PART 1 - GENERAL

ORIENTATION AND PREPARATION FOR NDT TESTS

1. Operator Qualifications

A. It is necessary for operators to be trained to make the correct analysis of the data from nondestructive tests (NDT). Examples of the types of nondestructive test data operators can possibly see include the radiographs of X-ray inspections or the signals that occur during ultrasonic and eddy current inspections. The operator must know the basic theory for these NDT inspections so that they know how and when to do the different NDT procedures. The operator must also know the airplane structure and the different causes of failure of the metal and nonmetal parts used on the airplanes.

2. Selection of the Inspection Procedure

A. To identify the type of NDT inspection procedure and equipment to use for an NDT inspection, think about:

(1) How easy it is to access the inspection area.

(2) The type of material of the structure or part.

(3) The type of defect you want to find.

B. Before you make a selection, read Part 1, 51-02-00 thru Part 1, 51-06-00 as necessary for details of the different types of nondestructive tests. To identify the advantages and disadvantages of each type of test, see Table 1.

3. Use of the NDT manual with the Structural Repair Manual

A. The structural repair manual must be used with the nondestructive test procedure to identify the materials and structural items of the airplane.

4. Airplane Structure and Component Location and Access

A. Many parts are not easy to access in the airplane. Structural components of the fuselage are usually behind blankets or internal panels. Many structural components of the wings, empennage, and other areas are also not easy to access. The NDT inspection procedures include the necessary access instructions and Figures for parts that are not easy to access. More figures and details related to specified inspection areas can be found in the applicable structural repair manuals.

Table 1 Comparison of Methods

PROCE˜ DURES	USES	ADVANTAGES	DISADVANTAGES
X-RAY	(1) TO FIND DISCONTINUITIES (CRACKS, VOIDS, POROSITY, INCLUSIONS, ETC.) (2) EXAMINE WELDS (3) EXAMINE FOR UNWANTED PARTS AND MATERIALS (4) IDENTIFY THE PROBLEM WITH COMPONENTS (E.G. SWITCHES, ACTUATORS, ETC) (5) FIND WATER IN HONEYCOMB STRUCTURE	CAN FIND INTERNAL AND SURFACE DEFECTS CAN EXAMINE COVERED OR HIDDEN PARTS OR STRUCTURES RADIOGRAPHS ARE PERMANENT TEST RECORDS	EXPENSIVE IT CAN BE NECESSARY TO DEFUEL THE AIRPLANE AREA MUST BE CLEARED OF OTHER PERSONS TO PREVENT RADIATION HAZARD IT CAN BE NECESSARY TO POSITION THE X-RAYS CORRECTLY RELATIVE TO THE CRACKS SO YOU CAN FIND THE CRACKS. THE DIRECTION OF THE X-RAYS IS IMPORTANT. ACCESS TO TWO SIDES IS NECESSARY MUCH SKILL AND EXPERIENCE ARE NECESSARY TO PREPARE EQUIPMENT FOR THE INSPECTION AND TO MAKE AN ANALYSIS OF THE RESULTS
EDDY CURRENT	USED TO: (1) FIND SURFACE CRACKS (2) FIND CRACKS BELOW THE SURFACE AND CORROSION ON AN INTERNAL SURFACE (3) IDENTIFY THE TYPE OF ALLOY, THE HEAT TREAT CONDITION AND FIRE DAMAGE	PORTABLE MODERATE COST IMMEDIATELY GIVES RESULTS SENSITIVE TO SMALL DEFECTS NOT MUCH TIME IS NECESSARY TO PREPARE AN AREA FOR INSPECTION	IT IS NECESSARY TO ACCESS THE INSPECTION SURFACE TO PUT THE PROBE ON IT CAN BE USED TO EXAMINE METALS ONLY NO PERMANENT RECORD MUCH SKILL AND EXPERIENCE ARE NECESSARY TO PREPARE EQUIPMENT FOR THE INSPECTION AND TO MAKE AN ANALYSIS OF THE RESULTS

PROCE˜ DURES	USES	ADVANTAGES	DISADVANTAGES
ULTRASO˜ NIC	USED TO: (1) IDENTIFY SURFACE AND SUB-SURFACE DEFECTS (E.G., CRACKS, DELAMINATIONS, POROSITY) (2) MEASURE MATERIAL THICKNESS	CAN FIND SURFACE AND SUB-SURFACE DEFECTS SENSITIVE TO SMALL DEFECTS IMMEDIATELY GIVES RESULTS NOT MUCH TIME IS NECESSARY TO PREPARE AN AREA FOR INSPECTION MODERATE COST IT IS NECESSARY TO ACCESS ONLY ONE SURFACE TO DO THE INSPECTION	IT IS NECESSARY TO ACCESS THE INSPECTION SURFACE TO PUT THE PROBE ON IT ROUGH SURFACES EFFECT THE TEST RESULTS THE RELATION BETWEEN THE SOUND BEAM AND THE DEFECT IS IMPORTANT. SOME SOUND BEAM DIRECTIONS WILL NOT IDENTIFY DEFECTS MUCH SKILL AND EXPERIENCE ARE NECESSARY TO PREPARE EQUIPMENT FOR THE INSPECTION AND TO MAKE AN ANALYSIS OF THE RESULTS

5. Prepare for the Test

A. Usually it is easy to prepare for an inspection. When an inspection is necessary in a fuel tank it is necessary to defuel the airplane. It can also be necessary at times to remove access doors, structural items and equipment or furnishings to get access to the inspection area. For all but the X-ray inspections, it is necessary to clean the inspection area and/or, for some inspections, remove the finish such as paint or sealant. Precautions must be done to make sure persons do not go into a radiation hazard area during an X-ray inspection.

B. When it is necessary to remove the paint or the finish from a part, identify the part material and refer to SOPM 20-30-02 for the procedures which identify how to remove the finish.

NOTE: After the inspection you must apply the paint or finish to the part again (if the part is satisfactory).

6. Equipment Manufacturers and/or Suppliers

A. The pages that follow identify some of the manufacturers and/or suppliers for the NDT equipment identified in this manual. Not all of the NDT equipment manufacturers or suppliers are included in these pages. Equipment from manufacturers or suppliers not specified in these pages can also be used if the equipments performance is almost the same as the instruments specified in the applicable inspection procedure and if they can also be calibrated as specified in the applicable inspection procedure.

B. Composite Reference Standard Manufacturers (see Table 2 and Table 3)

Table 2

METALLIC AND NON-METALLIC REFERENCE STANDARDS

APPLIED AEROSPACE STRUCTURES
3437 SOUTH AIRPORT WAY
STOCKTON, CA 95206
USA
PHONE: [209] 983-3245
FAX: [209] 983-3375

NDT ENGINEERING CORP
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

Table 3

NON-METALLIC REFERENCE STANDARDS ONLY

PRECISION AEROSPACE COMPOSITES
1516 FRYAR AVENUE
SUMNER, WA 98390
USA
PHONE: [206] 863-7868
FAX: [206] 863-7875

C. Non-Destructive Test Equipment Suppliers (see Table 4 thru Table 17)

Table 4

EDDY CURRENT INSTRUMENT AND PROBE MANUFACTURERS

FOERSTER INSTRUMENTS, INC.
140 INDUSTRY DRIVE
RIDC PARK WEST
PITTSBURGH, PA 15275
USA
PHONE: [412] 788-8976
FAX: [412] 788-8964

HOCKING KRAUTKRAMER BRANSON
50 INDUSTRIAL PARK ROAD
LEWISTOWN, PA 17044
USA
PHONE: [717[242-0327
FAX: [717] 242-2606

HOCKING NDT, LTD
129-135 CAMP ROAD
ST. ALBANS
HERTFORDSHIRE, AL15HP UK
ENGLAND
PHONE: [0727] 40321
FAX: [0727] 45058

INSTITUTE DR. FORSTER
PRUFGERATEBAU GMBH & CO. KG
IN LAISEN 70 POSTFACH 1564
D-7410 REUTLINGEN
GERMANY
PHONE: [07121] 140-0
FAX: [07121] 140488

MAGNAFLUX
CENTURION NDT INC
707 REMINGTON RD SUITE 9
SCHAUMBURG, ILLINOIS 60173
USA
PHONE: [847] 884-4949
FAX: [847] 884-8772

NDT ENGINEERING CORP.
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

(Continued)

EDDY CURRENT INSTRUMENT AND PROBE MANUFACTURERS

QUEST INTEGRATED
1012 CENTRAL AVENUE SOUTH
KENT, WA 98032
USA
PHONE: [253] 872-9500
FAX: [253] 872-8967
E-MAIL: contactqi2@qi2.com

ROHMANN GMBH
RUDOLF-DIESEL-STR. 13
D-67227 FRANKENTHAL
GERMANY
PHONE: 0 62 33-3789-0
FAX: 0 62 33-3789-77

STAVELEY NDT
SUITE 205 SUNBEAM STUDIOS SUNBEAM ST
WOLVERHAMPTON WV2 4NU
UNITED KINGDOM
PHONE: [01902] 20772
FAX: [01902] 20808

STAVELEY INSTRUMENTS
421 NORTH QUAY
KENNEWICK, WA 99336
USA
PHONE: [509] 735-7550
FAX: [509] 735-4672

TECHNA NDT
6707 SOUTH 216TH STREET
KENT, WA 98032
USA
PHONE: [253] 872-2415
FAX: [253] 872-2416

UNIWEST
330 WEST CLARK STREET
PASCO, WA 99301
USA
PHONE: [509] 544-0720
FAX: [509] 544-0868

ZETEC, INC.
1370 N.W. MALL
P.O. BOX 140
ISSAQUAH, WA 98027
USA
PHONE: [425] 392-5316
FAX: [425] 392-2086

Table 5

EDDY-CURRENT PROBE MANUFACTURERS

ALL INSPECTION NDT, LTD
59 LYNCHFORD ROAD
FARNHAM
HANTS
ENGLAND
PHONE: [252] 514721
FAX: [252] 518030

EC/NDT
1020 S. 344TH ST. STE 214
FEDERAL WAY, WA 98003
USA
PHONE: [253] 815-0797
FAX: [253] 815-0827

(Continued)

EDDY-CURRENT PROBE MANUFACTURERS

GK ENGINEERING CORP
21610 UNIT 1
LASSEN STREET
CHATSWORTH, CA 91311
USA
PHONE: [818] 347-1373
FAX: [818] 407-1983

NDT ENGINEERING CORP*[1]
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

TECHNA NDT
6707 SOUTH 216TH STREET
KENT, WA 98032
USA
PHONE: [253] 872-2415
FAX: [253] 872-2416

VM PRODUCTS, INC.
P.O. BOX 44926
TACOMA, WA 98444
USA
PHONE: [253] 841-2939
FAX: [253] 841-3016

XACTEX CORP
3704 STEARMAN AVE.
PASCO, WA 99301
USA
PHONE: [509] 545-6364
FAX: [509] 545-6597

*[1] The NDT Engineering Corp. is a supplier of fasteners that are specified in the Boeing reference standard drawings.

