gases, soot, rain, dust, or other particulate matter are specifically prohibited.
- D. Protect surfaces from contamination. Do not touch cleaned parts or adhesive with bare hands. Use clean white gloves when handling parts.
- E. Store resin, and/or adhesive material at 40 to 80°F (4 to 27°C) in sealed containers. An identification label must accompany the material inside the container, with the following information: BMS type, class, grade, supplier name, batch number, and date of preparation.
- F. Refer to REPAIR MATERIALS, SECTION/51-30 for source of repair materials and equipment.
- G. Refer to Figure 1/GENERAL for resin mixes and potting compound data.
- H. Refer to Figure 13/GENERAL for substitute repair ply material.
- I. Refer to 51-30-06, GENERAL for composite repair material ordering data.

3. References

Reference	Title
51-11-01, GENERAL	Aerodynamic Smoothness - RB211-535 Engine Nacelle
51-30	REPAIR MATERIALS

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(Continued)

Reference	Title
51-30-06, GENERAL	Order Data for Composite Repair Materials
AMM 51-21-10/701	Decorative Exterior Finishes - Cleaning/Painting
NDT Part 1, 51-05-01	Tap Test Inspection of Honeycomb Sandwich Structure
SOPM 20-30-99	Solvents For Final Cleaning of Composites Before Structural Bonding (Series 99)

4. Repair Procedures Common to Various Repairs

A. Determine Damage.

CAUTION: CHEMICAL PAINT STRIPPERS WILL ATTACK RESIN SYSTEMS, AND SHOULD NOT BE USED TO REMOVE PAINT.

- (1) Examine visually for extent of damage.
- (2) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Water can be detected by radiographic methods. Remove contaminants. Refer to Paragraph 4.B./GENERAL for water removal instructions.
- (3) Check for delamination around the damage.

NOTE: Delamination can be detected by instrumental NDI methods or by tap test. For tap test, use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bonded area. Refer to NDT Part 1, 51-05-01.

B. Remove Water and Dry Out Damaged Area.

- (1) Remove water from honeycomb sandwich (Refer to Figure 11/GENERAL).
 - (a) Remove damaged skin plies to open up honeycomb area in the damaged area. Remove standing water using vacuum oil-free compressed air.
 - (b) Removal of adhesive fillets on core is not required. Adhesive must be removed from sealed cells.
 - (c) Apply a fiberglass or metallic fine mesh screen over exposed core.
 - (d) Apply a thermocouple to the center of the screen.
 - (e) Apply a layer of glass fabric bleeder cloth over the screen and hold in place with masking tape.
 - (f) Place a vacuum line on the edge of the bleeder cloth and hold in place with masking tape.
 - (g) When opposite face is accessible, apply thermocouple to the opposite side of honeycomb sandwich panel.
 - (h) When opposite face is accessible, apply heating blanket to opposite side of honeycomb sandwich panel.

NOTE: When opposite face is accessible, it is acceptable to heat the area using a heating blanket only on the opposite face. An additional heating blanket may be used on the near face at the location shown in Figure 11/GENERAL. Additional heating blanket accelerates water removal. When opposite face is inaccessible, use of a heating blanket on the near side is required.

- (i) When opposite face is inaccessible or when using additional heating blanket, perform the following steps:
 - 1) Apply a thermocouple to the center of the bleeder cloth.

STRUCTURAL REPAIR MANUAL

- 2) Place the heating blanket over the bleeder cloth.
- (j) Place extruded sealing compound around the entire area and seal the area with vacuum bag material.
- (k) Evacuate the layup to a minimum 22 in/Hg (75 kPa) vacuum.
- (l) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
- (m) Remove layup materials and proceed with repair procedure.
- (2) Remove water from solid laminate.
 - (a) Remove damage and/or delamination. Remove standing water using vacuum and oil-free compressed air.
 - (b) Heat the area for 1 hour minimum at 220°F (104°C) to 240°F (115°C). The rate of temperature rise must not exceed 5°F (3°C) per minute.
- C. Remove Damage and Prepare Damaged Area.
 - (1) Damage removal.
 - (a) Trim out the damaged lamination to a square or rectangular shape with rounded corners, or a circular or oval shape. Take care not to damage the undamaged plies, core or surrounding material.

NOTE: Remove only damaged plies, damaged doublers and damaged fillers.
 - (b) When the core is also damaged, remove the core by trimming to the same outline as the skin. The core area removed should extend at least 0.50 in. (12.7 mm) further than visible core damage limits. Take care to avoid cutting into an undamaged skin on the opposite side.

NOTE: When a potted core repair is to be made, removal of damaged core is not required.
 - (c) In areas where contamination can not be removed by cleaning or drying asiven in Paragraph 4.B./GENERAL, remove the contaminated structure along with the other damage.
 - (d) When opposite inner skin is also damaged, trim out the damage as described in Paragraph 4.C.(1)(a)/GENERAL.
 - (e) When core is removed from the inner surface of opposite skin, carefully sand core down to adhesive fillets.
 - (f) Inspect cut out area to ensure that all damage has been removed.

CAUTION: SANDING FOR ADHESION OR FINISH REMOVAL MUST NOT EXPOSE OR DAMAGE FILAMENTS IN THE UNTAPERED SURFACE REPAIR AREA.

DO NOT USE PAINT STRIPPERS FOR THE REMOVAL OF FINISH. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THESE CAUTIONS ARE NOT OBSERVED.

- (2) Preparation of damaged area (Refer to Figure 14/GENERAL).

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- (a) Determine the number and orientation of plies that have been cut. Mask off the area around the cleaned up damage allowing 0.75 in. (19 mm) overlap for each ply replacement, plus 1.00 in. (25 mm) extra for extra ply to ensure that the existing top ply is completely covered by the repair.

NOTE: Where the number of plies is not apparent, refer to the applicable structure identification of engineering drawing.

WARNING: SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS FOR SKIN AND RESPIRATION PROTECTION.

EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

- (b) Internal surface of panel (nonaerodynamic surface) and noncritical aerodynamic surfaces.
- 1) Remove the paint finish using No. 240 or finer Scotch-Brite Abrasive, or No. 150 or finer sandpaper in the masked off area.
 - 2) Sand each ply around the cleaned up damage. Refer to Figure 14/GENERAL. Sand or taper sand each ply a minimum of 0.75 in. (19 mm) per ply.
 - 3) An optional procedure for two or three ply laminate face sheets is to fill the cleaned up damaged area flush with the original surface using filler plies during the repair layup. The repair plies are then installed directly on the resulting smooth surface of the repair area.
 - 4) Abrade surfaces around repair using No. 150 or finer, Scotch-Brite abrasive.
- (c) External surface of panel (critical aerodynamic surfaces).
- 1) Taper sand a uniform taper around the cleaned up damage using No. 80 sandpaper. The taper is to be over an approximate distance of 0.75 in. (19 mm) for each existing ply of the laminate. As an option on sandwich structure, sanding as given in Paragraph 4.C.(2)(b)3)/GENERAL may be used instead of taper sanding. Refer to 51-11-01, GENERAL for locations of areas of critical aerodynamic smoothness.
- NOTE:** For sanding, use a flexible disk sander, a belt sander, a rotating pad sander, or sand by hand.
- 2) Remove exterior finish, including enamel finish and any conductive coatings from the surface of the 1.00 in. (25.4 mm) border using No. 150 or finer sandpaper.
- (d) Edgeband of panel.
- 1) Taper sand panel edgeband as given in Paragraph 4.C.(2)(c)/GENERAL.
- NOTE:** Edgeband is the solid laminate around the outer periphery of the honeycomb panel.
- (e) Cleaning of repair area.
- 1) Remove all sanding dust by applying oil-free compressed air and use a vacuum cleaner.

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WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

CAUTION: DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PART WILL OCCUR.

- 2) Wipe surfaces with a clean cloth moistened with solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99). Allow solvent to evaporate before proceeding with the repair.
- 3) Perform water break test on both sides of repair elements after removing peel plies. Apply deionized or distilled water with an atomizing spray to cover the area.

NOTE: An acceptable surface will momentarily support an unbroken film of water for approximately 30 seconds. If surface is not acceptable repeat surface preparation and apply water break test.

Remove the majority of the water with clean cheesecloth.

Force dry at 180°F (82°C) to 200°F (93°C) for 60 to 90 minutes to remove all traces of moisture.

D. Fabricate, Clean, Install Honeycomb Replacement Core Plug

(1) Fabricate core plug.

- (a) Fabricate core plug. Refer to specific component structural identification section to determine type of core called out on engineering drawing.
- (b) For butt splicing, the honeycomb core plug should fit flush with original core and with ribbon direction the same as in original core. The replacement core must overlap and make intimate contact with the cell walls of surrounding core material.
- (c) Trim core plug using a 200-grit high speed sanding disk to full depth of original core as given in Paragraph 4.C.(1)(b)/GENERAL and shown in Figure 2/GENERAL.

NOTE: When applicable, depth of core plug should allow for shrinkage during cure and for thickness of filler plies of fabric cloth and adhesive between core plug and skin (Refer to Figure 2/GENERAL, Figure 3/GENERAL, Figure 8/GENERAL, and Figure 14/GENERAL).

(2) Clean core plug.

WARNING: BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE OR SPARKS.

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(WARNING PRECEDES)

CAUTION: DO NOT EXCEED IMMERSION CRITERIA GIVEN IN PARAGRAPH 4.D.(2)(A)/GENERAL. DAMAGE TO CORE MATERIAL WILL OCCUR. DO NOT IMMERSE PARTS IN SOLVENTS OR ALLOW STANDING SOLVENT ON PARTS. DAMAGE TO PARTS WILL OCCUR.

- (a) Clean visually contaminated core by dipping (a maximum of four times) in solvent, Series 99 (Refer to AMM 20-30-99 or SOPM 20-30-99) bath for 60 seconds.
 - (b) Locally contaminated areas can be washed with acetone or MEK.
 - (c) The core must be completely dry, clean and free of evidence of solvents before installation.
- (3) Install core plug (Refer to Figure 2/GENERAL, Figure 3/GENERAL, Figure 6/GENERAL, Figure 7/GENERAL, and Figure 8/GENERAL).

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (a) If one skin is undamaged, cut two plies of H-2 fiberglass fabric (Refer to Figure 1/GENERAL) that will fit on the inside surface of the undamaged skin (Refer to Figure 2/GENERAL and Figure 14/GENERAL). Saturate the plies with Resin Mix 1, prepared as shown in Figure 1/GENERAL, then position in core cavity.
- (b) If both skins are damaged, apply a caul plate against the exterior surface of farside skin and tape in place. Apply repairs to one surface as given in Paragraph 4.E./GENERAL.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR NOEPRENE GLOVES OVER COTTON FOR PROTECTION OR HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

- (c) For butt splicing, spread Resin Mix 3 on the edges of the replacement core and the undamaged core that will mate when the plug is installed. Orient ribbon in the direction of original core ribbon.
- (d) Put the layup materials and equipment in place as shown in Figure 3/GENERAL.
- (e) Evacuate the repair area to a minimum of 22 in/Hg (75 kPa) vacuum.
- (f) Cure as given in the component repair chart and Figure 1/GENERAL.

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- (g) Sand repair core plug approximately flush with surrounding material, making allowance for film adhesion and slight core crush during cure.
- (h) Vacuum to remove sanding residue from cells.

NOTE: The above procedure is based on the core plug installation being cured separately from the repair plies. As an option, core plug installation and repair plies may be cured at the same time.

E. Prepare and Apply Repair Plies

NOTE: Refer to applicable paragraphs for preparation of glass and graphite fabrics. Aramid fabric damaged will be repaired using glass fabric plies. Refer to Figure 13/GENERAL for substitution of glass fabric for aramid fabric.

CAUTION: USE OF PRECURED PATCHES IS NOT RECOMMENDED. PRECURED PATCHES BONDED TO THE STRUCTURE UNDER VACUUM PRESSURE ONLY AND LARGE PATCHES BONDED TO CONTOURED SURFACES CAN RESULT IN POROUS OR NONCONTINUOUS BOND LINES.

(1) Prepare graphite fabric repair plies.

- (a) Refer to the specific structural component identification to determine number, style, and orientation of graphite fabric used in original structure. Refer to the structural component repair section for repair ply requirements. Refer to Figure 13/GENERAL for substitution of repair ply fabrics.
- (b) From each type of material required, cut a piece that is large enough for cutting the required number of plies for the repair patch.

NOTE: In the patch, use one repair ply for each damaged ply of the original laminate, plus extra repair plies as indicated by specific structural component repair. Each repair ply must be of equivalent thickness and the same orientation as the original plies. If extra repair plies are not required by individual repair, one extra ply is required and is to have the same orientation as the original surface ply. Refer to Figure 18/GENERAL for extra repair ply material and orientation.

- (c) When replacing ply over core, a filler ply the size of the cutout is required to minimize surface depression.
- (d) Impregnate repair plies with resin as given in Paragraph 4.E.(2)/GENERAL.

(2) Impregnate plies with resin.

- (a) Cut two pieces of parting film approximately 3.0 in. (7.6 cm) larger all around than the fabric and tape down one piece to a smooth surface.

NOTE: Use Teflon film or other parting films.

- (b) Lay fabric onto parting film.
- (c) Spread Resin Mix 1, prepared as shown in Figure 1/GENERAL, to adequately cover fabric evenly.
- (d) Cover the fabric on the parting film with the second piece of parting film.
- (e) Press the resin through the fabric by working over the parting film with a squeegee or roller, in order to impregnate the fabric and to remove entrapped air.
- (f) Work excess resin to edges of fabric such that fabric weave is barely visible.

NOTE: Resin content of the impregnated fabric should be 55 ± 5 percent by weight.

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- (g) Cut the impregnated fabric to the required sizes for each individual ply of the patch. The parting film on both sides of the fabric decreases fraying of the edges while cutting the fabric.

NOTE: The total number of repair plies is to be in accordance with Paragraph 4.E.(1)/GENERAL. Refer to Figure 14/GENERAL for required overlap of repair plies. The repair plies must be installed with the same orientation as that of the original plies being repaired. The filler ply over an exposed honeycomb core must be installed with the same orientation as the original surface ply. Other extra repair plies must be installed as specified in individual structural component repair sections.

- (3) Apply plies (Refer to Figure 2/GENERAL and Figure 14/GENERAL).

NOTE: Where the damage has occurred at a lap joint in the original laminates, it is not necessary to make a comparable lap in the repair plies. Where the original core was undamaged and was provided with a recess to match the lap joint, the recess should be filled with filler plies before application of the repair plies.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS, PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESIN OR CURING AGENT. WEAR NEOPRENE GLOVES OVER COTTON FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESIN OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

ENSURE THAT PARTING FILM IS REMOVED FROM REPAIR PLIES PRIOR TO LAYUP AND CURING. NONCOMPLIANCE WILL RESULT IN A RUINED REPAIR.

- (a) Apply a coat of Resin Mix 1, prepared as shown in Figure 1/GENERAL, over the repair area.

NOTE: Repair should be completed within pot life of Resin Mix 1 as given in Figure 1/GENERAL.

- (b) Remove parting film from one side of the smallest ply of the patch and place the exposed face against the repair area with orientation as in original structure.
- (c) Use a squeegee over the parting film that covers the patch to remove wrinkles and entrapped air. Do not apply excessive pressure. Excessive pressure will produce a patch deficient in resin.
- (d) After removing parting film from the contact faces, place the next larger size ply of the impregnated patch over the ply on the repair area with proper orientation and with overlap all around as given in Figure 14/GENERAL.
- (e) Place succeeding plies of the patch as described in Paragraph 4.E.(3)(c)/GENERAL and Paragraph 4.E.(3)(d)/GENERAL.
- (f) Proceed to layup/bagging procedure.

F. Layup/Bagging Procedure (Refer to Figure 3/GENERAL and Figure 23/GENERAL)

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- (1) Place a layer of perforated FEP parting film (1 mil thick) over the repair. Cut the FEP so that the edges extend 3.0 in. (7.6 cm) beyond the edge of the repair patch.

NOTE: Thermocouples should not exceed 0.0625 in. (1.59 mm) in total diameter.

- (2) Secure three thermocouples (spaced evenly around repair) to the panel at the edge of the repair and secure them to the appropriate recorders.
- (3) Place a layer of dry peel ply or Style 120 glass fabric (BMS 9-3, Type D) or equivalent thickness glass fabric over the perforated FEP as a surface bleeder. Cut the surface bleeder so that the edges extend 2 in. (5 cm) beyond the edge of the perforated FEP.
- (4) Place a layer of solid FEP parting film (2 mil thick) over the surface bleeder. Cut the solid FEP so that the edges are even with the edge of the perforated FEP.
- (5) Place a layer of Airweave SS or open weave glass fabric over the solid FEP as a surface breather. Cut the surface breather so that edges extend to the edge of the surface bleeder. Make certain the surface breather makes contact with the surface bleeder along the edges.
- (6) Secure a vacuum line on the edge of the surface breather.

WARNING: FOR ACCELERATED CURE, USE HEAT-CURING EQUIPMENT THAT IS ACCEPTABLE TO LOCAL FIRE PROTECTION AUTHORITIES. FAILURE TO COMPLY COULD CAUSE PERSONNEL INJURY.

- (7) If a heat blanket is used as a heat source, perform the following steps:

NOTE: A heat blanket, infrared heat lamp, or equivalent heat source may be used to accelerate the cure.

If the repair is made on structure too small to allow the heat blanket to be vacuum bagged, proceed to Paragraph 4.F.(8)/GENERAL and place heat blanket over the vacuum bag. A second vacuum bag may then be placed over the part to hold the heat blanket in place.

- (a) Place a heat blanket over the surface breather. The heat blanket must extend a minimum of 2 in. (5 cm) beyond the repair patch edges.

NOTE: When using a heat blanket larger than 12 in. (30 cm) on one side, an aluminum caul plate (0.16 in. (4 mm) thick) can be used under the heat blanket to minimize localized heating. Make the caul plate slightly smaller than the surface breather.

- (b) Place controlling thermocouple over the center of the heat blanket.
- (c) Place 4 to 6 layers of glass fabric (Refer to Figure 1/GENERAL) over the heat blanket. The glass fabric will insulate the heat blanket and prevent damage to the bagging film.
- (8) Apply extruded sealing compound around the entire repair area, approximately 6 in. (15 cm) outside the edge of the heat blanket.
- (9) Lay a piece of vacuum bag material over the entire repair area, sealing the edge with the extruded sealing compound. Pleat the vacuum bag where needed to prevent bridging of bag material and subsequent bag breakage. Pad all sharp objects and corners to prevent bag breakage. In some cases, it is optional to vacuum bag the entire part.

NOTE: The entire surface must be vacuum bagged and restrained in place to prevent delamination when the repair area exceeds 15 percent of panel area. Regardless of the method of heat application, restraining devices that maintain the contour and support the part must be used for large parts where sagging and distortion could occur due to the weight of the part.

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- (10) Evacuate the space under the vacuum bag and maintain a vacuum of 22 in/Hg (75 kPa) minimum.

NOTE: Maintain a vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.

- (11) Cure the repair as given in Figure 1 (Sheet 1).

G. Cure the Repair

NOTE: Determination of the temperature must be made by using thermocouples placed at edge of patch.

The gel and cure times of the potting and lamination resins are based on ambient temperature (70 to 80°F; 21 to 27°C); elevated temperatures will advance the reactions and lower temperatures will retard the reactions.

An infrared heat lamp (250-watt), heating blankets or equivalent source may be used to accelerate the cure. The graph shown in Figure 4/GENERAL indicates the approximate temperatures obtained on the patch surface when the heat lamp is a certain height. Monitor temperature by thermocouples.

WARNING: USE EXPLOSIONPROOF HEAT LAMP OR HEAT BLANKETS FOR ACCELERATED CURE. NONCOMPLIANCE COULD CAUSE PERSONNEL INJURY.

CAUTION: SURFACE TEMPERATURE MUST NOT EXCEED 170°F (77°C). DAMAGE OR DISTORTION OF STRUCTURE MAY OCCUR IF TEMPERATURE EXCEEDS 170°F (77°C).

- (1) Cure of wet layup.

- (a) Cure of the repair will be accelerated by the use of the heat blanket or heat lamp. Refer to Figure 1/GENERAL and graph in Figure 4/GENERAL for time at temperature requirements. Heat at a maximum of 7°F (4°C) per minute. Refer to component repair chart for cure requirements.

NOTE: Cure time does not include the time required for the mold and part to heat up to temperature. Cure time is the period after the part has reached that temperature.

- (b) Maintain vacuum of 22 in/Hg (75 kPa) minimum during entire cure cycle.
(c) Remove bagging and parting film after curing.
(d) The patch should be free from pits, blisters, starved areas, and excess resin deposits.

H. Refinish After Repair

CAUTION: DO NOT SAND INTO ORIGINAL STRUCTURE. FAILURE TO COMPLY WILL REDUCE THE STRENGTH OF THE COMPONENT.

- (1) Lightly sand edge of topmost repair ply as necessary to fair the edge. Sand surface of repair to produce a smooth finish without damaging fibers.
(2) Refinish repair area as required. Refer to AMM 51-21-10/701.

I. Perform Post Repair Requirements

- (1) Inspect completed repairs for voids or bonding flaws using instrumented nondestructive inspection methods. Inspection should cover an area that includes a band 2 in. (5 cm) minimum around the area heated. If a defective repair is indicated by the inspection, remove and install the repair again.

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- (2) Where instrumented NDI methods are not available, tap testing may be used for inspection of the completed repair. Use a solid metal disk and tap the repair area lightly but firmly. Void areas will produce a dull sound as opposed to a sharp ring on a solid bonded area. Tap testing is not considered as reliable a method for inspection of the finished repair as instrumented NDI methods.

5. Typical Repairs

NOTE: These repairs apply to graphite fabric reinforced honeycomb components.

CAUTION: REFER TO THE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR THE REPAIR LIMITS AND MATERIAL FOR THE COMPONENT BEFORE USING THESE REPAIR INSTRUCTIONS. FAILURE TO COMPLY COULD RESULT IN AN UNACCEPTABLE AND UNAUTHORIZED REPAIR.

A. Repair of Delamination Between Plies

- (1) Delamination of Plies over Core Area of Panel (Figure 5/GENERAL)
- (a) Determine damage as given in Paragraph 4.A./GENERAL. Ensure that water and other contamination are removed as given in Paragraph 4.B./GENERAL.
 - (b) Cut away delaminated plies as given in Paragraph 4.C.(1)/GENERAL. Do not remove any core.
 - (c) Prepare damaged area as given in Paragraph 4.C.(2)/GENERAL.
 - (d) Prepare and apply fabric repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- (2) Repair of Delamination between Plies of Panel Edgeband (Refer to Figure 12/GENERAL)
- (a) Determine damage as given in Paragraph 4.A./GENERAL.
 - (b) Remove all contaminants and water from damaged area. Area must be completely dried out as given in Paragraph 4.B./GENERAL.
 - (c) Force Resin Mix 1 (Refer to Figure 1/GENERAL) into delaminated area.
 - (d) Clamp plies together and remove excess resin.
 - (e) Cure the repair as given in Paragraph 4.G./GENERAL, maintaining pressure until cured. Vacuum pressure is not required for this repair.
 - (f) Refinish surface as required.
 - (g) Perform applicable post-repair requirements as given in Paragraph 4.I./GENERAL before returning the repaired component to flight service.

B. Repair of Puncture, 0.50 in. (12.7 mm) Diameter or Less, in Honeycomb Panel (Refer to Figure 15/GENERAL)

- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
- (2) Remove exterior finishes as applicable, including enamel finish and conductive coating, from the repair surface around the puncture using No. 150 or finer sandpaper as given in Paragraph 4.C./GENERAL.
- (3) Dry out structure around puncture as given in Paragraph 4.B./GENERAL.
- (4) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape as given in Paragraph 4.C./GENERAL.
- (5) Clean repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (6) Prepare Resin Mix 4 as given in Figure 1/GENERAL.

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- (7) Work resin into the hole filling as much as possible.
- (8) Cure the repair as given in Paragraph 4.G./GENERAL.
- (9) Carefully sand any projecting material to fair with surrounding surface within +0.010 in. (0.254 mm).

NOTE: A 0.010 in. (0.254 mm) thick aluminum template may be used to protect surrounding surface while sanding.

- (10) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
 - (11) Clean the repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
 - (12) Prepare and apply two fabric cover plies same material and orientation as original surface ply.
 - (13) Complete repair as given in Paragraph 4.F./GENERAL through Paragraph 4.I./GENERAL.
- C. Repair of Damage to One Skin and Honeycomb Core Using Replacement Core Plug, Punctures Greater than 0.50 in. (12.7 mm) Diameter (Refer to Figure 2/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 4.D./GENERAL.
 - (5) Clean surface as given in Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Prepare and apply repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- D. Repair of Large Puncture Through Internal and External Surface of Panel Including Core Damage (Refer to Figure 6/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean and install honeycomb replacement core plug as given in Paragraph 4.D./GENERAL, except it is not necessary to vacuum bag the core plug installation at this time.
 - (5) Prepare and apply repair plies to one surface of the panel as given in Paragraph 4.E./GENERAL. A caul plate may be used on the opposite face of the panel to restrain the core plug in place.
 - (6) Apply vacuum and cure as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Ensure that temperature is approximately equal on both sides of panel.
 - (7) Sand core plug approximately flush with surrounding material, making allowance for film adhesive and slight core crush during cure.
 - (8) Prepare and apply repair plies to the other surface of the panel and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.

NOTE: The above two-stage cure procedure is recommended. As an option, a three-stage cure procedure may be used wherein the core plug installation and the repair plies on each side may be cured separately.

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- E. Replacement of Honeycomb Core on Damaged Edge of Panel (Refer to Figure 7/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL.
 - (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
 - (4) Fabricate, clean, and install honeycomb replacement core plug as given in Paragraph 4.D./GENERAL.
 - (5) Clean surfaces as given in Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Prepare and apply repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- F. Repair of Hole Through Both Skins of a Honeycomb Panel with Access Available from One Side Only (Refer to Figure 8/GENERAL)

NOTE: This repair applies to flat panels (or nearly flat panels) where the damage extends completely through the panel, but access is not readily available to repair the unexposed side. Refer to Figure 8/GENERAL when making this repair.

- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL.
- (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL and do the following:
 - (a) Cut a hole in the outer skin and core (D diameter) to permit a repair to be made to the inner skin with the required overlap.

NOTE: $D \text{ diameter} = d + 1.5 \times [N \times (1.0 \text{ in. (25.4 mm) for each ply}]$

d = major diameter of oval hole in inner skin and is limited to 1.5 in. (38 mm) maximum for this repair

N = number of plies in the inner skin

Stepping of the plies in the inner skin is not necessary for this repair.

- (b) Clean out damaged area in inner skin leaving an oval-shaped hole.
- (c) Sand the outer skin plies as given in Paragraph 4.C.(2)/GENERAL.
- (4) Fabricate an airtight patch (Refer to Figure 8/GENERAL, Details II thru IV) to cover the oval hole from the inaccessible side as follows:
 - (a) Make a suitable mold on which to lay up the patch. A thin gage aluminum sheet or any smooth surface can be used as a mold.
 - (b) Cover the mold with parting film or release agent.
 - (c) Lay up five plies of the same prepreg material used in the repair on the mold, using the procedures of Paragraph 4.E./GENERAL, except that all repair plies will have the same diameter and adhesive film will not be used. Make diameter of the repair plies at least equal to D Diameter.
 - (d) Bag and cure the patch as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL. Place thermocouples at the edge of the patch before cure.
 - (e) Remove the patch from the mold.
 - (f) Trim patch into an oval shape with a minor diameter slightly smaller than the major diameter of the cutout.

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- (g) Drill a 1/8 inch (3.2 mm) diameter hole in the center of the patch for a Cleco fastener.
- (h) Abrade the surface of the patch using No. 240 or finer Scotch-Brite abrasive. Remove all sanding dust by applying oil-free compressed air and using a vacuum cleaner.
- (i) Fabricate a strip of spring steel 1.0 x 10.0 inches (2.5 x 25 cm) and drill a 1/8 inch (3.2 mm) diameter hole in the center for the Cleco fastener.

NOTE: This repair illustrates the use of a spring steel clamp. However, any suitable retaining method may be used.

- (j) Assemble the patch and spring steel together with a 1/8 inch diameter Cleco fastener.
- (5) Abrade the backside of the inner skin to a distance of 0.75 in. (19 mm) from the edge of the elliptical cutout using No. 180 or finer sandpaper. Avoid abrasion of the existing ply filaments.

CAUTION: DO NOT IMMERSE PARTS IN TRICHTHLORETHANE SOLVENT OR ALLOW STANDING SOLVENT TO REMAIN ON PART. DAMAGE TO PART WILL OCCUR.

- (6) Clean repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
 - (7) Bend up both ends of the spring steel and apply Resin Mix 1 to the precured patch.
 - (8) Holding the spring steel up, insert the patch into the oval hole, and orient so that the hole is covered. Release the spring steel so that it holds the patch tightly up against the inner skin.
 - (9) Cure the adhesive as given in Figure 1/GENERAL. When cure is complete, remove the cleco fastener and spring. Fill the hole for cleco fastener with Resin Mix 5. Allow this to cure. Figure 4/GENERAL may be used as a reference when a heat lamp is used for curing patch.
 - (10) Clean out the repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
 - (11) Apply Resin Mix 1 to the surface of the inner skin which fays with the inner skin repair plies.
 - (12) Cut the required number of repair plies to diameter D and apply repair plies to the inner skin as given in Paragraph 4.E./GENERAL.
 - (13) Fabricate, clean, and install core plug as given in Paragraph 4.D./GENERAL.
 - (14) Prepare and apply repair plies to the outer skin surface of the panel and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- G. Repair of Damaged Skin Plies in Panel Edgeband (Refer to Figure 9/GENERAL)
- (1) Determine extend of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out.

CAUTION: DO NOT SAND INTO BOND PLY OR CORE (REFER TO FIGURE 9/GENERAL). LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR IF THIS CAUTION IS NOT OBSERVED. BOND PLY IS PLY ADJACENT TO CORE.

- (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
- (4) Prepare and apply repair plies as given in Paragraph 4.E./GENERAL.
- (5) Bag repair and cure as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (6) Refinish the repair as given in Paragraph 4.H./GENERAL.
- (7) Perform applicable post-repair requirements as given in Paragraph 4.I./GENERAL before returning to repaired component to flight service.

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- H. Repair of Punctures and Damage to Multiple Plies in Solid Laminate Panels (Refer to Figure 20/GENERAL)

NOTE: This repair applies to components made from laminated fabric plies and epoxy resin without a honeycomb core.

- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.

CAUTION: DO NOT PENETRATE THE UNDAMAGED PLIES. LOSS OF STRUCTURAL STRENGTH OF THE COMPONENT WILL OCCUR.

- (3) Remove damage and prepare area as given in Paragraph 4.C./GENERAL.
 - (4) Prepare and apply repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- I. Repair of Punctures, 0.50 in. (12.7 mm) Diameter or Less, in Solid Laminate Panels (Refer to Figure 21/GENERAL)
- (1) Determine extent of damage as given in Paragraph 4.A./GENERAL.
 - (2) Remove exterior finishes as applicable, from the repair surface around the puncture using No. 150 or finer sandpaper as given in Paragraph 4.C./GENERAL.
 - (3) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out.
 - (4) Remove loose fragments and other contamination from the hole. Clean up damaged area to a smooth and rounded shape as given in Paragraph 4.C./GENERAL.
 - (5) Clean repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
 - (6) Prepare Resin Mix 1, including 42 \pm 3 percent milled glass fiber, as given in Figure 1/GENERAL.
 - (7) Work resin into the hole filling as much as possible.
 - (8) Cure the repair as given in Paragraph 4.G./GENERAL.
 - (9) Carefully sand any projecting material to fair with surrounding surface within +0.010 in. (0.254 mm).