Table 6

ULTRASONIC TRANSDUCER MANUFACTURERS (See also Table 7)

ALL INSPECTION NDT, LTD
59 LYNCHFORD ROAD
FARNHAM
HANTS
ENGLAND
PHONE: [252] 514721
FAX: [252] 518030

NDT ENGINEERING CORP
CONTACT OLYMPUS NDT INC
421 N QUAY ST
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

SEARCH UNIT (SU) SYSTEMS
DIVISION OF NDT ENGINEERING CORP
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

STAVELEY SENSORS, INC.*[1]
CONTACT OLYMPUS NDT INC
421 N QUAY ST
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

(Continued)

ULTRASONIC TRANSDUCER MANUFACTURERS (See also Table 7)

TECHNA NDT
6707 SOUTH 216TH STREET
KENT, WA 98032
USA
PHONE: [253] 872-2415
FAX: [253] 872-2416

XACTEX CORP
3704 STEARMAN AVE.
PASCO, WA 99301
USA
PHONE: [509] 545-6364
FAX: [509] 545-6597

*[1] Automation Industries Inc. transducers can be purchased from Staveley Sensors, Inc. Use the Automation Industries Inc. part number as written in the NDT Inspection Procedure when you order the transducer.

Table 7

ULTRASONIC INSTRUMENT AND TRANSDUCER MANUFACTURERS

ANA TRADING CORP. U.S.A.*[1]
AVIATION & MACHINERY DEPT.
333 SOUTH HOPE ST., SUITE 3100
LOS ANGELES, CA 90071
PHONE: [213] 620-1504
FAX: [213] 620-1448

DUPONT NDT SYSTEMS, INC.
NDT INSTRUMENTS DIVISION
17811 GEORGETOWN LANE
HUNTINGTON BEACH, CA 92647
USA
PHONE: [714] 893-2438
FAX: [714] 897-3840

GE INSPECTION TECHNOLOGIES
50 INDUSTRIAL PARK RD
LEWISTOWN, PA 17044-9990
USA
PHONE: 1-866-243-2638
PHONE: [717] 242-0327
FAX: [717] 242-2606

KRAUTKRAMER BRANSON
CONTACT GE INSPECTION TECHNOLOGIES
50 INDUSTRIAL PARK ROAD
LEWISTOWN, PA 17044-9990
USA
PHONE: 1-866-243-2638
PHONE: [717] 242-0327
FAX: [717] 242-2606

KRAUTKRAMER GMBH
ROBERT BOSCH STRASSE 3
P.O. BOX 1363
D-5030 HUERTH 5 (EFFEREN)
GERMANY
PHONE: 2233-6010
TELEX: 88866955

MAGNAFLUX
3624 W LAKE AVE
GLENVIEW, ILLINOIS 60026
USA
PHONE: [847] 657-5300
FAX: [847] 657-4720

NDT SYSTEMS
17811 GEORGETOWN LANE
HUNTINGTON BEACH, CA 92647
USA
PHONE: [714] 893-2438
PHONE: [714] 897-3840

OLYMPUS NDT INC
48 WOERD AVENUE
WALTHAM, MA 02453
USA
PHONE: [781] 419-3900
FAX: [781] 419-3980

(Continued)

ULTRASONIC INSTRUMENT AND TRANSDUCER MANUFACTURERS

PANAMETRICS NDT
CONTACT OLYMPUS NDT INC
48 WOERD AVENUE
WALTHAM, MA 02453
USA
PHONE: [781] 419-3900
FAX: [781] 419-3980

RUSSELL NDE SYSTEMS INC
4909 75TH AVENUE
EDMONTON, ALBERTA,
CANADA T6B 2S3
PHONE: 1-800-661-0127
PHONE: [780] 468-6800
FAX: [780] 462-9378

SONATEST INC
12775 COGBURN
SAN ANTONIO, TEXAS 78249
USA
PHONE: [210] 697-0335

SONATEST NDE
DICKENS ROAD
OLD WOLVERTON
MILTON KEYNES
MK12 5QQ
UNITED KINGDOM
PHONE: +44 (0)1908 316345
PHONE: +44 (0)1908 321323

STAVELEY INSTRUMENTS
421 NORTH QUAY
KENNEWICK, WA 99336
USA
PHONE: [509] 735-7550
TELEX: [509] 735-4672

STAVELEY NDT
CONTACT OLYMPUS NDT INC
48 WOERD AVENUE
WALTHAM, MA 02453
USA
PHONE: [781] 419-3900
FAX: [781] 419-3980

TECHNOPORT USA.*[2]
CONTACT TOKIMEC USA INC
445 SOUTH FIGUEROA ST.
SUITE 3770
LOS ANGELES, CA 90071
PHONE: [213] 689-4747
FAX: [213] 689-0303

TOKIMEC INC.
2-16-46, MINAMI-KAMATA
OTA-KU, TOKYO 144-8551
JAPAN
PHONE: (81) 3-3732-2111
FAX: (81) 3-3736-0261

XACTEX CORP
3704 STEARMAN AVENUE
PASCO, WA 99301
USA
PHONE: [509] 545-6364
FAX: [509] 545-6597

*[1] An alternative source for TOKIMEC INC. or TECHNOPORT instruments

*[2] An alternative source for TOKIMEC INC. instruments

Table 8

X-RAY EQUIPMENT MANUFACTURERS

ANDREX RADIATION PRODUCTS
HALFDANSGADE 8 DK-2300
COPENHAGAN S.
DENMARK
PHONE: 45 3154 1540
FAX: 45 3154 9960

MAGNAFLUX
CENTURION NDT INC
707 REMINGTON RD SUITE 9
SCHAUMBURG, ILLINOIS 60173
USA
PHONE: [847] 884-4949
FAX: [847] 884-8772

PHILIPS
INDUSTRIAL X-RAY SYSTEMS
ROENTGENSTRASSE 24-26 D 2000
HAMBURG 63
GERMANY
PHONE: [040] 50 78-0

PHILIPS ELECTRONIC INSTRUMENTS
INSPECTION SYSTEMS GROUP
5110 MEGINNES FERRY RD
ALPHARETTA, GA 30202
USA
PHONE: [770] 751-4420
FAX: [770] 751-4456

RICH. SIEFERT & CO
RONTGENWERK
BOGENSTRABE 41
D-2070 AHRENSBURG
GERMANY
PHONE: 49 4102/760
FAX: 49 4102/76189

SIEFERT U.S.A.
[EAST COAST AGENTS]
P.O. BOX 294
FAIRVIEW VILLAGE, PA 19049
USA
PHONE: [610] 539-4700
FAX: [610] 539-6031

STAVELEY INSTRUMENTS/QUALCORP
421 NORTH QUAY
KENNEWICK, WA 99336
USA
PHONE: [509] 735-7550
FAX: [509] 735-4672

X-IT
7676 CHARLES PAGE BLVD
TULSA, OK 74127
USA
PHONE: [800] 245-0076
FAX: [213] 948-5904

Table 9

CONDUCTIVITY MEASUREMENT MANUFACTURERS

FISCHER TECHNOLOGY
750 MARSHALL PHELPS ROAD
WINDSOR, CT 06095
USA
PHONE: [860] 683-0781
FAX: [860] 688-8496

HOCKING KRAUTKRAMER BRANSON
50 INDUSTRIAL PARK ROAD
LEWISTOWN, PA 17044
USA
PHONE: [717] 242-0327
FAX: [717] 242-2606

(Continued)

CONDUCTIVITY MEASUREMENT MANUFACTURERS

HOCKING NDT, LTD
129-135 CAMP ROAD
ST. ALBANS
HERTFORDSHIRE, AL15HP UK
ENGLAND
PHONE: [0727] 40321
FAX: [0727] 45058

INSTITUT DR. FORSTER
IN LAISEN 70 POSTFACH 1564
D-7410
REUTLINGEN
GERMANY
PHONE: 07121/140-265

K.J. LAW
42300 W. NINE MILE ROAD
NOVI, MI 48375-4103
USA
PHONE: [800] 521-5245
FAX: [313] 347-3345

MAGNAFLUX
CENTURION NDT INC
707 REMINGTON RD SUITE 9
SCHAUMBURG, ILLINOIS 60173
USA
PHONE: [847] 884-4949
FAX: [847] 884-8772

Table 10

REFERENCE STANDARD MANUFACTURERS*[1]

ALL INSPECTION NDT, LTD
59 LYNCHFORD ROAD
FARNHAM
HANTS
ENGLAND
PHONE: [252] 514721
FAX: [252] 518030

IDEAL SPECIALTY COMPANY
2531 EAST INDEPENDENCE STREET
TULSA, OK 74100
USA
PHONE: [918] 834-1657
FAX: [918] 834-5338
TELEX: 350548 (ISCO.TUL)

NDT ENGINEERING CORP
(OLYMPUS NDT)
421 N. QUAY STREET
KENNEWICK, WA 99336
USA
PHONE: [509] 736-2751
FAX: [509] 735-4672

TECHNA NDT
6707 SOUTH 216TH STREET
KENT, WA 98032
USA
PHONE: [253] 872-2415
FAX: [253] 872-2416

VM PRODUCTS, INC.
P. O. BOX 44926
TACOMA, WA 98444
USA
PHONE: [253] 841-2939
FAX: [253] 841-3016

*[1] These are manufacturers of reference standards that are specified in Boeing NDT procedures.