NOTE: A 0.010 in. (0.254 mm) aluminum template may be used to protect surrounding surface while sanding.

- (10) Abrade surfaces around repair using No. 240, or finer, Scotch-Brite abrasive.
- (11) Clean the repair area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (12) Prepare and apply two fabric cover plies as given in Paragraph 4.E./GENERAL.

NOTE: Refer to specific component structure identification for laminate material and orientation. Use repair plies with same orientation as the original surface plies.

Refer to Figure 13/GENERAL for repair ply substitutions.

- (13) Complete repair as given in Paragraph 4.F./GENERAL through Paragraph 4.I./GENERAL.
- J. Repair or Delaminations Between plies in Solid Laminate Panels

NOTE: This repair applies to components made from laminated graphite or aramid fabric plies and epoxy resin without a honeycomb core.

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- (1) Repair delaminations using methods described in Paragraph 5.H./GENERAL.
- K. Repair of Damaged Panel Attach Holes in Honeycomb Panel Edgebands or Along Edges of Laminated Panels (Refer to Figure 10/GENERAL)
- (1) Determine the extent of damage as given in Paragraph 4.A./GENERAL.
- (2) Remove all contamination and water from damaged area as given in Paragraph 4.B./GENERAL. Area must be completely dried out. Any structure in the repair area that cannot be dried out must be removed along with the other damage.
- (3) Taper sand around the hole to remove damage as given in Figure 10/GENERAL.
- (4) Clean area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (5) Prepare and apply repair plies and complete repair as given in Paragraph 4.E./GENERAL through Paragraph 4.I./GENERAL.
- L. Repair of Surfaces Dents (Refer to Figure 16/GENERAL)
- (1) Check for delamination and broken fibers as given in Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair as given in Paragraph 5.A./GENERAL.
- (3) If broken fibers are found, repair as given in Paragraph 5.B./GENERAL or Paragraph 5.C./GENERAL.
- (4) If no delamination or broken fibers are found, mark off damaged area allowing 1.00 in. (25.4 mm) of overlap for the repair ply.
- (5) Clean the damaged area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (6) Mask area for repair with masking tape.
- (7) Remove decorative finish using methods described in Paragraph 4.C.(2)(b)/GENERAL and Paragraph 4.C.(2)(c)/GENERAL.
- (8) Pot dent flush or slightly higher than surrounding surface with Resin Mix 2 potting compound (Refer to Figure 1/GENERAL).
- (9) Cure as given in Paragraph 4.G./GENERAL.
- CAUTION:** DO NOT SAND INTO FIBERS IN THE AREA SURROUNDING DENT.
- (10) Sand flush using 150-grit or finer sandpaper.
- (11) Clean area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (12) Prepare and apply one ply in the same orientation as the original surface ply as given in Paragraph 4.E./GENERAL. The ply layer is to be 2.00 in. (5 cm) larger than the potted area as shown in Figure 16/GENERAL. Refer to Figure 13/GENERAL for repair ply substitution.
- (13) Bag repair and cure as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.
- (14) Refinish as given in Paragraph 4.H./GENERAL.
- M. Repair of Lightning Strike Damage (Refer to Figure 17/GENERAL)

CAUTION: THIS REPAIR IS LIMITED TO LIGHTNING STRIKE DAMAGE NOT PENETRATING FIBERS. IF FIBERS OR CORE HAVE BEEN DAMAGED, REMOVE AND REPLACE AS GIVEN IN PARAGRAPH 4.A./GENERAL THROUGH PARAGRAPH 4.I./GENERAL.

- (1) Check for delaminations as given in Paragraph 4.A./GENERAL.
- (2) If delamination is found, repair as given in Paragraph 5.A./GENERAL or Paragraph 5.G./GENERAL.

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- (3) If delamination is not found, mask off damaged area allowing 1.00 in. (25.4 mm) of overlap for the repair ply.
- (4) Clean damaged area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (5) Mask area for repair with masking tape.
- (6) Remove decorative finish using methods described in Paragraph 4.C.(2)(b)/GENERAL and Paragraph 4.C.(2)(c)/GENERAL.
- (7) Cure as given in Paragraph 4.G./GENERAL.
- (8) Prepare and apply one layer fabric as given in Paragraph 4.E./GENERAL. The ply layer is to overlap the lightning damage by 1.0 in. (25.4 mm) all around (Refer to Figure 17/GENERAL).
- (9) Complete repair as given in Paragraph 4.F./GENERAL through Paragraph 4.I./GENERAL.

N. Repair of Small Damage to One Skin (Refer to Figure 19/GENERAL)

CAUTION: THIS REPAIR HAS INSPECTION REQUIREMENTS AND TIME LIMITS. SEE SPECIFIC STRUCTURAL COMPONENT REPAIR SECTION FOR REPAIR LIMITATIONS.

- (1) Determine damaged area as given in Paragraph 4.A./GENERAL.
- (2) Mask area for repair with masking tape.
- (3) Remove decorative finish using method described in Paragraph 4.C./GENERAL.
- (4) Remove any moisture and contamination using vacuum or oil-free compressed air.
- (5) Heat the area for 1 hour minimum at 150°F (66°C) to 170°F (77°C). The rate of temperature rise must not exceed 7°F (4°C) per minute.
- (6) Lightly abrade masked area with 150-grit or finer sandpaper.
- (7) Clean area as given in Paragraph 4.C.(2)(e)/GENERAL.
- (8) Make a wet layup of two plies with the same orientation as the original surface ply. Refer to Figure 13/GENERAL for substitute repair ply material. The plies are to overlap the damage and each other as shown in Figure 19/GENERAL.
- (9) Bag repair and cure as given in Paragraph 4.F./GENERAL and Paragraph 4.G./GENERAL.

O. Repair of Erosion Damage to Panel Edges (Refer to Figure 22/GENERAL)

- (1) Determine the damaged area as given in Paragraph 4.A./GENERAL. If damage exceeds the limits specified in Figure 22/GENERAL, repair as given in Paragraph 5.G./GENERAL. If delamination is present, repair as given in Paragraph 5.A.(2)/GENERAL.
- (2) Mask the damaged area with masking tape. Use care to keep the rework area within the limits specified in Figure 22/GENERAL.
- (3) Remove the moisture and contamination from the rework area with a vacuum or oil-free compressed air and by heating the area to between 150°F (66°C) and 170°F (77°C). The rate of heating must not exceed 5°F (3°C) per minute. Refer to Paragraph 4.B./GENERAL.
- (4) Taper sand the damaged area using 180-grit or finer sandpaper. Maintain the limits specified in Figure 22/GENERAL.
- (5) Clean the area. Refer to Paragraph 4.C.(2)(e)/GENERAL.
- (6) Seal the area with laminating Resin Mix 1. Refer to Figure 1/GENERAL for resin specifications, mixing, and curing procedures.

757-200 STRUCTURAL REPAIR MANUAL

RESIN PREPREG, OR ADHESIVE TYPE	COMPONENTS	PARTS BY WEIGHT	OPEN TIME BEFORE USE, OR POT LIFE OF MIXTURE	CURE CYCLE SUFFICIENT FOR HANDLING, DRILLING, SANDING
RESIN MIX 1 (LAMINATING RESIN)	FR 7020 PART A RESIN BASE PART B HARDENER [B]	100 \pm 2 58 \pm 0.5	APPROX 30 MIN OF 75°F	180 MIN AT 150°F (66°C) +10°F (6°C) -0°F (0°C)
RESIN MIX 2 (POTTING RESIN)	FR 7162-A RESIN FR 7162-B HARDENER [B]	100 \pm 5 40 \pm 2	60 MIN AT 70°F (21°C)	16 HRS AT 77°F (25°C) 2-4 HRS AT 122°F (50°C) FOR SECTIONS OVER 1-INCH THICK SEE [A]
RESIN MIX 3 (POTTING RESIN)	RESIN MIX 2 MICROBALLOONS	100 5	SAME AS RESIN MIX 2	SAME AS RESIN MIX 2
RESIN MIX 4	RESIN MIX 1 MILLED GLASS FIBER	80 20	SAME AS RESIN MIX 1	SAME AS RESIN MIX 1
RESIN MIX 5	RESIN MIX 2 MILLED GLASS FIBER	80 20	SAME AS RESIN MIX 2	SAME AS RESIN MIX 2

NOTES

- MATERIALS MUST GEL AT ROOM TEMPERATURE PRIOR TO HEATING. RATE OF HEAT RISE MUST BE NO GREATER THAN 7°F (4°C) PER MINUTE.
- REFER TO SRM 51-31-03 FOR SOURCES OF MATERIALS.
- REFER TO SRM 51-30-06 FOR MATERIAL ORDERING DATA.

[A] THICK SECTIONS (OVER 1 INCH) SHOULD BE MADE IN MULTIPLE POURS, ALLOWING THE PREVIOUS PORTION TO GEL BEFORE REPOURING.

[B] SOURCE: FIBER - RESIN CORP.
170 WEST PROVIDENCIA AVE.
BURBANK, CA 91503

[C] BE SURE TO STIR THE ENTIRE CONTAINER OF FR 7162-A. IT CONTAINS HOLLOW GLASS SPHERES WHICH RISE TO THE SURFACE OF THE LIQUID RESIN. THE CONTENTS MUST BE OF UNIFORM CONSISTENCY BEFORE ADDING HARDENER.

TO 100 PARTS-BY-WEIGHT OF FR 7162-A, ADD 40 PARTS-BY-WEIGHT OF HARDENER 7162-B. STIR THOROUGHLY WITH A SLOW SPEED MIXER, TO AVOID BREAKING THE GLASS MICROBALLOONS.

**Resin Specifications and Mixing Procedures
Figure 1 (Sheet 1 of 2)**

757-200
STRUCTURAL REPAIR MANUAL

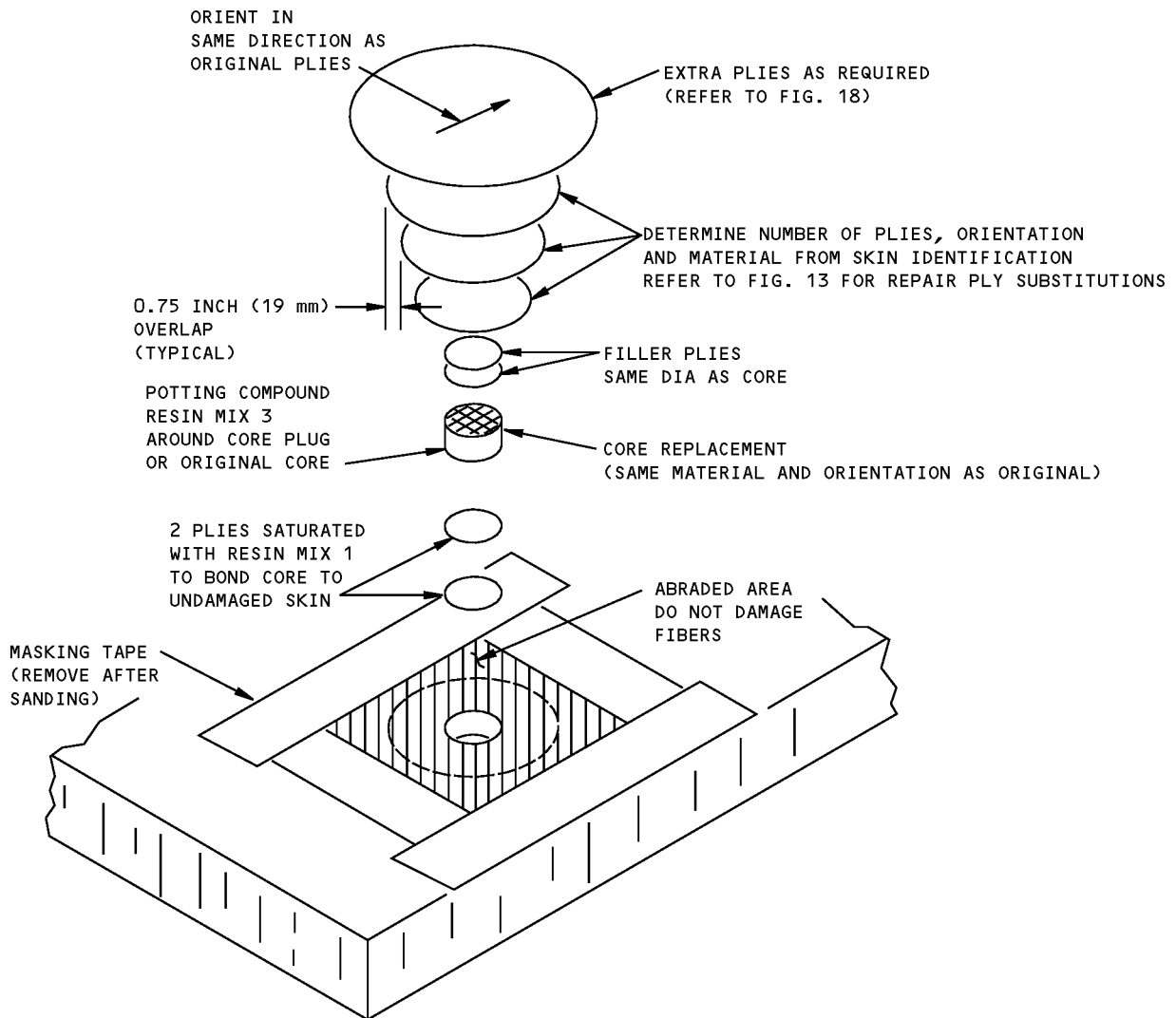
WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT THE SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING THE SKIN.

CAUTION: TO PREVENT CONTAMINATION OF THE RESIN, DO NOT USE WAXED CONTAINERS FOR MIXING.

MIXING PROCEDURE	
RESIN MIX 1	ADD HARDENER TO RESIN AND MIX THOROUGHLY.
RESIN MIX 2	ADD 100 PARTS-BY-WEIGHT RESIN TO 40 PARTS-BY-WEIGHT HARDENER, STIR SLOWLY. C
RESIN MIX 3	1. ADD PHENOLIC MICROBALLOONS TO RESIN AND MIX THOROUGHLY. 2. ADD HARDENER AND MIX THOROUGHLY.
RESIN MIX 4 RESIN MIX 5	ADD MILLED GLASS FIBERS TO RESIN MIX TO PROVIDE A CONSISTENCY SIMILAR TO A THIN PUTTY.

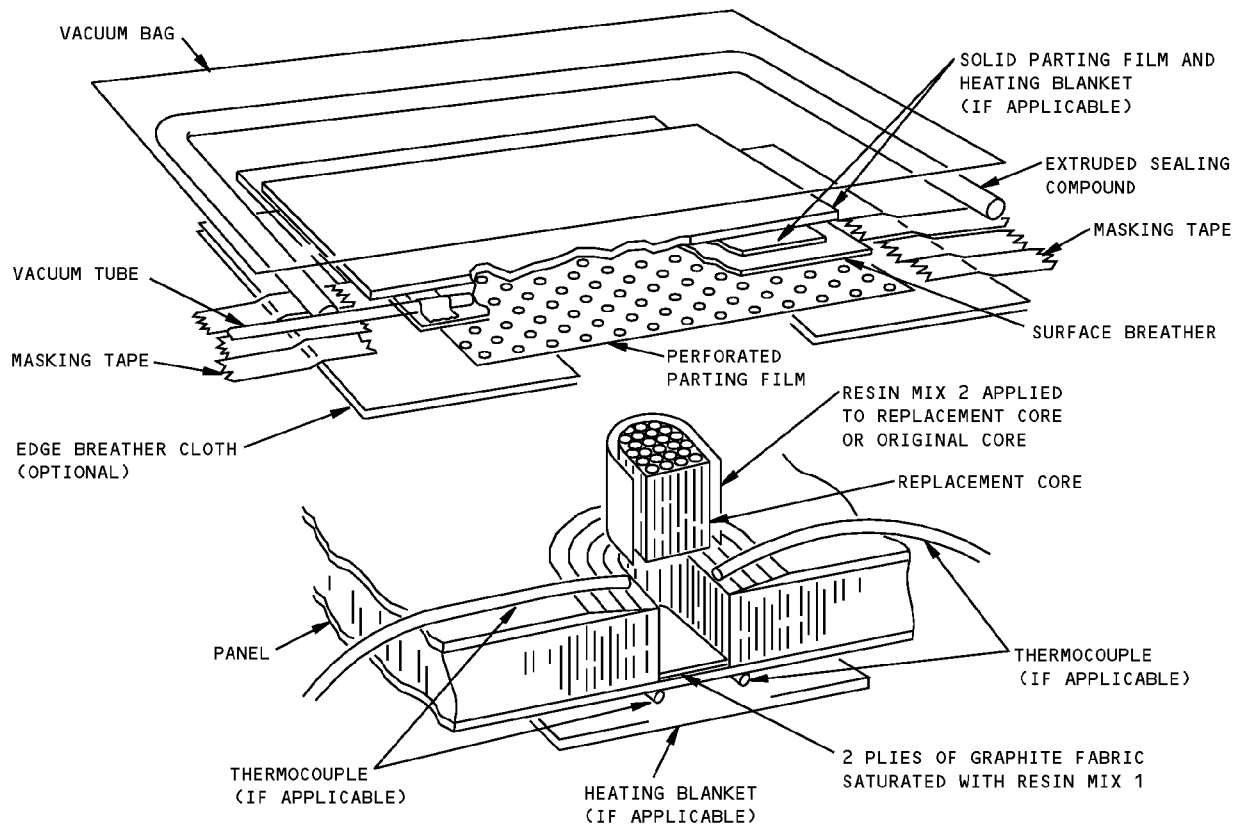
Resin Specifications and Mixing Procedures
Figure 1 (Sheet 2 of 2)

757-200 STRUCTURAL REPAIR MANUAL

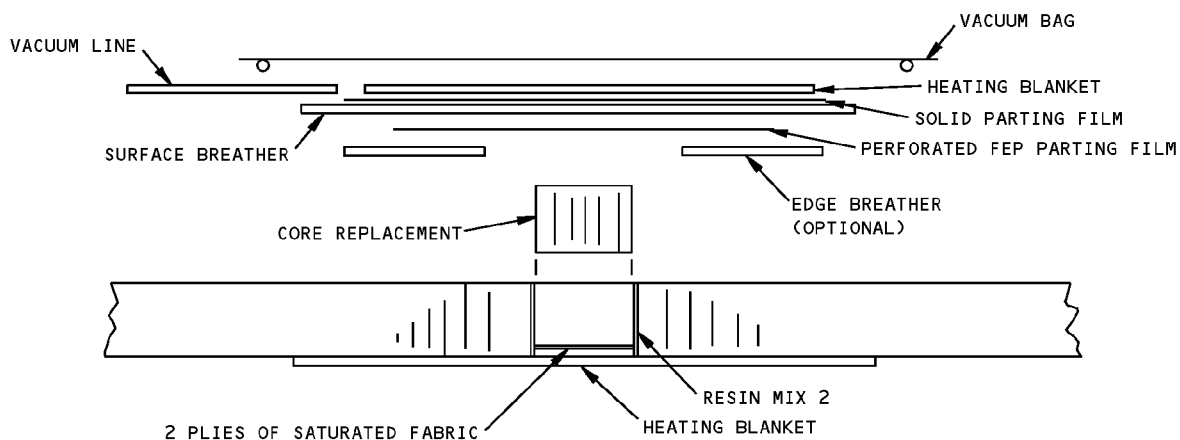


Repair of Large Punctures through One Skin of a Sandwich Structure Including Core Damage - Wet Layup
Figure 2

757-200

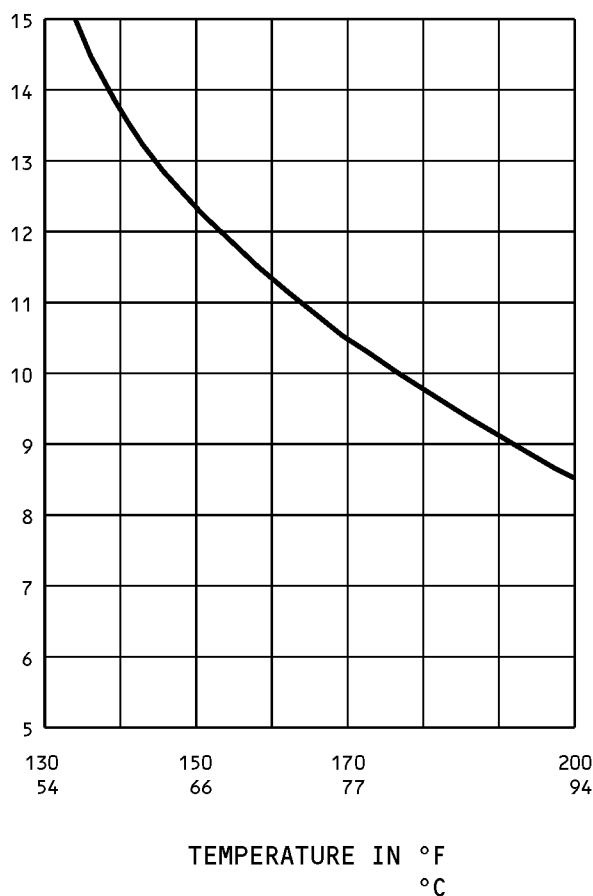
STRUCTURAL REPAIR MANUAL

**BAGGING SEQUENCE FOR CORE REPLACEMENT
(WET LAYUP ONLY)**



**SECTION THRU LAYUP FOR CORE REPLACEMENT
(WET LAYUP ONLY)**

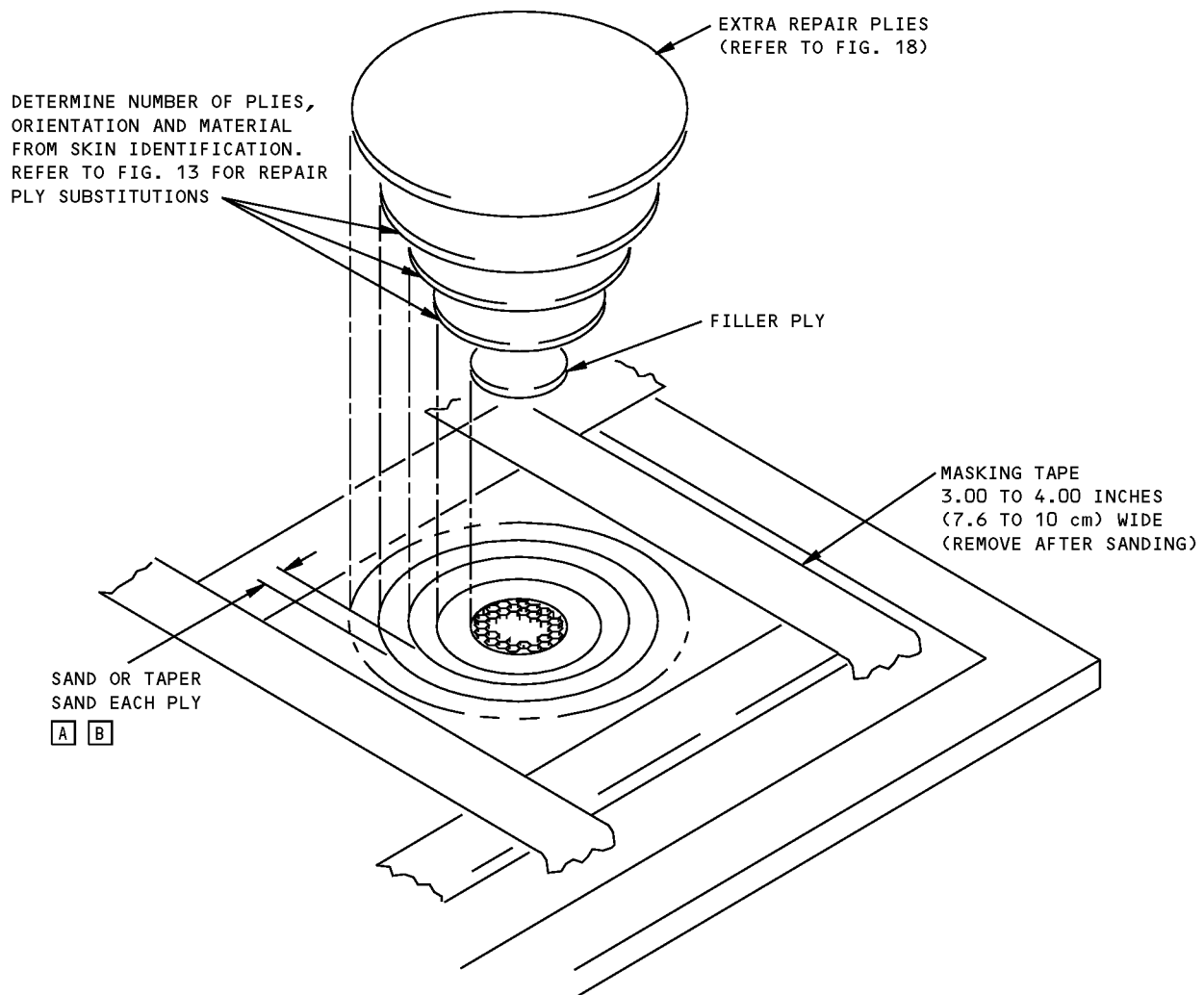
**Application of Pressure During Cure - Wet Layup
Figure 3**

757-200
STRUCTURAL REPAIR MANUALHEAT LAMP –
HEIGHT (INCHES)

NOTE: THE HEIGHT IN INCHES OF 250-WATT HEAT LAMP FROM SURFACE OF THE PATCH VS TEMPERATURE AT SURFACE OF PART.

Approximate Temperatures Using Heat Lamp
Figure 4

757-200 STRUCTURAL REPAIR MANUAL



WET LAYUP ONLY

NOTES

- A TAPER SANDING OF EACH PLY OF EXTERNAL SKIN IS RECOMMENDED B.
- B REFER TO PAR. 4.C.(2)(b) FOR OPTIONAL SANDING/LAYOUT PROCEDURES.

Repair of Damaged External or Internal Skins of a Sandwich Panel - Wet Layup
Figure 5

757-200

STRUCTURAL REPAIR MANUAL

DETERMINE NUMBER OF PLYS,
ORIENTATION AND MATERIAL
FROM SKIN IDENTIFICATION.
REFER TO FIG. 13 FOR REPAIR
PLY SUBSTITUTIONS

FILLER PLYS

REPLACEMENT CORE

EXTRA REPAIR PLYS
(REFER TO FIG. 18)

CORE SPLICE
ADHESIVE [A]

REPAIR PLY
LOCATIONS

TAPER SAND
EACH PLY [B]

DETERMINE NUMBER OF PLYS,
ORIENTATION AND MATERIAL
FROM SKIN IDENTIFICATION.
REFER TO FIG. 13 FOR REPAIR
PLY SUBSTITUTIONS

FILLER PLYS

NOTES

- [A] RESIN MIX 3 APPLIED TO CORE PLUG OR ORIGINAL CORE
- [B] TAPER SANDING OF EACH PLY OF EXTERNAL SKIN IS RECOMMENDED. FOR OPTIONAL SANDING/LAYUP METHOD REFER TO PAR. 4.C.(2)(b)

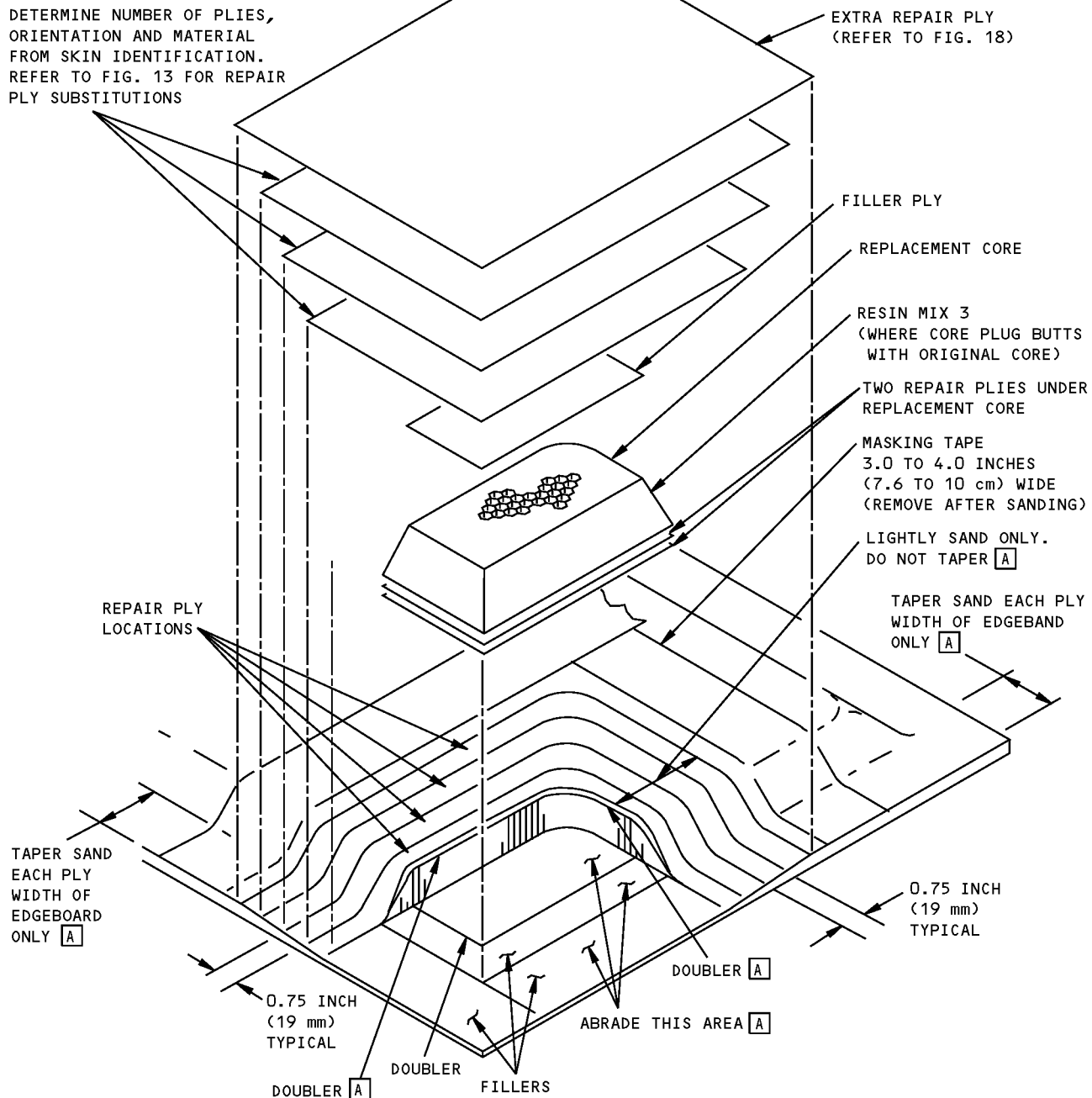
WET LAYUP ONLY

EXTRA REPAIR
PLY
(REFER TO FIG. 18)

Repair of Large Punctures through Both Skins of a Sandwich Panel Including Core Damage - Wet Layup
Figure 6

STRUCTURAL REPAIR MANUAL

DETERMINE NUMBER OF PLYS,
ORIENTATION AND MATERIAL
FROM SKIN IDENTIFICATION.
REFER TO FIG. 13 FOR REPAIR
PLY SUBSTITUTIONS