Table 11

FASTENER SUPPLIERS *[1]

ALLFAST FASTENING SYSTEMS, INC
15200 DON JULIAN ROAD
CITY OF INDUSTRY, CA 91745
USA
PHONE: [626] 968-9388
FAX: [626] 968-9393

SIERRA PACIFIC SUPPLY
1801 WEST EL SEGUNDO BOULEVARD
COMPTON, CA 90222-1096
PHONE: [310] 638-9318
FAX: [310] 638-8105

*[1] These are suppliers of fasteners that are specified in the Boeing reference standard drawings.

Table 12

ULTRASONIC BOND INSPECTION EQUIPMENT

DUPONT NDT SYSTEMS, INC.
NDT INSTRUMENTS DIVISION
17811 GEORGETOWN LANE
HUNTINGTON BEACH, CA 92647
USA
PHONE: [714] 893-2438
FAX: [714] 897-3840

FOKKER B.V.-DEPT. INDUSTRIAL PRODUCTS/APS
P.O. BOX 12222
1100 AE AMSTERDAM - ZUIDOOST
THE NETHERLANDS
PHONE: 020-5647302

JR TECHNOLOGY LTD.
81 NORTHY END
MELDRETH, ROYSTON
HERTS SG86NU
UNITED KINGDOM
PHONE: [01763] 260721
FAX: [01763] 260809

MITSUI (USA)
1001 FOURTH AVENUE
SUITE 3950
SEATTLE, WA 98154-1196
USA
PHONE: [206] 223-5636
FAX: [206] 223-5651

ROHMANN INC
154 BROAD ST.
NASHUA, NH 03063
USA
PHONE: [603] 595-4220
FAX: [603] 595-4221

STAVELEY INSTRUMENTS
421 NORTH QUAY
KENNEWICK, WA 99336
USA
PHONE: [509] 735-7550
FAX: [509] 735-4672

STAVELEY NDT TECHNOLOGIES
THE TECHNOLOGY CENTRE
GLAISHER DRIVE
WOLVERHAMPTON SCIENCE PARK
WOLVERHAMPTON, UK, WV10 9RU
PHONE: [01902] 824180
FAX: [01902] 824181

UNIWEST
330 WEST CLARK STREET
PASCO, WA 99301
USA
PHONE: [509] 544-0720
FAX: [509] 544-0868

(Continued)

ULTRASONIC BOND INSPECTION EQUIPMENT

WICHITECH INDUSTRIES, INC.
8980-L ROUTE 108
COLUMBIA, MARYLAND 21045-2115
USA
PHONE: [410] 715-1076 OR
PHONE: [800] 776-4277
FAX: [410] 715-1078

ZETEC, INC
1370 N.W. MALL P.O. BOX 140
ISSAQUAH, WA 98027
USA
PHONE: [425] 392-5316
FAX: [425] 392-2086

Table 13

THERMOGRAPHY EQUIPMENT

FLIR SYSTEMS, BOSTON
16 ESQUIRE ROAD
NORTH BILLERICA, MA 01862
USA
PHONE: [978] 901-8000
PHONE: 800-GO-INFRA (USA ONLY)
E-MAIL: marketing@flir.com

INDIGO SYSTEMS CORPORATION
5385 HOLLISTER AVE #103
SANTA BARBARA, CA 93111
PHONE: [805] 964-9797
FAX: [805] 964-7708
WEBSITE: http://www.indigosystems.com

MIKRON INSTRUMENT COMPANY, INC.
16 THORNTON ROAD
OAKLAND NEW JERSEY, 07436
USA
PHONE: [201] 405-0900
PHONE: [800] 631-0176
FAX: [201] 405-0090
WEBSITE: http://www.IRimaging.com

NEC SAN-EI INSTRUMENTS, LTD
1-25-12, AKEBONO-CHO, TACHIKAWA-SHI,
TOKYO 190-8537, JAPAN
PHONE: +81-42-522-0529
FAX: +81-42-522-0538
E-MAIL: san-eios@muh.biglobe.ne.jp

RAYTHEON INFRARED
PHONE: [201] 344-4000
PHONE: [800] 990-3275 (USA ONLY)
E-MAIL: infrared@raytheon.com

Table 14

LIQUID CRYSTAL SHEETS

HALLCREST
1820 PICKWICK LANE
GLENVIEW, IL 60025-5741
USA
PHONE: [847] 998-8580
PHONE: [800] 527-1419
FAX: [847] 998-6866
FAX: [800] 998-8551
E-MAIL: hcsales@hallcrest.com

Table 15

THERMAL IMAGING NDT SYSTEMS

THERMAL WAVE IMAGING, INC.
845 LIVERNOIS ST.
FERNDALE, MI, 48220-2308
USA
PHONE: [248] 414-3730
FAX: [248] 414-3764
E-MAIL: info@thermalwave.com

Table 16

PORTABLE C-SCAN EQUIPMENT MANUFACTURERS

ABB AMDATA, INC.
1000 DAY HILL ROAD
WINDSOR, CONNECTICUT 06095
USA
PHONE: [860] 688-2400
FAX: [860] 688-2722

BOEING - MCDONNELL AIRCRAFT AND MISSILES SYSTEMS
DEPT. 257, BLDG 102, M/S 1021111
P.O. BOX 516
ST. LOUIS, MO 63166
USA
PHONE: [314] 234-9028
FAX: [314] 777-2650

(FLAWINSPECTA)
CONTACT NDT SOLUTIONS, IND (NDTS)
1682 COUNTY ROAD K
NEW RICHMOND, WI 54017
USA
PHONE: (715) 246-0433
FAX: (715) 246-0466

(HARFANG X-32)
CONTACT HARFANG MICROTECHNIQUES GROUP 4975
RUE RIDEAU (SUITE 140)
QUEBEC, QC CANADA G2E 5H5
PHONE: +1 418 683-6222
FAX: +1 418 683-7032

(ANDSCAN)
CONTACT QINETIQ LTD
ROOM G070, A7 BUILDING
CODY TECHNOLOGY PARK
FARNBOROUGH
GU14 0LX
UNITED KINGDOM
PHONE: 01252 392668
FAX: 01252 393053

DIAGNOSTIC SONAR LTD
BAIRD ROAD, KIRKTON CAMPUS
LIVINGSTON, WEST LOTHIAN
SCOTLAND, EH54 7BX
PHONE: +44 (0)1506 411877
FAX: +44 (0)1506 412410

GE INSPECTION TECHNOLOGIES
50 INDUSTRIAL PARK RD
LEWISTOWN, PA 17044-9990
USA
PHONE: 1-866-243-2638
PHONE: [717] 242-0327
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Table 17

SHEAROGRAPHY EQUIPMENT

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7. Reference Standards, Transducer and Probe Positioners

A. Most inspection procedures in this manual use one or more reference standards and/or positioners during the instrument calibration. The details for how to make these items are included in the specific procedure in which it is used. Each reference standard or positioner can be made by an operator or purchased from one of the manufacturers or suppliers identified in Paragraph 6. It is recommended that you send a copy of the reference standard or positioner drawing with each order to make sure that the item you get is made as specified by the current drawing revision. After the reference standard or positioner is received, the operator must change the item as necessary so it agrees with all subsequent drawing changes.

B. Most of the reference standards in this manual are made from the same material as the part to be examined. Alternative materials can be used if the materials agree with the conditions that follow and the conditions (such as grain direction) that are specified on the reference standard drawings.

(1) The electrical conductivity is the significant property for reference standards that are used during eddy current inspections of aluminum materials. The material is not important if the electrical conductivity is in the range of the material specified. Each reference standard drawing identifies the material to use to make the reference standard. All other materials with equivalent electrical conductivity can be used.

(2) Steel reference standards that are used for eddy current inspections must be identified as magnetic or non-magnetic. The specific type of steel material is not important. What is important is that magnetic steel reference standards must be used to do a test of magnetic parts and non-magnetic reference standards must be used to do tests of non-magnetic parts.

(3) For reference standards used during ultrasonic inspections of aluminum, the electrical conductivity is not important. The electrical conductivity (that is, the heat treat condition) of aluminum does not have a large effect on the velocity of ultrasonic sound. The velocity of ultrasonic sound in all of the usual aluminum alloys such as 2024 and 7075 is almost equal. These aluminum alloys are interchangeable for use as reference standards for ultrasonic inspections.

(4) For reference standards used during ultrasonic inspections of steel, the type of steel material (which includes if it is magnetic or non-magnetic) is not important. The velocity of ultrasonic sound in all of the typical steel alloys is the same. Thus, all steels are interchangeable for use as reference standards during ultrasonic inspections of steels. Operators can use corrosion resistant steel (CRES) materials for protection from surface corrosion and pitting.

C. There have been reports of very high ultrasonic sound attenuation in materials used to make ultrasonic reference standards. The reports have all been related to alloy steel materials (for example, 4330, 4340) that were examined at 10 MHz. This high sound attenuation causes very strong noise signals to occur and very high instrument gain. In some reports, it was not possible to calibrate the instrument.

(1) A solution to this problem is to normalize the reference standard. To normalize the material, heat it in a furnace to 1650°F for the time specified in Table 18 and cool the part in air.

Table 18 Normalize Times

Part Thickness (inches)	Minimum Time (minutes)
Up to 0.25	35
0.251 to 0.500	55
0.501 to 1.000	70
1.001 to 1.500	90
1.501 to 2.000	105
2.001 to 2.500	130
2.501 to 3.000	150
more than 3.000	150 plus 23 for each 0.5 inch of added thickness

(2) During normalization a black oxide layer can occur on the parts. It is best to normalize the material before you machine so you can remove the oxide layer. To prevent the oxide layer during normalization, use a vacuum furnace and fill the furnace with an inert gas such as Argon to cool the part. Refer to BAC 5617 for more data about normalization of alloy steels.

D. Reference standards and the procedures that use them are identified in Table 19 for all airplane models.

Table 19 Reference Standard to Nondestructive Test Procedure Cross-Reference

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
1	707	6	57-10-07, FIG. 5
1	707	6	57-10-07, FIG. 21
2	707	6	57-10-07, FIG. 5
3	707	6	57-10-07, FIG. 5
4	707	6	57-10-07, FIG. 5
5	707	6	57-10-07, FIG. 8
6	707	6	57-10-07, FIG. 6
7	707	6	57-10-07, FIG. 6
8	707	6	57-10-07, FIG. 6

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
9	707	6	57-10-07, FIG. 6
11	707	6	57-10-07, FIG. 21
12	707	6	57-10-07, FIG. 41
13	707	6	57-10-07, FIG. 41
14	707	6	57-10-07, FIG. 30
15	707	6	57-10-07, FIG. 30
16	707	6	57-10-07, FIG. 30
17	707	6	57-10-07, FIG. 22
18	707	6	57-10-07, FIG. 22
19	707	6	57-10-07, FIG. 18
20	707	6	57-10-07, FIG. 11
21	707	6	57-10-07, FIG. 11
22	707	6	57-10-07, FIG. 17
23	707	6	57-10-07, FIG. 17
24	707	6	57-10-07, FIG. 19
25	707	6	57-10-07, FIG. 19
26	707	6	57-10-07, FIG. 40
27	707	6	57-10-07, FIG. 40
28	707	6	57-10-07, FIG. 39
29	707	6	57-10-07, FIG. 39
30	707	6	57-10-07, FIG. 27
31	707	6	57-10-07, FIG. 28
32	707	6	57-10-07, FIG. 28
33	707	6	57-10-07, FIG. 28
A34	707	6	57-10-07, FIG. 31
35	707	6	57-10-07, FIG. 32
36	707	6	57-10-07, FIG. 32
37	707	6	57-30-07, FIG. 5
38	707	6	57-30-07, FIG. 8
39	707	6	57-30-07, FIG. 8
40	707	6	57-30-07, FIG. 12
41	707	6	57-10-07, FIG. 70
41	707	6	57-30-07, FIG. 10
42	707	6	57-10-07, FIG. 61

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
43	707	6	57-10-07, FIG. 55 AND FIG. 70
44	707	6	57-30-07, FIG. 7
45	707	6	57-30-07, FIG. 7
46	707	6	57-30-07, FIG. 7
47	707	6	57-30-07, FIG. 8
48	707	6	57-30-07, FIG. 8 AND FIG. 9
49	707	6	57-30-07, FIG. 8
50	707	6	57-30-07, FIG. 9
51	707	6	57-10-07, FIG. 48
52	707	6	57-10-07, FIG. 48
53	707	6	57-10-07, FIG. 46
54	707	6	57-10-07, FIG. 46
55	707	6	57-10-07, FIG. 47
56	707	6	57-10-07, FIG. 47
57	707	6	57-10-07, FIG. 54
58	707	6	57-10-07, FIG. 66
59	707	6	57-10-07, FIG. 66
60	707	6	57-10-07, FIG. 57 AND FIG. 66
61	707	6	57-10-07, FIG. 66
62	707	6	57-10-07, FIG. 57
63	707	6	57-10-07, FIG. 50
64	707	6	57-10-07, FIG. 50
65	707	6	57-10-07, FIG. 50
66	707	6	57-10-07, FIG. 50
67	707	6	57-10-07, FIG. 49
68	707	6	57-10-07, FIG. 49
69	707	6	57-10-07, FIG. 56
70	707	6	57-10-07, FIG. 56
71	707	6	57-10-07, FIG. 56
72	707	6	57-10-07, FIG. 56
73	707	6	57-10-07, FIG. 56
74	707	4	57-10-07, FIG. 2
75	707	6	57-10-07, FIG. 68

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
A76	707	6	57-10-07, FIG. 73
77	707	4	57-10-07, FIG. 3
78	707	4	57-10-07, FIG. 3
79	707	4	57-10-07, FIG. 5 AND FIG. 10
80	707	4	57-10-07, FIG. 5
81	707	4	57-10-07, FIG. 4 AND FIG. 9
82	707	4	57-10-07, FIG. 4
A83	707	6	52-30-07, FIG. 3
84	707	6	52-30-07, FIG. 2
A85	707	6	53-30-07, FIG. 3 AND FIG. 5
87	707	6	57-10-07, FIG. 65
88	707	6	57-10-07, FIG. 65
89	707	6	57-10-07, FIG. 65
90	707	6	57-10-07, FIG. 65
91	707	6	57-10-07, FIG. 65
92	707	6	57-10-07, FIG. 83
93	707	4	57-10-07, FIG. 6
94	707	4	57-10-07, FIG. 2 AND FIG. 6
95,PF4	707	4	57-10-07, FIG. 2
95,PF1,PF2	707	4	57-10-07, FIG. 3 AND FIG. 6
96	707	4	57-10-07, FIG. 6 AND FIG. 7
97	707	4	57-10-07, FIG. 7
98	707	4	57-10-07, FIG. 9
98,PF3	707	4	57-10-07, FIG. 7
99	707	6	57-10-07, FIG. 63
100	707	4	57-10-07, FIG. 8
101	707	6	57-10-07, FIG. 74
102	707	6	57-10-07, FIG. 74
103	707	6	57-10-07, FIG. 72
104	707	4	57-40-07, FIG. 2

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
105	707	4	57-40-07, FIG. 2
106	707	4	57-40-07, FIG. 2
107	707	4	57-40-07, FIG. 2
108	707	4	57-40-07, FIG. 2
109	707	4	57-40-07, FIG. 3
110	707	6	57-10-07, FIG. 76
111	707	6	57-10-07, FIG. 76
112	707	6	57-10-07, FIG. 82
113	707	6	57-10-07, FIG. 78
114	707	6	57-10-07, FIG. 81
115	707	6	57-10-07, FIG. 86 FIG. 88 AND FIG. 89
117 thru 119	707	4	57-10-07, FIG. 11
120	707	4	57-10-07, FIG. 4
120P	707	4	55-10-07, FIG. 4
121	707	6	53-10-07, FIG. 17
121G	707	6	53-10-07, FIG. 17
122	707	4	57-30-07, FIG. 11
123	707	4	52-10-07, FIG. 1
123	727	4	52-10-07, FIG. 1
123	737	4	52-10-01
124	707/727	4	56-20-27, FIG. 1
125	*[1]	6	51-00-00, FIG. 2
125	*[2]	6	51-00-05
125	777	6	51-00-05, NO. 1
126	*[1]	6	51-00-00, FIG. 4
126	*[2]	6	51-00-01
126	707	6	53-10-07, FIG. 19 57-10-07, FIG. 13
126	727	6	53-10-27, FIG. 51
126	737	6	53-10-08, 53-10-39, 53-10-43, 53-10-45, 53-10-48, 53-10-49, 53-10-55, 53-10-57, 53-10-64, 53-10-65, 53-30-28, 55-10-02, 55-10-09, 55-10-13, 57-10-19, 57-10-22, 57-10-24, 57-10-27, 57-10-28, 57-30-05, 57-30-07, 57-50-03, 57-50-10, 57-50-11, 57-50-12

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
126	747	6	53-10-37, 53-10-38, 53-10-40, 53-10-55, 53-30-00 FIG. 2, 53- 30-24, 57-10-36
126	757	6	53-10-10, 53-10-11, 53-10-13, 53-10-14, 53-10-17, 53-10-22, 53-40-01, 53-40-04, 53-40-05, 53-60-07, 53-60-08, 57-50-05, 57-50-06, 57-50-07, 57-51-07, 57-51-10
126	*[2]	6	51-00-01
126	767	6	53-10-04, 53-10-07, 53-10-08, 53-10-10, 53-30-15, 53-30-16, 53-50-05, 53-50-06, 53-60-05, 55-10-04, 55-10-05, 57-10-03, 57-10-04, 57-20-05, 57-50-03, 57-50-05
126	777	6	51-00-01, NO. 1, 2
126	787	6	51-00-01 NO. 1
127	*[2]	6	51-00-02, 51-00-10
127	*[1]	6	51-00-00, FIG. 5, FIG. 12 AND FIG. 21
127	777	6	51-00-03 NO. 1, 2
127A	*[2]	6	51-00-02 AND 51-00-10
127A	*[1]	6	51-00-00, FIG. 5 AND FIG. 12
127A	777	6	51-00-03 NO. 1, 2
128	*[1]	6	51-00-00, FIG. 7
128	*[2]	6	51-00-06
128	777	6	51-00-10
128P	*[2]	6	51-00-06
128P	*[1]	6	51-00-00, FIG. 7
130A,B,C	*[1]	6	53-50-00, FIG. 1
130A,B,C	*[2]	6	53-10-01
130C	777	6	53-10-01
130-350	*[2]	6	53-10-01
131	707	4	53-10-07, FIG. 2
131P	707	4	53-10-07, FIG. 2
132	707	4	53-10-07, FIG. 3
132PR,PL	707	4	53-10-07, FIG. 3