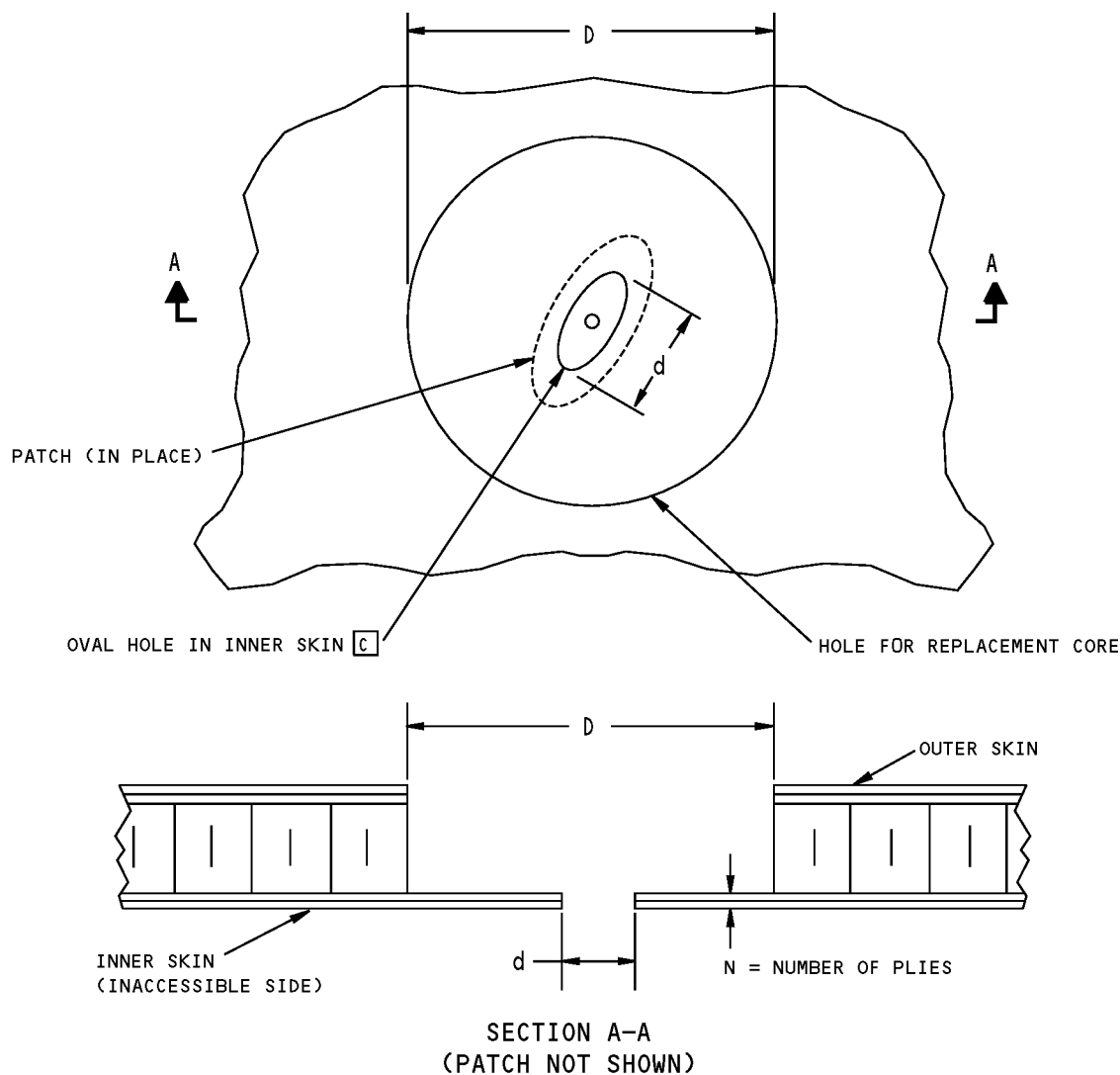
NOTES

- [A] DO NOT TAPER SAND SKIN OR
DOUBLER PLYS OVER CORE

WET LAYUP ONLY

Replacement of Honeycomb Core on Damaged Edge of Sandwich Panel - Wet Layup
Figure 7

757-200 STRUCTURAL REPAIR MANUAL



NOTES

- THIS REPAIR ILLUSTRATES THE USE OF A SPRING STEEL CLAMP. HOWEVER, ANY SUITABLE RETAINING DEVICE MAY BE USED
- $D = d + 1.5 \times [N \times (1.0 \text{ INCH (25.4 mm) FOR EACH PLY})]$
 d = MAJOR DIAMETER OF OVAL HOLE IN INNER SKIN
 N = NUMBER OF PLYS

FOR EXAMPLE:

IF $d = 0.50 \text{ INCH (12.7 mm)}$

$N = 2$

THEN, $D = 0.50 \text{ INCH (12.7 mm)} + (1.5)$

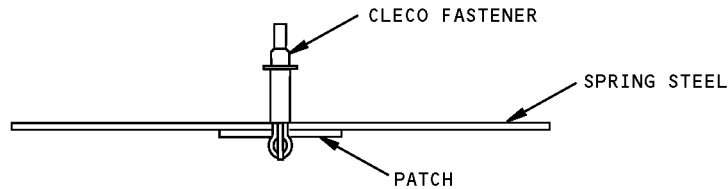
$[(2 \text{ PLYS}) \times 1.0 \text{ INCH (25.4 mm)}]$

$D = 3.50 \text{ INCH (88.9 mm) DIAMETER}$

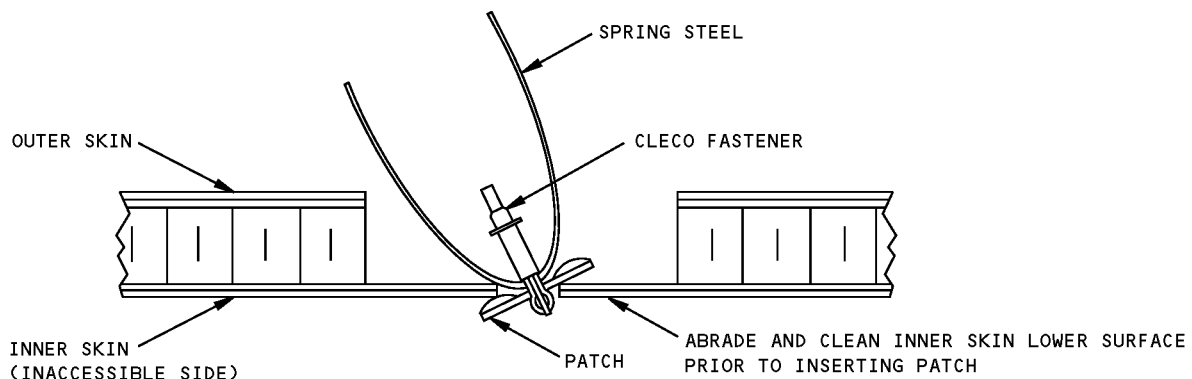
- A** RESIN MIX 3 APPLIED TO CORE PLUG OR ORIGINAL CORE
- B** MAKE TAPER AND OVERLAP AS SHOWN IN FIGURE 14
- C** MAJOR DIAMETER d OF OVAL HOLE IN INNER SKIN IS LIMITED TO 1.5 INCH (38 mm) FOR THIS REPAIR

**Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 1 of 3)**

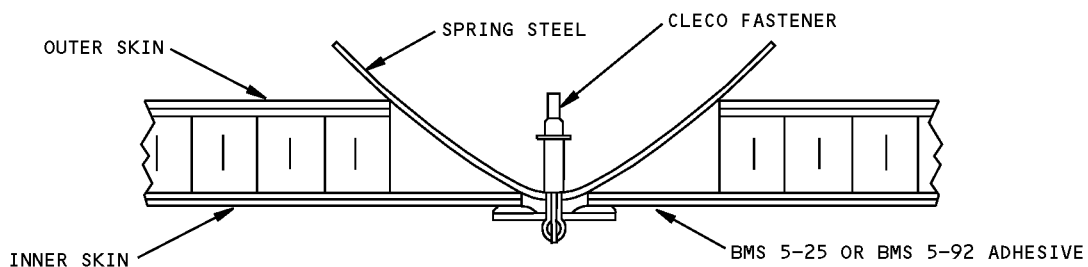
757-200 STRUCTURAL REPAIR MANUAL



ASSEMBLE PATCH AND SPRING STEEL
DETAIL II



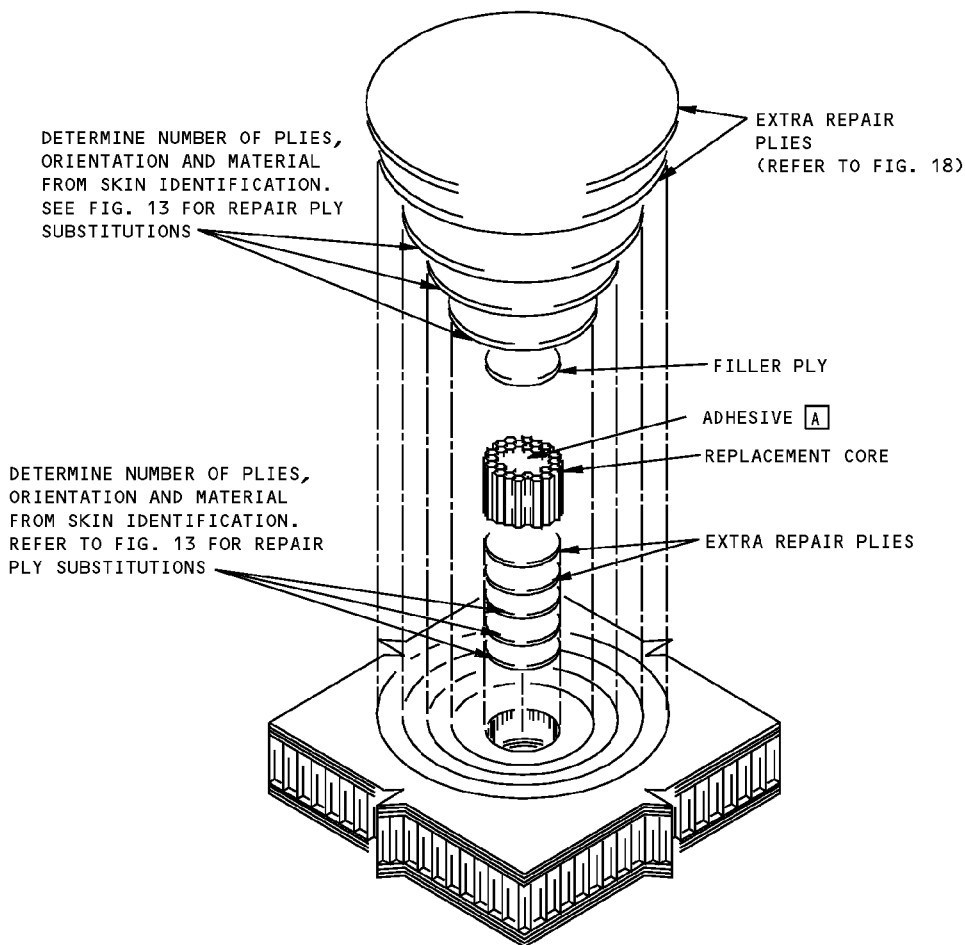
INSERT PATCH INTO OVAL HOLE
DETAIL III



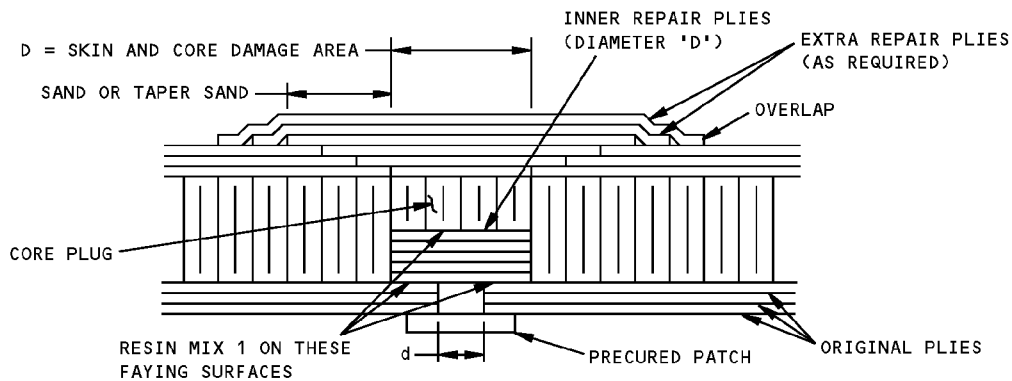
HOLD PATCH IN PLACE WHILE CURING
DETAIL IV

Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 2 of 3)

757-200 STRUCTURAL REPAIR MANUAL



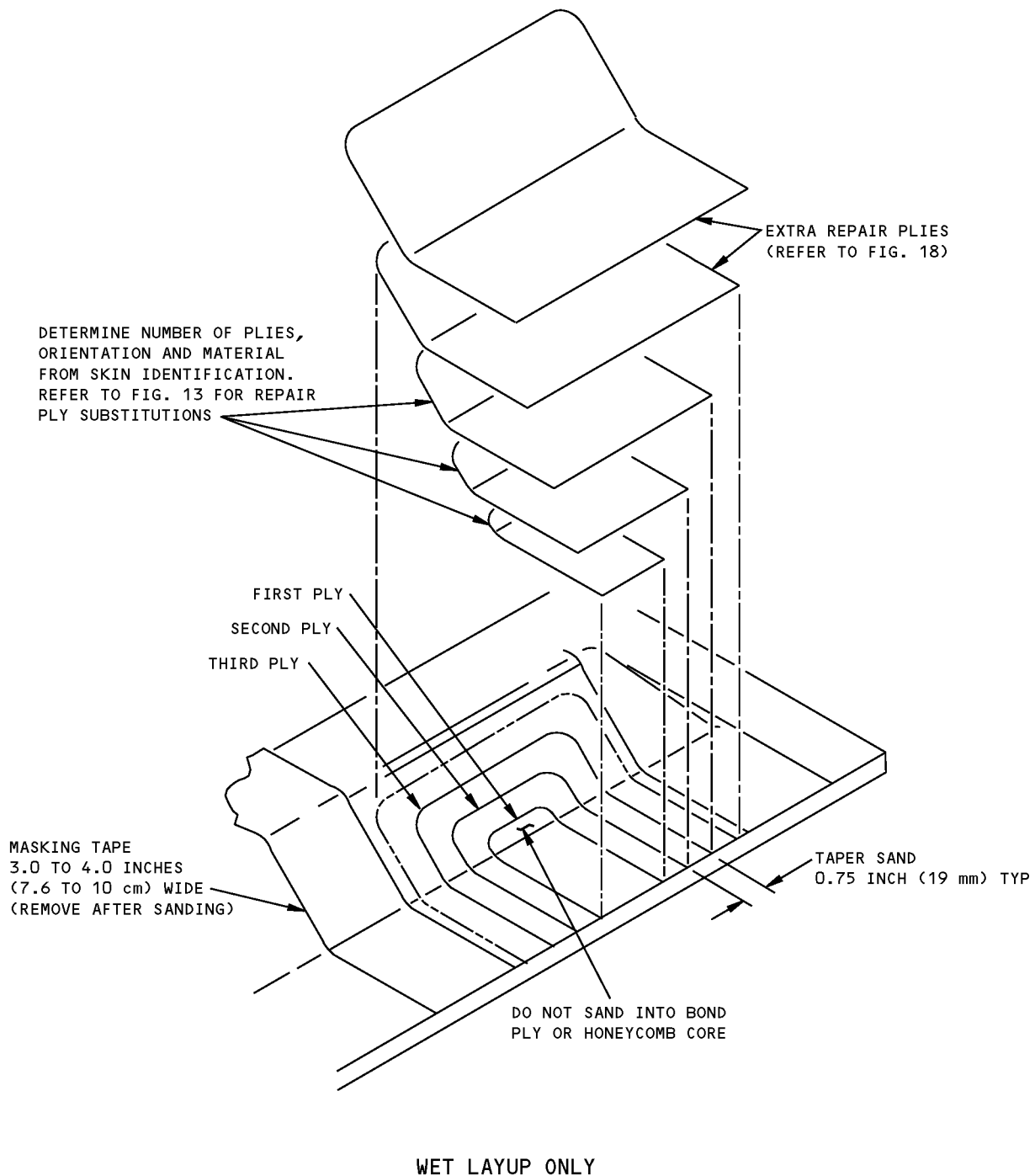
WET LAYUP ONLY



SECTION THROUGH REPAIR
(WET LAYUP ONLY)

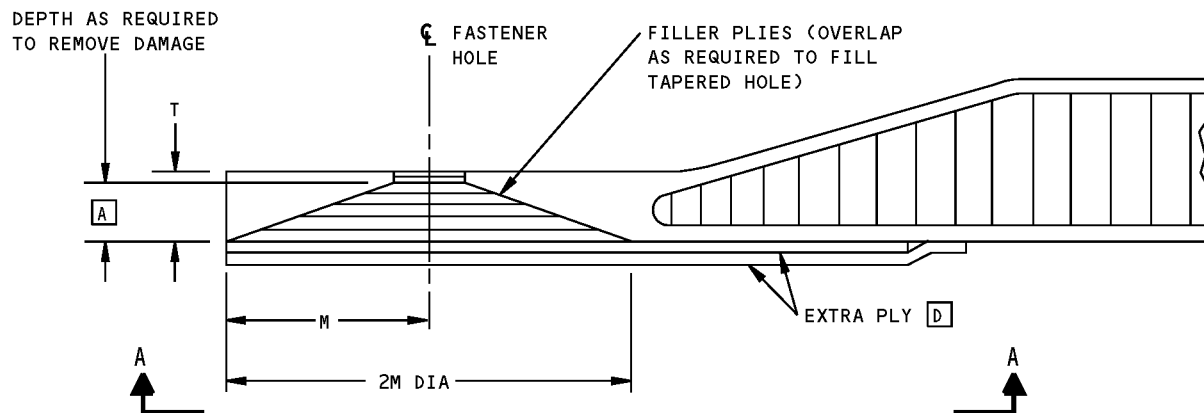
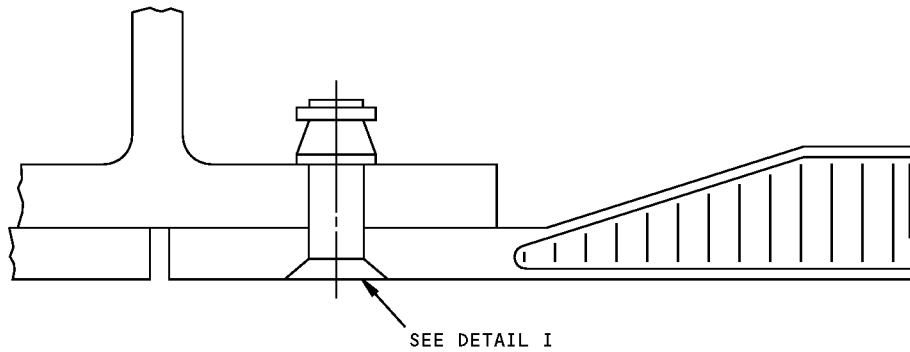
Repair of Damage to External and Internal Skins with Access Limited to One Side - Wet Layup
Figure 8 (Sheet 3 of 3)

757-200
STRUCTURAL REPAIR MANUAL



Repair of Damaged Skin Plies on a Panel Edge - Wet Layup
Figure 9

757-200 STRUCTURAL REPAIR MANUAL



DETAIL I

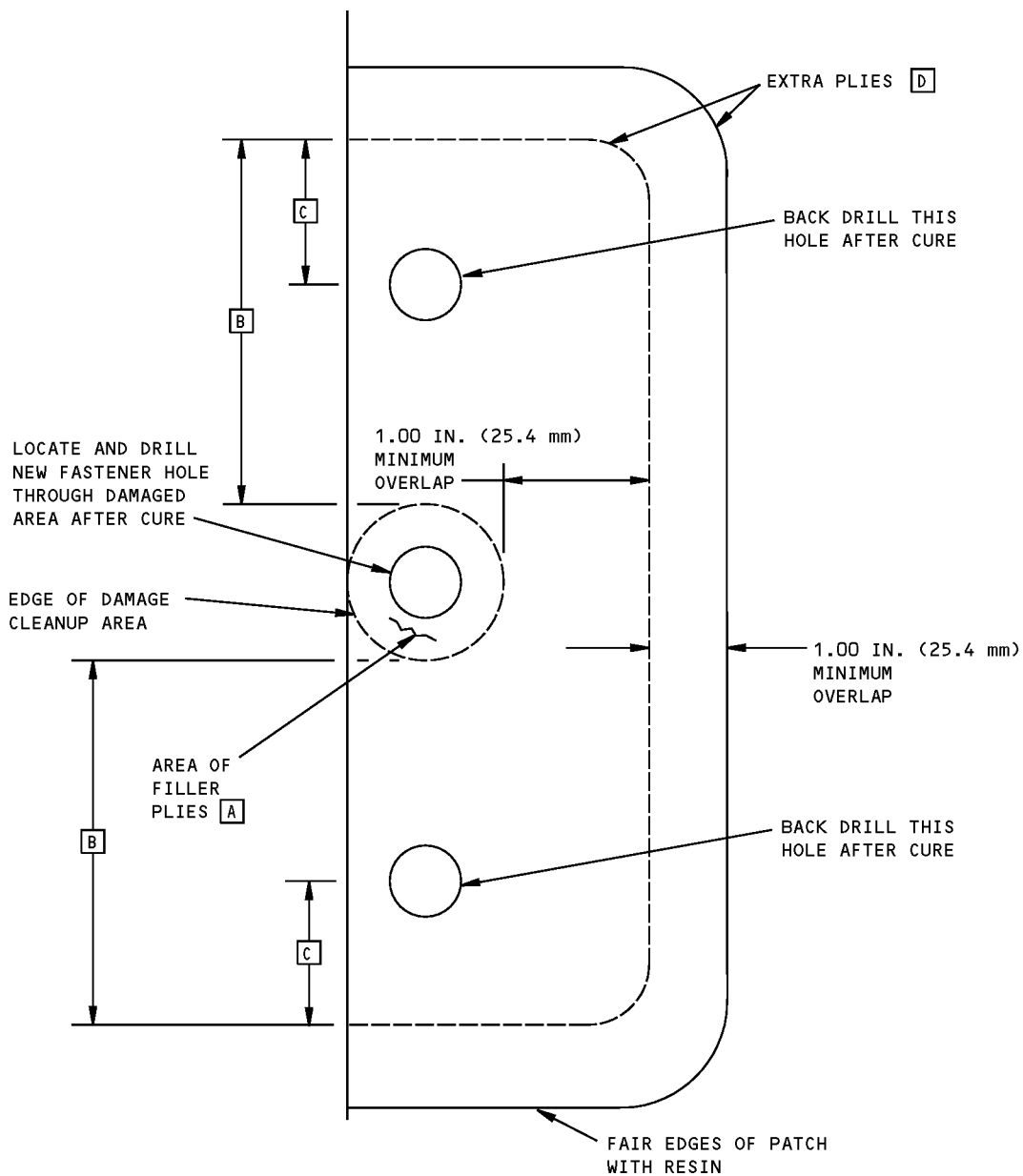
NOTES

- $M = 5T$ MAXIMUM AS SHOWN, WHERE T IS THE THICKNESS OF THE EDGE BAND. DO NOT CUT INTO CORE
- THIS REPAIR APPLIES ONLY WHERE NO MORE THAN TWO ATTACH HOLES ARE DAMAGED IN ANY TEN CONSECUTIVE ATTACH HOLES
- D EQUALS FASTENER DIAMETER

- [A] APPLY FILLER PLIES AS REQUIRED TO FILL THE DAMAGED AREA
- [B] EXTEND EXTRA PLY FAR ENOUGH SO THAT IT EXTENDS AT LEAST 1.00 INCH (25 mm) PAST EDGE OF DAMAGED AREA
- [C] EXTEND EXTRA REPAIR PLY FAR ENOUGH TO PROVIDE AT LEAST $2D$ EDGE MARGIN
- [D] ORIENT EXTRA REPAIR PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER

Repair of Damaged Panel Attach Hole - Wet Layup
Figure 10 (Sheet 1 of 2)

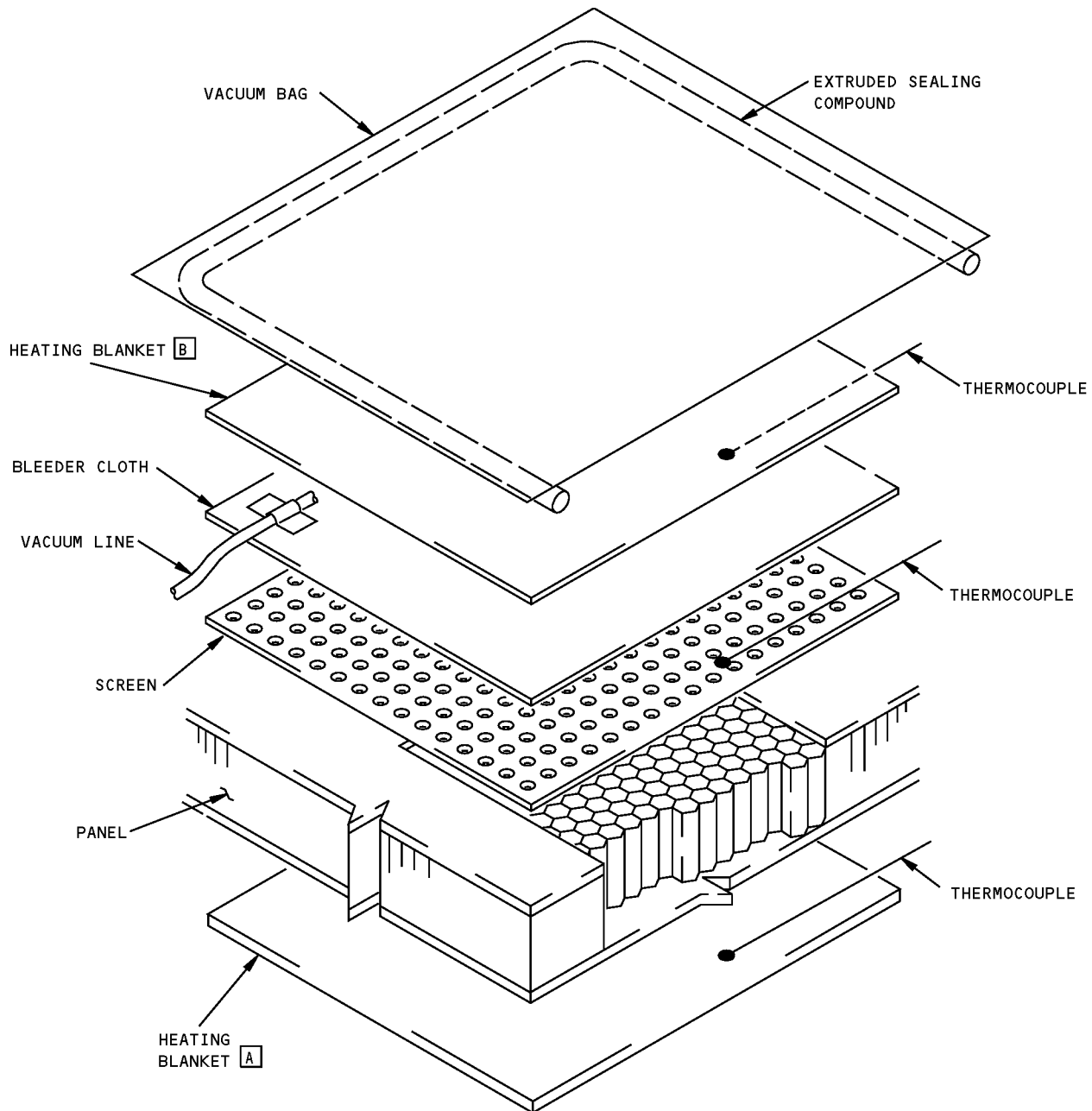
757-200
STRUCTURAL REPAIR MANUAL



SECTION A-A

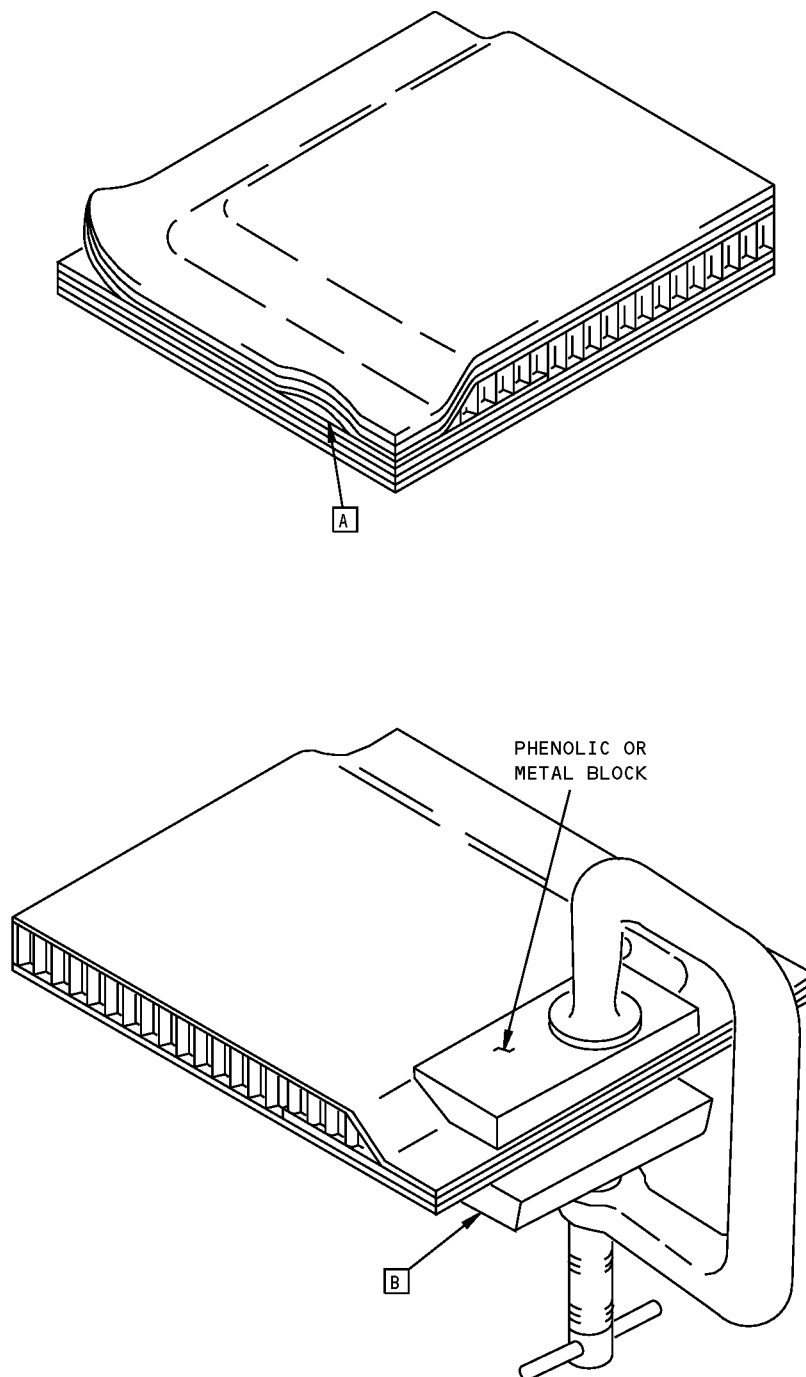
Repair of Damaged Panel Attach Hole - Wet Layup
Figure 10 (Sheet 2 of 2)

757-200
STRUCTURAL REPAIR MANUAL

**NOTES**

- [A]** PREFERRED LOCATION OF HEATING BLANKET WHEN OPPOSITE FACE IS ACCESSIBLE
- [B]** ALTERNATE LOCATION OF HEATING BLANKET WHEN OPPOSITE SIDE IS INACCESSIBLE. THIS LOCATION MAY BE USED FOR AN ADDITIONAL HEATING BLANKET TO ACCELERATE WATER REMOVAL