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
133P1,P2	707	4	53-40-07, FIG. 1
133	707	4	53-40-07, FIG. 1
134P1,P2	707	4	53-40-07, FIG. 2
134	707	4	53-40-07, FIG. 2
135	707	4	53-10-07, FIG. 4
136A,B	707	4	57-40-07, FIG. 1
137A-C	707	4	57-30-07, FIG. 4
138	707	4	32-20-07, FIG. 2
138P	707	4	32-20-07, FIG. 2
139	707	4	32-20-07, FIG. 2
139P	707	4	32-20-07, FIG. 2
140	707	4	55-10-07, FIG. 1
140P1A,P2	707	4	55-10-07, FIG. 1
141	707	4	55-10-07, FIG. 2
141P1,P2	707	4	55-10-07, FIG. 2
142	707	4	57-10-07, FIG. 1
143	707	4	57-10-07, FIG. 1
144	707	4	57-10-07, FIG. 1
145	707	4	57-10-07, FIG. 1
146	707	4	57-30-07, FIG. 1
147P	707	4	57-30-07, FIG. 3
147	707	4	57-30-07, FIG. 2
148	707	4	57-30-07, FIG. 5
149	707	4	57-30-07, FIG. 6
150P1,P2	707	4	54-40-07, FIG. 1
150	707	4	54-40-07, FIG. 1
151	707	4	54-40-07, FIG. 1
152	707	4	54-40-07, FIG. 1
153	707	4	54-40-07, FIG. 1
154	707	4	54-40-07, FIG. 1
155	707	4	54-40-07, FIG. 1
156	707	4	57-30-07, FIG. 10
156P	707	4	57-30-07, FIG. 10
157	707	4	53-10-07, FIG. 5

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
158	707	4	57-40-07, FIG. 4
159	707	4	55-30-07, FIG. 1
160	707	4	57-40-07, FIG. 5
A161	707	6	53-10-07, FIG. 2
162	707	6	55-10-07, FIG. 4
163	707	6	57-10-07, FIG. 2
164	707	6	57-10-07, FIG. 3
165	707	6	57-10-07, FIG. 3
166	707	6	57-10-07, FIG. 3
167	707	6	57-10-07, FIG. 3
168	707	6	57-10-07, FIG. 4
169	707	6	57-10-07, FIG. 4
170	707	6	57-10-07, FIG. 4
171	707	6	57-10-07, FIG. 4
172	707	6	57-10-07, FIG. 4
173	707	6	57-30-07, FIG. 1 AND FIG. 2
174A-C	707	6	57-30-07, FIG. 3
175	707	6	57-10-07, FIG. 29
176	707	6	57-30-07, FIG. 6
177	707	6	53-10-07, FIG. 12
178	707	6	57-10-07, FIG. 1
179	707	6	57-10-07, FIG. 1
180	707	6	57-10-07, FIG. 1
A181	707	6	55-10-07, FIG. 1 AND FIG. 2
182	707	6	55-10-07, FIG. 3 AND FIG. 8
183	707	4	32-10-07, FIG. 2
184P1,P2	707	4	57-30-07, FIG. 1
185	*[1]	6	51-00-00, FIG. 13 AND FIG. 24
185	*[2]	6	51-00-12
185	727	6	57-40-27, FIG. 2
185	737	6	57-50-04, 57-50-03, 57-50-06, 57-50-09, 57-50-10

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
185	747	6	53-10-43
185	757	6	57-50-04
185	777	6	51-00-04 NO. 1, 2
185	787	6	51-00-01 NO. 1
186A	767	6	53-50-08
186A, B	767	6	53-30-09
186A THRU F	777	6	51-00-02 NO. 1, 2
186A THRU F	*[1]	6	51-00-00, FIG. 1
186A THRU F	*[2]	6	51-00-04
186B	767	6	53-30-11
187	*[1]	6	51-00-00, FIG. 4 AND FIG. 23
187	*[2]	6	51-00-01
187	777	6	51-00-01 No. 1, 2
188A	*[1]	6	51-00-00, FIG. 4 AND FIG. 23
188A	*[2]	6	51-00-01, 51-00-19
188A	727	6	55-30-27
188A	737	6	53-10-50, 53-10-57, 53-10-64, 57-10-23, 57-10-28, 57-50-11, 57-50-14
188A	747	6	53-10-37, 53-10-48, 53-10-53, 53-10-55, 53-30-12, 53-30-24, 57-40-11, 57-40-12
I 188A	757	6	53-10-02, 53-10-09, 53-10-21, 53-10-22, 53-40-01, 53-60-02, 53-60-03, 53-60-05, 57-51-06, 57-51-07, 57-51-09, 57-51-10
188A	767	6	53-10-05, 53-10-07, 53-10-08, 53-10-10, 53-10-19, 53-30-07, 53-30-08, 53-30-10, 53-30-13, 53-50-05, 53-50-06, 53-50-07, 53-50-10, 53-50-11, 53-60-02, 53-60-05, 53-60-06, 53-60-07, 53-60-08, 53-60-09, 53-80-05, 55-10-05, 57-10-01, 57-50-07
188A	777	6	51-00-01 NO. 1, 2
188A	787	6	51-00-01 NO. 1
189	*[1]	6	51-00-00, FIG. 4
189	*[2]	6	51-00-01
189	737	6	53-10-65, 55-10-10, 55-10-11, 57-50-12, 57-50-13, 57-50-14
189	747	6	53-10-37, 53-10-53, 53-30-24, 55-10-12
189	757	6	53-10-17, 53-40-01

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
189	767	6	53-10-07, 53-10-08, 53-30-10, 53-50-06, 55-10-05
189	777	6	51-00-01 NO. 1, 2
189	787	6	51-00-01 NO. 1
190 THRU 192	*[1]	6	51-00-00, FIG. 13 AND FIG. 24
190 THRU 192	*[2]	6	51-00-12
190 THRU 192	777	6	51-00-04 NO. 1, 2
192	737	6	57-50-06
192	*[2]	6	51-00-21
192	787	6	51-00-03 NO. 1
194, 194A	*[1]	6	53-30-00, FIG. 1, FIG. 3 AND FIG. 4
194, 194A	757	6	53-30-02, 53-30-03, 53-30-04
194, 194A	767	6	53-30-01, 53-30-02, 53-30-03
194, 194A	777	6	53-00-01
196	777	6	53-30-01 THRU 53-30-03
196	727	4	53-10-27, FIG. 5
198ABCDEF	727	6	20-10-27
198ABCDEF	737, 757	6	20-10-01
A201	727	6	55-10-27, FIG. 3
202A,B	727	6	57-10-27, FIG. 8
203	727	6	57-10-27, FIG. 8
204	727	6	57-10-27, FIG. 8
205A,B	727	6	57-10-27, FIG. 8
206	727	6	57-10-27, FIG. 19
208	727	6	57-10-27, FIG. 19
A210	727	6	52-30-27, FIG. 1
216	727	6	55-30-27, FIG. 2
220A,B	727	6	53-10-27, FIG. 36
230	727	6	53-10-27, FIG. 21
231	727	6	53-10-27, FIG. 28
233	727	6	53-10-27, FIG. 15
236A-E	727	6	53-10-27, FIG. 30

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
238SE,SSE	727	6	53-10-27, FIG. 8
238SA-SD	727	6	53-10-27, FIG. 8
238SSA-SSD	727	6	53-10-27, FIG. 8
239	727	6	57-10-27, FIG. 18
240	727	6	57-10-27, FIG. 18
241	727	6	53-40-27, FIG. 1
242	727	6	53-40-27, FIG. 1
243	727	6	53-40-27, FIG. 1
248	727	4	53-10-27, FIG. 3
249	727	6	53-10-27, FIG. 37
250,M	727	6	57-30-27, FIG. 2
251,251A	727	6	57-30-27, FIG. 3
251A	727	4	57-30-27, FIG. 1
253	727	4	53-10-27, FIG. 4
254	727	6	57-40-27, FIG. 2
255	727	6	53-10-27, FIG. 29
A256	727	6	53-10-27, FIG. 40
A257	727	6	53-10-27, FIG. 40
A258	727	6	53-10-27, FIG. 40
A259	727	6	53-10-27, FIG. 40
A260	727	6	53-10-27, FIG. 40
A261	727	6	53-10-27, FIG. 27
262	727	6	53-10-27, FIG. 11
262A	727	6	53-10-27, FIG. 11
263	727	6	53-10-27, FIG. 6
264	727	6	53-10-27, FIG. 42
A265A-E	727	6	52-30-27, FIG. 4
A266	727	6	57-50-27, FIG. 1
270A-B	727	6	54-20-27, FIG. 1
271	727	6	32-30-27, FIG. 2
272	727	6	55-10-27, FIG. 2
273	727	6	53-10-27, FIG. 26
275	727	4	32-30-27, FIG. 1
275P	727	4	32-30-27, FIG. 1