Water Removal from Honeycomb Sandwich
Figure 11

**757-200
STRUCTURAL REPAIR MANUAL****NOTES**

- REFER TO PARAGRAPH 5.A.(2) FOR COMPLETE REPAIR INSTRUCTIONS

A FORCE RESIN MIX 1 INTO DELAMINATED AREA

B CLAMP PLIES TOGETHER AND CURE

**Repair of Delaminations between Plies of Panel Edgeband
Figure 12**

757-200 STRUCTURAL REPAIR MANUAL

ORIGINAL PLY MATERIAL		REPAIR PLY MATERIAL	REPAIR PLY SUBSTITUTION NOTES
ARAMID FABRIC	KEVLAR 49-285 F1610188	BMS 9-3 TYPE D, H-2, OR H-3 (GLASS FABRIC)	A C D E
GRAPHITE TAPE	3501-5A-AS4	5HSW-AS4-6K STYLE ES-1506 (GRAPHITE FABRIC)	B F
GRAPHITE FABRIC	A-370-5H/3501-5A, AS4 CYCOM 985-1, AS4 EM 7198 CELION 6K-ST	5HSW-AS4-6K STYLE ES-1506	B F

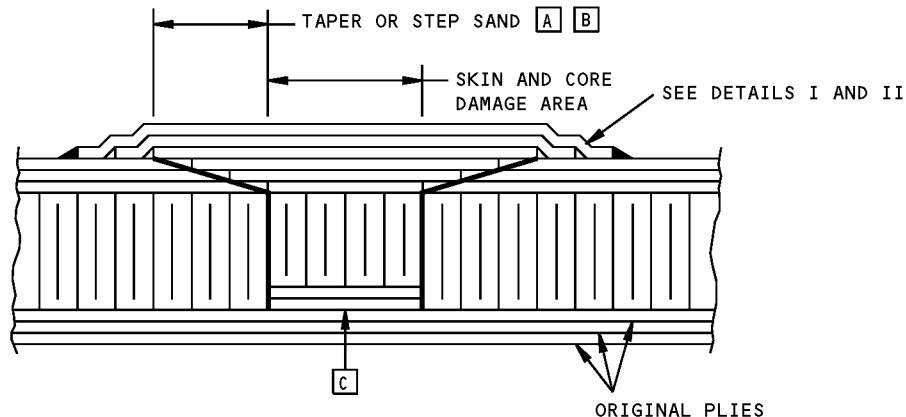
NOTES

- REFER TO SRM 51-31-03 FOR SOURCE OF MATERIALS.

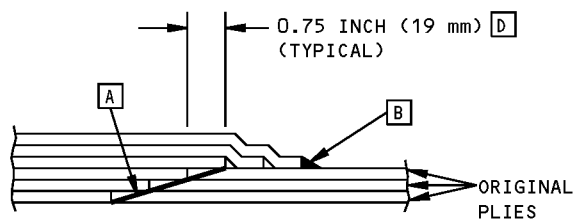
- A ALL CLASSES EXCEPT CLASS 7 MAY BE USED.
- B TWO CONSECUTIVE PLIES OF GRAPHITE FABRIC ARE REQUIRED FOR EACH PLY OF GRAPHITE TAPE. ALIGN THE FABRIC WARP FIBERS IN THE SAME DIRECTION AS THE TAPE FIBERS.
- C USE ONE PLY OF TYPE H-2 OR H-3 IN PLACE OF TWO PLIES OF TYPE D.
- D USE THREE PLIES OF TYPE D IN PLACE OF ONE PLY OF TYPE H-2 OR H-3 UNLESS OTHERWISE STATED.
- E USE ONE PLY OF TYPE H-3 IN PLACE OF ONE PLY OF TYPE H-2, AND VICE VERSA.
- F SOURCE: HERCULES INC., MAGNA, UTAH, USA.
WOVEN STRUCTURES, 1600 W. 135TH ST.
GARDENA, CA. USA 90249

**Repair Ply Substitutions
Figure 13**

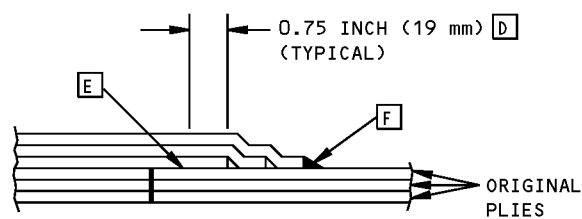
757-200 STRUCTURAL REPAIR MANUAL



SECTION THROUGH TYPICAL REPAIR
(WET LAYUP ONLY)



TAPER SANDED SKIN
DETAIL I



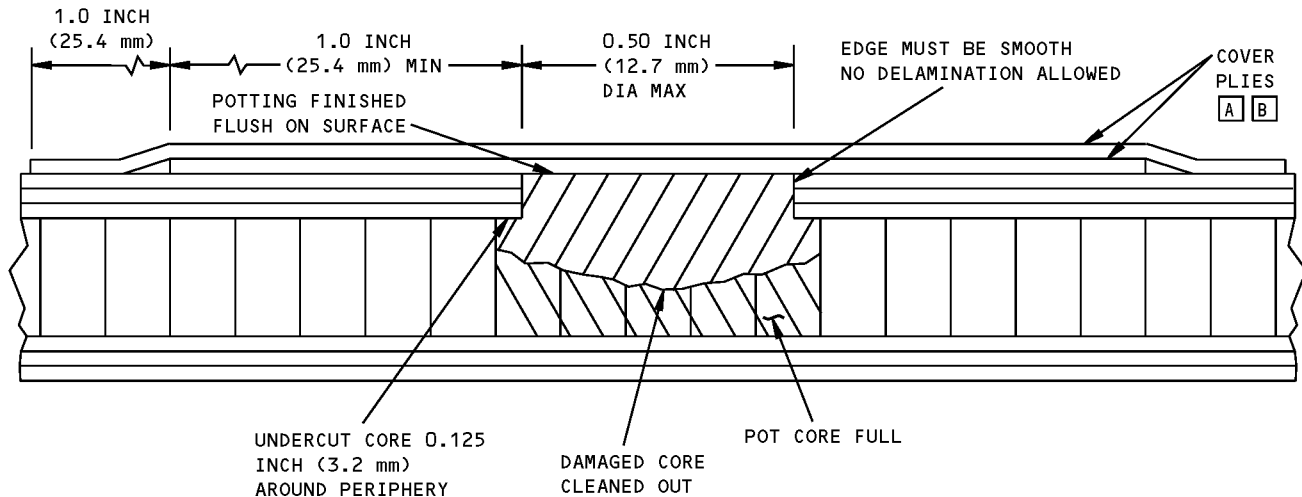
OPTIONAL SANDED SKIN
DETAIL II

NOTES

- | | |
|--|---|
| <p>A TAPER SAND OR STEP SAND EXISTING PLIES AROUND REPAIR AREA A MINIMUM OF 1.00 INCH (25 mm) FOR EACH EXISTING PLY</p> <p>B DO NOT EXPOSE OR DAMAGE FILAMENTS IN UNTAPERED AREA WHEN SANDING</p> <p>C SANDING MUST NOT EXPOSE OR DAMAGE THE FILAMENTS IN BOND PLY (PLY BONDED TO CORE)</p> <p>D EACH PLY MUST OVERLAP AT LEAST 1.00 INCH (25 mm) PAST EDGE OF PRECEDING PLY</p> | <p>E PREPARE PER PARAGRAPH 4.C.(2)(b)</p> <p>F DO NOT EXPOSE OR DAMAGE FILAMENTS WHEN SANDING THIS AREA</p> |
|--|---|

Sanding and Overlap Requirements
Figure 14

757-200 STRUCTURAL REPAIR MANUAL



TYPICAL SECTION

NOTES

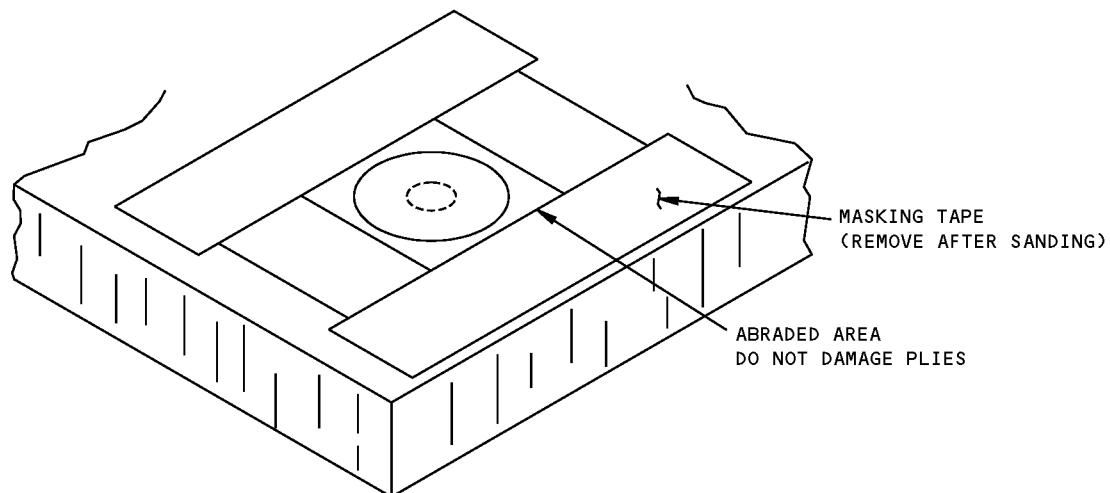
- OVERLAP COVER PLIES AS SHOWN IN FIG. 14. DO NOT TAPER SAND OR STEP SAND ANY PLIES

A ORIENTATE COVER PLIES IN THE SAME DIRECTION AS THE ORIGINAL OUTER LAYER

B PREPARE AND APPLY TWO PLIES OF THE SAME MATERIAL AND ORIENTATION AS ORIGINAL SURFACE PLIES AS GIVEN IN PAR. 4.E. REFER TO FIG. 13 FOR SUBSTITUTE REPAIR PLY MATERIAL

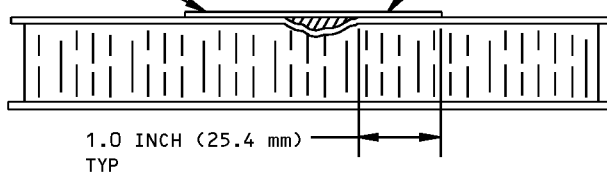
Typical Puncture Repair, 0.50 Inch Diameter or Less - Wet Layup
Figure 15

757-200 STRUCTURAL REPAIR MANUAL



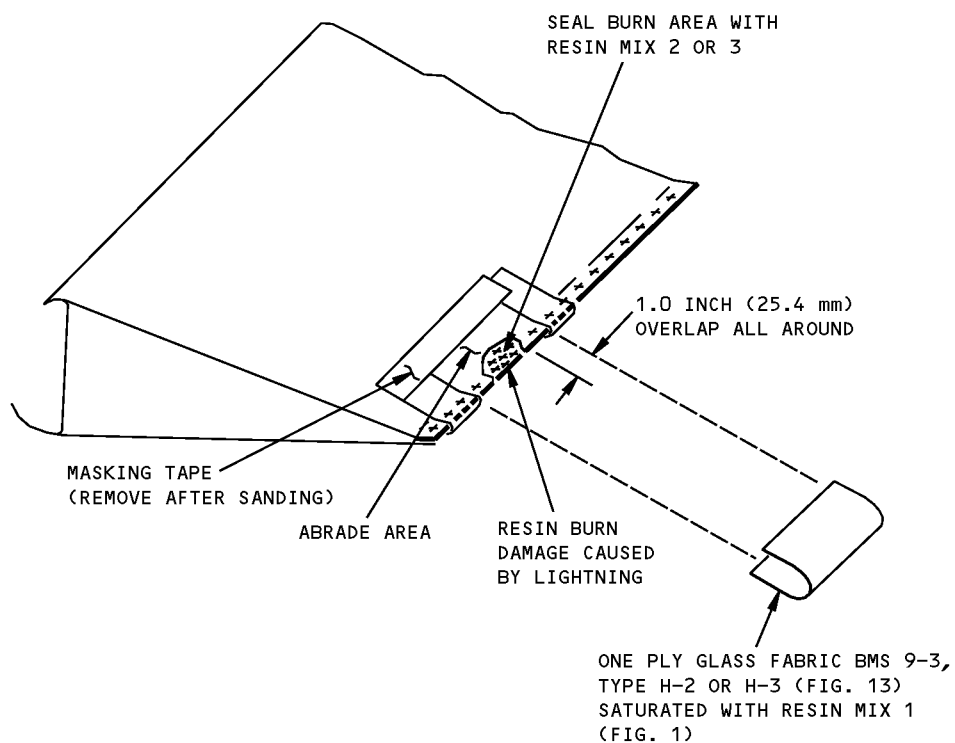
ONE PLY OVERLAY SAME ORIENTATION
AS ORIGINAL SURFACE PLY (REFER TO
FIG. 13 FOR SUBSTITUTE REPAIR PLY
MATERIAL). SATURATE WITH RESIN
MIX 1 (FIG. 1)

FILL DEPRESSION WITH RESIN MIX 2.
ALLOW TO CURE 12 HOURS AT 65°F (19°C)
MIN OR 2 HOURS AT 125°F (52°C)



Typical Repair for Dents - Wet Layup
Figure 16

757-200
STRUCTURAL REPAIR MANUAL



Typical Repair for Lightning Damage at Trailing Edge - Wet Layup
Figure 17

757-200

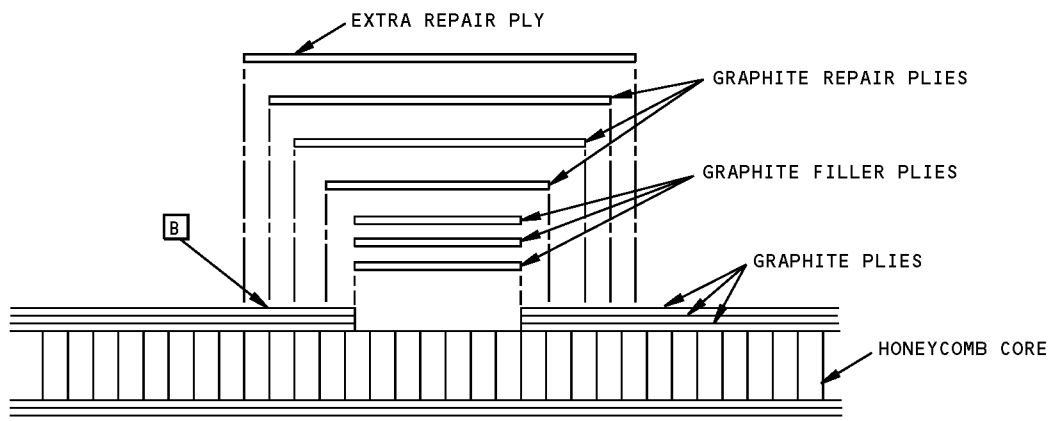
STRUCTURAL REPAIR MANUAL

COMPONENT MATERIAL	EXTRA PLY MATERIAL ^[B]
GRAPHITE FABRIC	GRAPHITE FABRIC, 5HSW-AS4-6K (MFG STYLE ES-1506) (FIG. 13) ^[A]
ARAMID FABRIC	GLASS FABRIC, BMS 9-3 TYPE H-2 OR H-3 (MFG STYLE 181-150 OR 181-77) (FIG. 13) ^[A]

NOTES

^[A] THE ORIENTATION OF THE EXTRA REPAIR PLIES MUST REPEAT THE ORIENTATIONS OF THE EXISTING PLIES IN THE ORIGINAL LAMINATE STARTING WITH THE OUTERMOST PLY

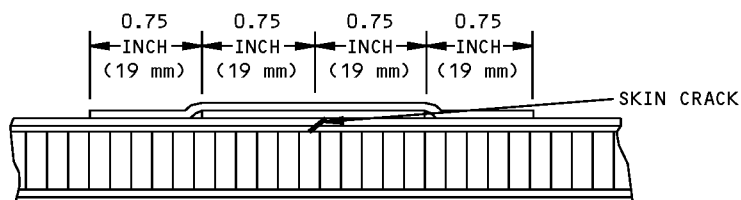
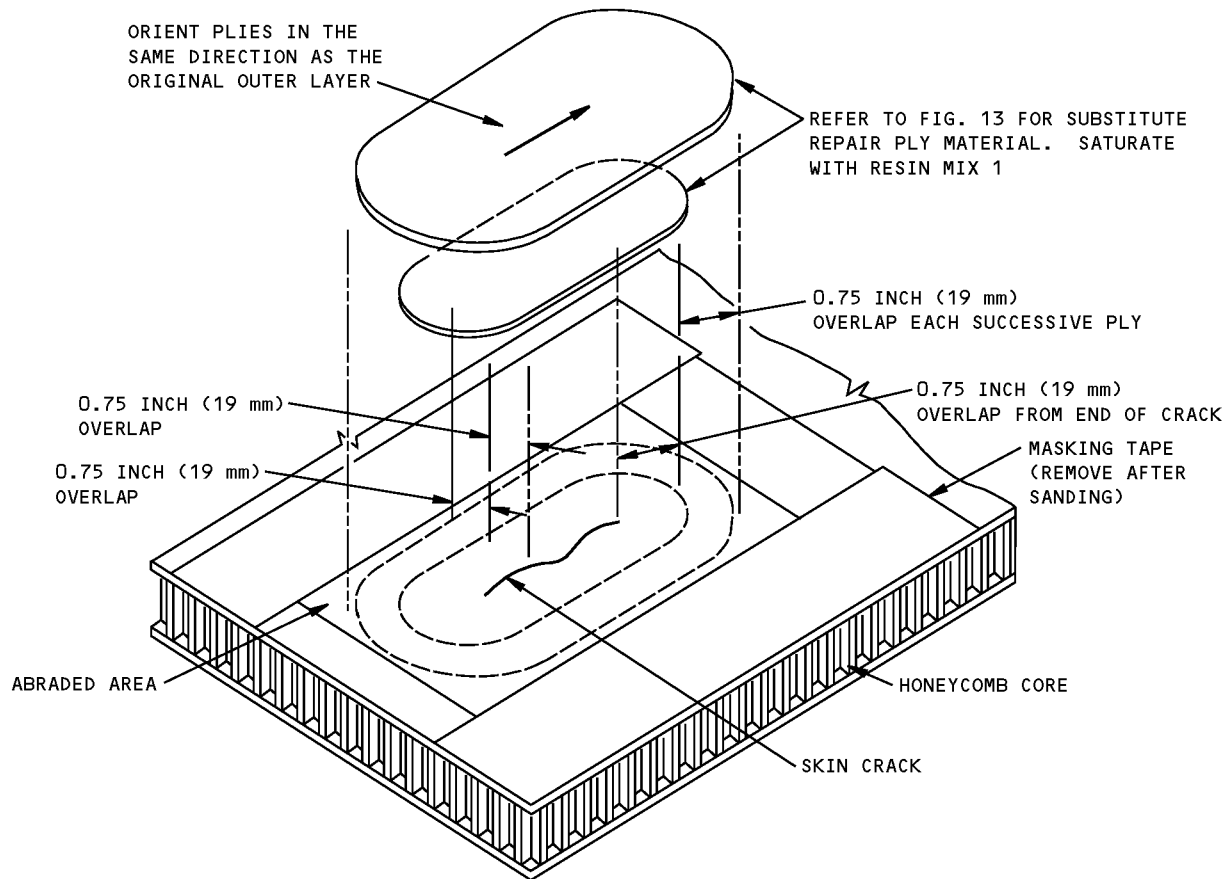
^[B] WHEN EXTRA GRAPHITE REPAIR PLY OR PLIES ARE REQUIRED, THE EXISTING OUTER PLY MUST BE SANDED TO ALLOW AN OVERLAP OF 1.00 INCH (25.4 mm) FOR EACH EXTRA REPAIR PLY.



SECTION THRU HONEYCOMB SANDWICH
DETAIL I

Extra Repair Ply Materials
Figure 18

757-200
STRUCTURAL REPAIR MANUAL

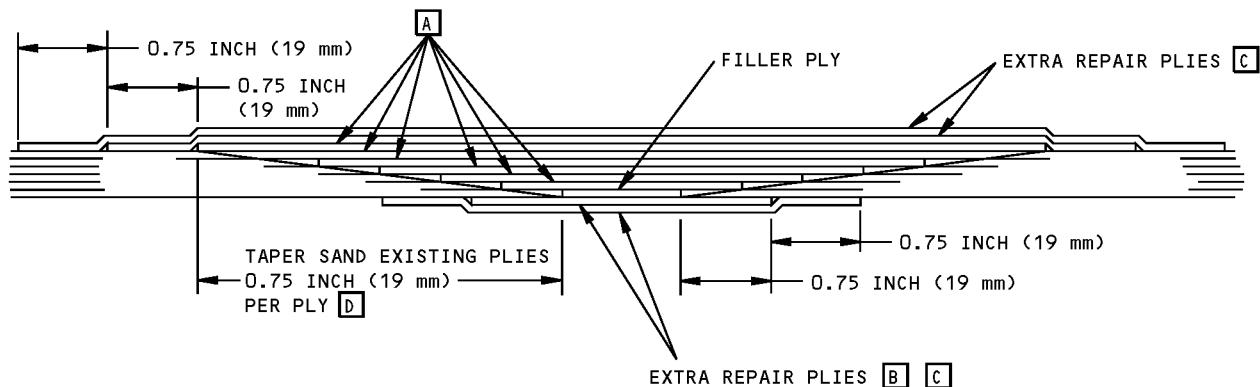


SECTION VIEW

Repair of Small Damage to One Skin
Figure 19

757-200

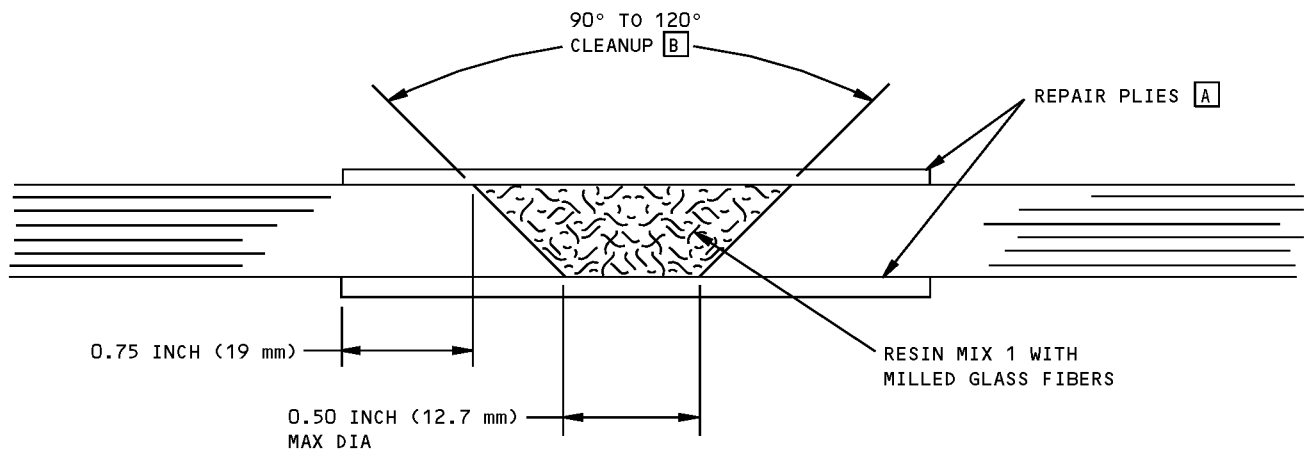
STRUCTURAL REPAIR MANUAL



NOTES

- [A]** DETERMINE NUMBER OF PLIES, ORIENTATION, AND MATERIAL FROM SPECIFIC COMPONENT STRUCTURE IDENTIFICATION.
- [B]** EXTRA REPAIR PLIES AT THIS LOCATION ARE REQUIRED ONLY IF THE DAMAGE PENETRATES THIS SURFACE.
- [C]** THE ORIENTATION OF THE OUTERMOST EXTRA REPAIR PLY IS TO BE THE SAME AS THE OUTERMOST PLY OF THE ORIGINAL LAMINATE. ANY OTHER EXTRA REPAIR PLY IS TO BE ORIENTED +45° TO THE EXTRA REPAIR PLY IMMEDIATELY ABOVE IT.
- [D]** FOR OPTIONAL SANDING/LAYUP PROCEDURE, REFER TO PARAGRAPH 4.C.(2)(b).

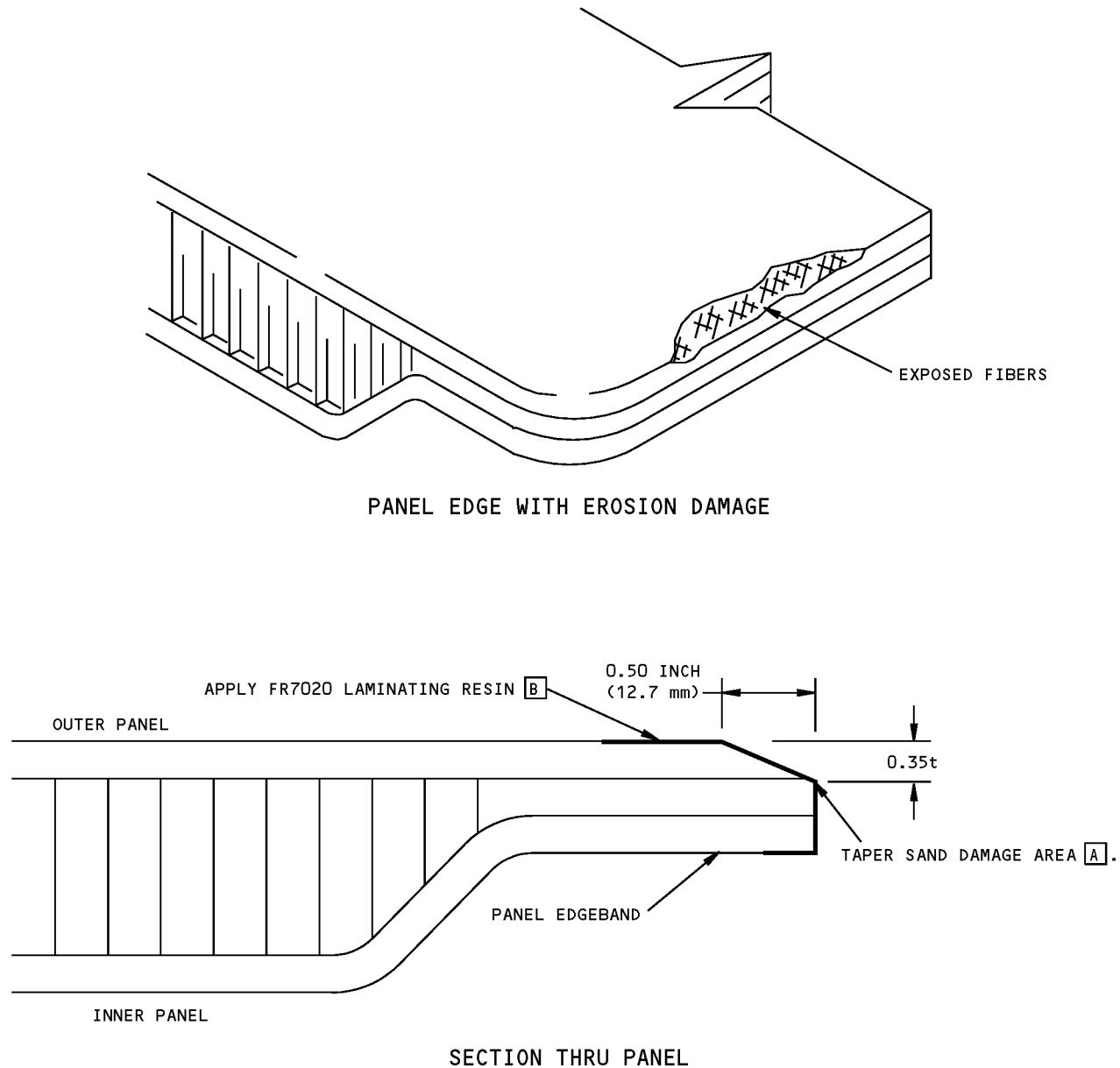
Solid Laminate Repair
Figure 20

**757-200
STRUCTURAL REPAIR MANUAL****NOTES**

- [A] REPAIR PLIES ARE TO HAVE THE SAME ORIENTATION AS THE ORIGINAL SURFACE PLIES.
- [B] CLEANUP OF DAMAGED MATERIAL MAY BE ACCOMPLISHED WITH STRAIGHT OR TAPERED SIDES.

**Repair of Punctures, 0.50 Inch Diameter or Less, in Solid Laminates
Figure 21**

757-200 STRUCTURAL REPAIR MANUAL



NOTES

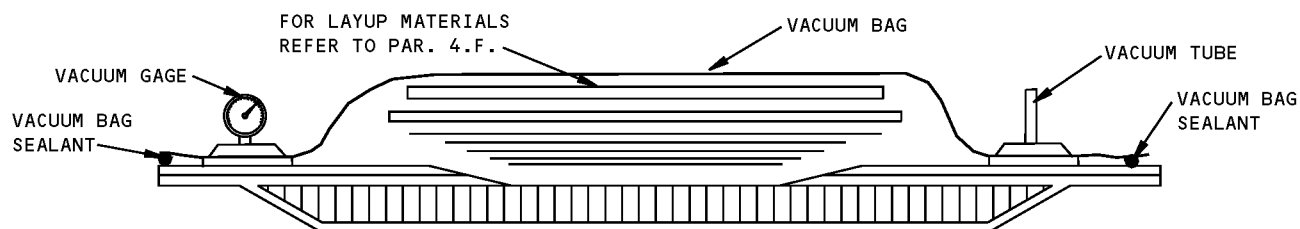
- REFER TO SRM 51-11-01 FOR AERODYNAMIC SMOOTHNESS REQUIREMENTS.
- REPAIR IS APPLICABLE TO BOTH HONEYCOMB PANEL EDGEBANDS AND SOLID LAMINATE PANEL EDGES.

[A] TAPER SAND EROSION DAMAGE AREA TO 0.50 INCH (12.7 mm) MAX DISTANCE FROM PANEL EDGE AND 0.35t MAX DEPTH. t = PANEL EDGEBAND THICKNESS.

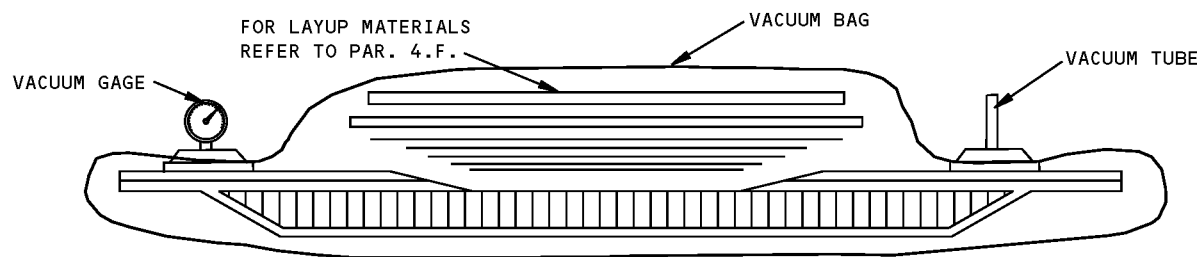
[B] REFER TO FIGURE 1 FOR RESIN SPECIFICATIONS AND MIXING PROCEDURES.

Repair of Erosion Damage to Panel Edges
Figure 22

757-200
STRUCTURAL REPAIR MANUAL



ACCEPTABLE – VACUUM BAG SEALED TO ONE SIDE ONLY



ACCEPTABLE – VACUUM BAG SEALED AROUND ENTIRE PART

PARTS CONSISTING OF ONE PANEL **B**

Vacuum Bagging Restrictions
Figure 23