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
276	727	4	32-30-27, FIG. 2
276P	727	4	32-30-27, FIG. 2
277	727	4	32-30-27, FIG. 2
278P	727	4	32-30-27, FIG. 3
278	727	4	32-30-27, FIG. 3
79P	727	4	32-30-27, FIG. 3
279	727	4	32-30-27, FIG. 3
280PA,PB,PC	727	4	32-30-27, FIG. 4
280	727	4	32-30-27, FIG. 4
281A-C	727	4	53-30-27, FIG. 1
282	727	4	57-10-27, FIG. 1
284P	727	6	57-10-27, FIG. 21
284	727	6	57-10-27, FIG. 21
285	727	6	57-10-27, FIG. 20
286	727	6 4	57-10-27, FIG. 20
287	727	4	32-10-27, FIG. 1
290	727	6	53-30-27, FIG. 5
291	727	6	54-40-27, FIG. 1
292	727	6	53-10-27, FIG. 46
293A,B	727	6	53-30-27, FIG. 9
A294	727	6	53-30-27, FIG. 10
295	727	4	53-30-27, FIG. 2
295	727	6	53-30-27, FIG. 8
296	727	6	53-30-27, FIG. 7
297	727	4	32-30-27, FIG. 5
298	727	4	32-30-27, FIG. 5
A299	727	6	53-10-27, FIG. 47
A305	737	6	57-10-18, 57-30-03
A306	737	6	57-10-07
312	737	6	53-10-17
313A,B	737	6	53-10-17
315	737	4	55-30-01
316	737	4	55-30-01
317	737	6	53-10-16

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
320	737	6	53-10-19
321	737	6	53-10-19
323A,B AND P	737	4	55-50-01
326	737	6	53-10-28
328A-D	737	6	53-10-38
335	737	6	53-10-31
336A-B	737	6	57-30-02
338A-N	737	6	53-10-35
341	737	6	53-10-40
343A-B	737	4	55-10-01
345	737	6	57-40-01
349	737	4	32-10-01
350	737	4	32-20-01
350P	737	4	32-20-01
351A,B	737	6	53-10-01
A352	737	6	53-10-04
353A-D	737	6	53-10-12, 53-10-15
354A-C	737	6	57-30-04
355A-C	737	6	57-30-04
356	737	6	57-30-04
357	737	6	55-30-04
358	737	6	55-10-06
359	737	6	55-10-06
362	737	4	53-20-01
363	737	6	53-30-03
365, G	737	4	71-20-01
367	737	6	71-20-01
A368	737	6	53-10-42
369	727	6	53-30-27, FIG. 4 AND FIG. 6
369	737	6	53-30-05
369A	727	4	53-30-27, FIG. 5
370	737	4	53-30-01, 53-30-02
373A,P2	737	4	32-10-02
375	737	4	55-10-02

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
A376	737	6	53-10-45
378	737	6	53-10-44
379	737	6	57-40-02
380X	737	6	32-10-01
383,PX.X	737	6	53-30-07
384A,B	737	6	53-40-04
A386	737	6	53-10-45
A389A	737	6	53-10-64
A389A,B,C	737	6	53-10-41
401	747	4	57-10-01, 57-30-02
402	747	4	57-10-04
403A,B	747	4	57-10-04
404	747	6	57-10-08
405	747	4	57-10-02
406	747	6	57-10-09
408	747	4	57-10-03
409	747	4	54-30-03
410	747	4	57-10-05
411	747	6	55-10-04
412	747	6	55-10-01
413	747	4	54-40-03
413A,AP	747	4	54-40-03
414	747	4	54-40-03
419P	747	4	54-40-03
419	747	4	54-40-03
420P	747	4	54-40-02
423	747	6	57-10-17
424	747	6	57-10-17
425A-C	747	4	54-40-03
426	747	4	55-10-01
A428	747	6	53-10-15
A429	747	6	53-10-15
A430	747	6	53-10-15
431	747	6	53-10-19

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
432	747	6	57-30-02
433	747	4	32-10-01
434A,B	747	6	53-10-06
435	747	6	57-10-20
436	747	6	57-10-20
437	747	4	53-10-01
438	747	4	53-10-01
439	747	6	57-10-22
440	747	4	57-10-11
441	747	4	57-10-10
442	747	4	53-10-02
443	747	4	53-10-02
446	747	4	57-10-13
447	747	4	57-10-13
448	747	4	57-10-13
449	747	4	57-10-13
450PA	747	4	54-40-05, 54-40-06 AND 54-40-21
451P	747	4	54-40-04
452P	747	4	54-40-04
453P	747	4	54-40-04
454/454P	747	4	54-40-01
455	747	4	53-40-01
456	747	4	53-40-01
457	747	4	54-40-07
458A-C	747	6	53-10-10
A459	747	6	53-10-13
460	747	6	57-10-28
461PL	747	4	57-40-01
461P/461PR	747	4	57-40-01
461-6,-9	747	4	57-40-01
462PL50	747	4	57-40-01
462PR50	747	4	57-40-01
462G	747	4	57-40-01
462PR29	747	4	57-40-01

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
462PL29	747	4	57-40-01
463	747	6	53-10-27
464A-B	747	6	53-10-01
471	747	4	57-30-02
474	747	6	53-10-20
475	747	6	57-10-27
476	747	6	53-10-18
477	747	6	53-10-18
478	747	6	53-10-18
479	747	6	53-10-22
480	747	6	53-10-22
481	747	6	53-10-22
482	747	6	55-10-08
483	747	6	55-10-08
484A,B	747	6	53-10-25
485A,B	747	6	53-10-23
486	747	4	54-40-08
486PA,PB	747	4	54-40-08
490	747	4	57-30-06
491A-C	747	6	53-10-16, 53-10-21
497	767	6	53-00-04
497C,G,P	747	6	53-30-00, FIG. 2
497C,G,P	767	6	53-00-04
499	747	2	57-40-02
499	747	2	57-40-01
503	757	6	53-30-01
504	757	6	54-40-01
505	757	4	54-30-01
506	757	4	57-40-01
601PA,PF	767	4	52-30-01
601	767	4	52-30-01
602	767	4	32-10-01
603	767	4	55-10-01
603P	767	4	55-10-01

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
604A-B	767	6	53-60-01
605	767	6	22-10-01
606	767	6	53-10-01, FIG. 4
A607	767	6	53-80-02
A607A	767	6	53-80-02
608P1,P2	767	4	27-80-01
608	767	4	27-80-01
610	767	4	32-20-01
1000A,B	707	6	55-10-07, FIG. 10
1001	*[1]	6	51-00-00, FIG. 15
1001	*[2]	6	51-00-15
1001	777	6	51-00-09
1002	*[1]	6	51-00-00, FIG. 14
1002	*[2]	6	51-00-13
1002	747	6	57-40-07, 57-40-08, 57-40-10
1002	757	6	53-10-13
1002	777	6	51-00-06, NO. 1, 2
1002	777	6	57-50-01
1003 THRU 1005	*[1]	6	51-00-00, FIG. 14
1003 THRU 1005	*[2]	6	51-00-13
1004	737	6	57-50-09
1004	747	6	57-40-10
1005	777	6	51-00-06, NO. 1, 2
2001	727	4	28-10-27, FIG. 1
2002	727	4	53-10-27, FIG. 6
2004ABCD	727	6	28-10-27, FIG. 1
2005	727	4	28-10-27, FIG. 2
2006	727	6	57-10-27, FIG.20
4001A-E	747	4	54-30-02
4001P	747	4	54-30-02
4003	747	4	53-40-01
4004	747	4	53-40-01
4005	747	6	53-10-31
4007P	747	4	54-40-05, 54-40-06

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
4007P(M)	747	4	54-40-05
4008	747	6	53-10-28
4009	747	6	32-10-01
A4010	747	6	53-10-33
4011	747	4	54-40-03
4012	747	4	54-40-03
4015	747	6	53-10-34
4016	747	4	54-40-03
4018P	747	4	54-40-02
4019	747	6	53-30-04
4020	747	4	53-30-01
4021P	747	4	54-40-03
A4024	747	6	53-10-33
4025	747	6	53-10-36
4027	747	4	54-40-10
4028G,P	747	4	57-40-03
4028	747	4	57-40-03
4028P	747	4	57-40-05
4029	747	4	55-50-01
4029P	747	4	55-50-01
4030,A,B	747	4	54-40-08
4031,A,B	747	4	54-40-08
4032	747	4	54-40-08
4033	747	6	53-10-35
4034	747	4	53-40-02
4035	747	4	53-40-02
4036G	747	4	57-40-05
4036	747	4	57-40-05
4037PA	747	4	54-40-05
4039PA	747	4	54-40-05
4047P1,P2	747	4	54-40-05
4047P3,P4	747	4	54-40-05
4052	747	6	57-40-03, 57-40-04
4053A,B,C	747	4	53-40-03

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
4057	747	6	53-30-02, 53-30-03, 53-30-06
4059	747	4	57-10-12
4061	747	4	57-10-15
4062A,B,C	747	6	57-10-23
4064	747	6	53-30-02, 53-30-06
4065	747	6	53-30-08
4068	747	6	53-30-09
4071	747	4	54-40-10
4072,C	747	6	53-30-05
4074	747	4	54-40-02
4075	747	4	54-40-02
4076	747	4	54-40-05, 54-40-06
4077	747	4	54-40-04
4078	747	4	54-40-04
4079	747	4	54-40-04
4080	747	4	57-40-01
4081	747	4	57-40-01
4083	747	4	54-40-06, 54-40-15
4084	747	4	54-40-02
4084	747	4	54-40-02
4085	747	4	54-40-05
4086	747	4	54-40-05
4087	747	4	54-40-05
4088	747	4	54-40-05
4089	747	4	54-40-05
4243	747	6	57-10-31
NDT188A	767	6	57-10-01, 57-10-04
NDT194B	*[1]	6	53-30-00, FIG. 1, FIG. 3 AND FIG. 4
NDT194B	757	6	53-30-02, 53-30-03, 53-30-04
NDT194B	767	6	53-30-01, 53-30-02, 53-30-03
NDT194B	777	6	53-00-01
NDT297	727	4	32-30-27, FIG. 5
NDT298	727	4	32-30-27, FIG. 5

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT298PR,PL	727	4	32-30-27, FIG. 5
NDT322A	737	6	53-10-25
ANDT388	737	6	53-10-48, 53-10-49
NDT389C	737	6	53-10-41
ANDT390A	737	6	53-10-46, 53-10-47
ANDT390B	737	6	53-10-46, 53-10-47
NDT391	737	6	53-10-51
NDT392	737	4	53-30-03
NDT394,P	737	6	54-30-01
NDT396	737	6	53-30-09, 53-30-18, 55-10-07
NDT398	737	4	53-10-01
NDT504A THRU NDT504C	757	6	54-40-01, 54-40-02
NDT504D	757	6	54-40-01, 54-40-02
NDT511	757	6	57-10-02
NDT512	757	4	57-10-01
NDT514	757	6	57-20-01
NDT515	757	4	57-21-01
NDT516	757	6	57-23-01
NDT518	757	4	57-21-02
NDT519	757	6	52-30-01
ANDT520	757	6	52-30-02
NDT521	757	4	55-10-02
NDT522,P1	757	4	53-80-01
NDT523	757	6	53-10-12, 53-60-04
NDT524	757	6	53-10-06, 53-10-08
NDT525	757	4	54-50-01
ANDT527	757	6	53-30-06
NDT528	757	4	55-10-04
NDT530	757	6	53-10-04
NDT531	757	6	53-30-07, 53-60-01
NDT531	757	4	55-10-03
NDT532	757	4	55-10-05
NDT533	757	4	55-10-01

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT536	757	4	53-40-01
NDT537	757	4	57-10-02
NDT539	757	6	55-10-02
NDT542	757	4	55-10-07
NDT546	757	4	57-20-02
NDT549	757	6	57-20-02
NDT552	757	4	57-20-01
NDT553	757	6	52-30-02
NDT554	757	6	53-10-07
NDT555	757	6	53-10-19
NDT558	757	6	53-30-12
NDT559	757	6	57-51-01
NDT560	757	4	57-50-02
NDT560P1, P2	757	4	57-50-02
NDT561	757	4	57-50-02
NDT561P1, P2	757	4	57-50-02
NDT562	757	4	57-25-01
NDT564A, B	757	4	57-50-01
NDT566	757	4	54-50-03
NDT568	757	6	57-51-05
NDT611 THRU NDT613	767	6	54-51-01
NDT614	767	4	57-20-01
NDT615	767	4	53-80-01
NDT616	767	4	27-40-01
NDT616P	767	4	27-40-01
NDT617	767	6	53-80-03
NDT618	767	6	53-80-03
NDT618A	767	6	53-80-03
NDT619	767	4	55-10-04
NDT619P	767	4	55-10-04
NDT620	767	6	53-60-01
NDT621	767	6	57-10-01
NDT622	767	6	57-20-01
NDT623	767	4	57-10-03

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT625	767	4	55-10-03
NDT627	767	4	57-10-02
NDT628	767	4	53-50-01
NDT629	767	4	57-40-01
NDT630	767	4	55-10-02
NDT631	767	4	71-20-01
NDT632	767	4	71-20-01
NDT636	767	4	32-10-02, 32-10-03
NDT636	767	6	32-10-01, 32-10-02
NDT637	767	4	32-10-04
NDT638	767	4	57-40-02
NDT642	767	4	53-50-02, 53-50-03
NDT643	767	6	57-20-03
NDT644	767	4	57-20-02
NDT648	767	6	53-30-06
NDT650	767	6	57-04-01
NDT651	767	6	57-04-01
NDT652	767	6	57-20-07
NDT655,G	767	4	54-50-03
NDT656,G	767	4	54-50-03
NDT657	767	6	53-10-09
NDT658	767	4	53-10-01
NDT660	767	6	53-80-04
NDT661	767	4	53-30-01
NDT662	767	4	57-20-03
NDT663A, B	767	6	53-10-13
NDT664	767	6	57-20-06
NDT665	767	6	53-10-06
NDT666A,B,C	767	6	57-20-08
NDT667	767	4	54-50-05
NDT668	767	6	57-50-01
NDT669	767	4	32-10-05
NDT670	767	4	53-10-02
NDT671	767	4	53-30-12

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT672	767	6	54-50-01
NDT674	767	4	54-50-06
NDT675	767	4	54-50-06
NDT679	767	4	53-50-05
NDT680	767	4	32-10-06
NDT685	767	6	53-10-18, 53-10-19
NDT686	767	6	53-50-09
NDT687	767	4	57-50-08
NDT688	767	4	57-50-03
NDT690	767	4	57-50-04
NDT691	767	6	57-50-08
NDT693	767	4	53-50-04
NDT694	767	4	57-50-05
NDT695	767	4	57-50-05
NDT697	767	4	57-50-07
NDT698	767	4	57-50-03
NDT700X	767	4	57-50-02
NDT702	787	4	51-00-08
NDT703	777	6	57-60-01
NDT705	777	6	57-40-01
NDT706	777	6	53-10-01
NDT706P	777	6	53-10-01
NDT707	777	4	52-80-01
NDT708	777	6	53-50-01
NDT709	777	4	57-60-01
NDT710	777	6	54-51-01
NDT711	777	6	54-51-01
NDT712	777	6	54-51-01
NDT713	777	6	53-10-02
NDT714	777	6	53-10-03
NDT723	777	4	78-30-03, 78-30-04
NDT1002	757	6	57-50-03
NDT1002 THRU NDT1005	787	6	51-00-05 NO. 1

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT1006 THRU NDT1009	*[1]	6	53-30-00, FIG. 5
	*[2]	6	53-00-06
NDT1008	727	6	53-30-27, FIG. 15
NDT1008	747	6	53-30-10
NDT1009	727	6	53-30-27, FIG. 15 AND FIG. 16
ANDT1015	*[1]	6	53-30-00, FIG. 5
ANDT1015	*[2], 777	6	53-00-06
NDT1016	767	6	53-30-09, 53-50-08
NDT1016 THRU NDT1021	*[1]	6	51-00-16, FIG. 16
	*[2]	6	51-00-16
	777	6	51-00-02 NO. 3
	787	6	51-00-02 NO. 1
NDT1022 THRU NDT1027	*[1]	6	51-00-00, FIG. 17
	*[2]	6	51-00-14
	777	6	51-00-07
	787	6	51-00-06
NDT1017	757	6	57-50-02
NDT1017	767	6	53-30-09, 53-60-09
NDT1018	767	6	53-50-12
NDT1019	767	6	57-50-04
NDT1020	767	6	57-50-04
NDT1021	767	6	53-50-12
ANDT1028	707	6	53-10-07, FIG. 18
ANDT1029A	707	6	53-30-07, FIG. 12
ANDT1029B	707	6	53-30-07, FIG. 12
NDT1031	707	6	57-10-07, FIG. 93
NDT1033	*[1]	4	51-40-00, FIG. 1
NDT1033	*[2], 777, 787	4	51-00-01
NDT1034	707	6	53-30-07, FIG. 13
NDT1036, -P1,P2,-P4	707	4	54-40-07, FIG. 2
NDT1037	*[1]	6	51-00-00, FIG. 21
NDT1038	*[1], *[2]	1	51-05-01
NDT1038	777, 787	1	51-05-01
NDT1038	*[1], 777, 787	4	51-00-05
NDT1039-X	*[1]	4	51-00-05
NDT1039-X	757	4	53-30-01

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT1039-t1/t2	787	4	51-00-05
NDT1040	767	6	54-50-02
NDT1040 THRU NDT1045	*[1]	6	51-00-00, FIG. 19
NDT1040 THRU NDT1045	*[2]	6	51-00-17
NDT1040 THRU NDT1045	777	6	51-00-05, NO. 2
NDT1040 THRU NDT1045	787	6	51-00-04 NO. 1
NDT1041	737	6	57-50-16
NDT1042	737	6	57-50-16
NDT1043	737	6	57-50-17
NDT1046	*[1],*[2], 777, 787	9	51-00-01, 51-00-02
NDT1046	767	9	57-50-01
NDT1048	*[1]	6	51-00-00, FIG 4 AND FIG. 23
NDT1048	737	6	57-10-28, 57-50-12
NDT1048	747	6	53-10-49, 53-30-12, 53-30-24, 55-10-11
NDT1048	757	6	53-10-05, 53-10-17, 53-30-08, 57-51-08, 57-51-09, 57-51-10, 57-51-11
NDT1048	767	6	53-10-07, 53-10-08, 53-10-18, 53-50-06, 53-60-06, 53-60-07, 55-10-05
NDT1048	*[2]	6	51-00-01, 51-00-19
NDT1048	777	6	51-00-01 NO. 1, 2
NDT1048	787	6	51-00-01 NO. 1
ANDT1049 THRU ANDT1052	727	6	53-30-27, FIG. 18
ANDT1049 THRU ANDT1057	*[1]	6	53-30-00, FIG. 5
ANDT1049 THRU ANDT1057	*[2]	6	53-00-06
ANDT1051	747	6	53-10-56, 53-30-10, 53-30-15
ANDT1052	747	6	53-30-15
ANDT1053	757	6	53-10-16
NDT1061	*[1]	6	51-00-00, FIG. 13 AND FIG. 24
NDT1061	*[2]	6	51-00-12, 51-00-21
NDT1061	737	6	57-50-09
NDT1061	787	6	51-00-03 NO. 1
NDT1062	*[1]	6	51-00-00, FIG. 13 AND FIG. 24
NDT1062	*[2]	6	51-00-12, 51-00-21

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT1062	787	6	51-00-03 NO. 1
ANDT1068	707	6	53-10-07, FIG 21
NDT1069A, B	737	6	53-30-19, 53-30-25
NDT1070A, B	727	6	53-30-27, FIG. 19
NDT1071	*[1]	6	51-00-00, FIG. 25
NDT1071	*[2]	6	51-00-22
NDT1071	777	6	51-00-12
NDT1072 THRU NDT1075	*[1]	6	51-00-00, FIG. 13
NDT1072 THRU NDT1075	*[2]	6	51-00-12, 51-00-21
NDT1072 THRU NDT1075	787	6	51-00-03 NO. 1
ANDT1077	*[1]	6	53-30-00, FIG. 5
ANDT1077	*[2]	6	53-00-06
ANDT1077	777	6	53-00-06
ANDT1079 THRU ANDT1082	*[1]	6	53-30-00, FIG. 7
ANDT1079 THRU ANDT1082	*[2]	6	53-00-07
ANDT1079	767	6	53-80-06
NDT1083	*[2]	6	51-00-17
NDT1083	757	6	57-50-07
NDT1083	777	6	51-00-05 NO 2
NDT1083	787	6	51-00-04 NO. 1
NDT1083-0.880	757	6	71-20-01
NDT1084	*[2]	6	51-00-16
NDT1084	757	6	57-50-06, 57-50-07
NDT1084	777	6	51-00-02 NO 3
NDT1084	787	6	51-00-02 NO. 1
NDT1085-XXX	*[1]	4	53-30-23
NDT1085-XXX	*[2]	6	53-00-10
NDT1085-XXX	777	6	53-00-08
NDT1086-P1, -P2	757	4	53-00-01
NDT1086-XXX	*[1]	4	53-30-05
NDT1086-XXX	*[2]	4	53-00-01
NDT1087-P1, -X	*[1]	6	53-30-00, FIG. 9
NDT1087-P1, -X	*[2]	6	53-00-11

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT1087-P1, -X	777	6	53-00-09
NDT1087-1	727, *[2]	6	53-30-27, Fig. 23
NDT1087-1	737	6	53-30-08
NDT1087-2	727	6	53-30-27, Fig. 23
NDT1087-3	737	6	53-30-17
NDT1087-6	767	6	53-10-20
NDT1088-050/063	747	6	53-30-17
NDT1088-050/063	757, 767	6	53-00-13
NDT1088-062/071	747	6	53-30-17
NDT1088-062/071	767	6	53-00-13
NDT1088-072/050	727	6	53-30-24
NDT1088-072/050	737	6	53-30-24
NDT1088-072/050	757	6	53-30-09
NDT1088-095/071	747	6	53-30-17
NDT1088-112/100	747	6	53-30-17
NDT1088-112/100	767	6	53-00-13
NDT1088-112/100	777	6	53-00-05
NDT1088-133/071	747	6	53-30-17
NDT1088-144/050	727	6	53-30-24
NDT1088-144/050	737	6	53-30-24
NDT1091	*[1]	6	51-00-00, FIG. 15
NDT1092-t1/t2	707-777	9	51-00-03, 51-00-04
NDT1093-t1/t2	707-777	9	51-00-03, 51-00-04
NDT1094-XXX	*[1]	4	53-30-06
NDT1094-XXX	737	4	53-30-06
NDT1094-XXX	*[2], 777	4	53-00-02
NDT1095	757	6	53-00-16
NDT1095	767	6	53-00-14
NDT1095	777	6	53-00-10
ANDT2007	727	6	53-10-27, FIG. 48 AND FIG. 49
ANDT2008	727	6	52-30-27, FIG. 7
NDT2009	727	4	57-10-27, FIG. 2
NDT2011-A	727	6	53-30-27, FIG. 13
NDT2011-B	727	6	53-30-27, FIG. 13

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT2011-C	727	6	53-30-27, FIG. 13
NDT2011-D	727	6	53-30-27, FIG. 13
NDT2012	727	6	53-30-27, FIG. 2
NDT2013	727	4	32-10-27, FIG. 2
NDT2013-P2	727	4	32-10-27, FIG. 2
NDT2014	727	4	53-30-27, FIG. 3
NDT2015	727	4	53-30-27, FIG. 4
NDT2018-A THRU -D	727	6	53-30-27, FIG. 13
NDT2019	727	6	57-40-27, FIG. 3
NDT2023A,B,C	727	6	53-30-00, FIG. 21
NDT2024 THRU NDT2029	727	6	53-30-27, FIG. 22
NDT2031	727	6	55-30-27
NDT3001	727	4	53-10-27, FIG. 7
NDT3001	737	4	53-10-02
NDT3004	737	6	53-30-10, 53-30-11
ANDT3004	737	6	53-30-12
NDT3005	737	6	53-30-13
ANDT3006	737	6	53-30-14
NDT3008 THRU NDT3010	737	6	54-40-01, 54-40-02
NDT3011	737	6	53-30-10
NDT3012	737	4	53-10-03
NDT3015	737	6	53-30-15
ANDT3016-B	747	6	53-10-54
NDT3019	727	6	53-30-27, FIG. 17
NDT3019	737	6	53-30-16
NDT3020	737	6	53-30-17
NDT3021	737	4	57-50-01
NDT3021	737	6	57-50-01
NDT3023, P1, P2, P3	737	4	32-10-02
NDT3023	737	4	32-10-03
NDT3024	737	4	53-10-04
NDT3024A	737	4	53-10-04
NDT3030	737	4	57-10-01
NDT3036	737	6	55-10-08

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT3038,-P1	737	4	57-50-02
NDT3039	737	4	53-30-04
NDT3041	737	6	57-50-15
NDT3043	737	4	57-50-03
NDT3044	737	4	57-50-03
NDT3045	737	6	57-50-19
NDT3046	737	4	53-20-01
NDT3047	737	6	53-10-62
NDT3048	737	6	53-10-56
NDT3050	727	6	53-30-21
NDT3050	737	6	53-30-20, 53-30-29
NDT3052	737	6	57-10-25, 57-10-26
NDT3053	737	6	53-30-21
NDT3054	737	4	57-10-04
NDT3062	737	4	57-10-02
NDT3065	*[1]	6	53-30-22
NDT3065	*[2]	6	53-00-09
NDT3065	777	6	53-00-04, 53-00-07
NDT3068	737	4	52-10-02
NDT3070	737	6	57-10-30
NDT3071	737	6	53-10-65
NDT3073	737	6	57-10-31
NDT3075	727	6	53-30-25, 53-30-26
NDT3075	737	6	53-30-26, 53-30-27
NDT3075	747	6	53-30-20
NDT3077	737	6	53-10-69
NDT3078	737	6	53-10-38
NDT3080	737	4	55-30-02
NDT3081	737	4	55-10-01
NDT3082A, B, C	737	6	53-10-70
NDT3085A, B, C	737	6	57-10-32
NDT3086A, B, C	737	6	57-10-32
NDT3089	737	6	52-30-01
NDT3090A, B, C	737	6	53-10-52

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT3091	747	6	53-30-20
NDT3092	737	4	53-10-05
NDT4058	747	6	27-10-02
NDT4090	747	6	54-40-08
NDT4093	747	6	54-40-06
NDT4094	747	6	54-40-08
NDT4096	747	6	54-40-12
NDT4097	747	6	54-40-12
NDT4098	747	6	54-40-07, 54-40-10, 54-40-11, 54-40-12, 57-40-05
NDT4099	747	6	54-40-11, 54-40-12
NDT4100	747	6	57-40-06
NDT4101	747	6	54-40-09
NDT4104	747	4	53-10-06
NDT4105	747	6	57-10-35
NDT4106,-G1, -G2, -G3	747	4	54-30-05
NDT4107,-G5	747	4	54-30-06
NDT4108	747	4	54-30-06
NDT4109	747	4	54-30-08
NDT4115	747	4	54-30-07, 54-30-09, 54-30-10
NDT4116	747	4	54-40-02
NDT4117	747	4	54-40-02
NDT4118	747	4	54-40-02
NDT4121	747	6	54-40-13
NDT4123	747	4	54-30-10
ANDT4125	747	6	53-10-39
ANDT4126	*[1]	6	53-30-00, FIG. 6
ANDT4126	*[2]	6	53-30-05
ANDT4126	777	6	53-30-04
NDT4128	747	4	54-40-12
NDT4129	747	4	54-40-12
NDT4130	747	6	54-40-13
NDT4131,P	747	4	54-40-11

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT4132	747	4	54-40-11
NDT4133	747	4	54-40-11
NDT4144	747	6	57-40-09
NDT4147	747	4	54-40-13
NDT4147P	747	4	54-40-13
NDT4147PL	747	4	54-40-13
NDT4147PR	747	4	54-40-13
NDT4150	747	4	57-22-01
NDT4151	747	4	57-10-17, 57-10-21
NDT4152	747	4	53-10-07
NDT4153	747	4	57-30-08, 57-30-09
NDT4154	747	4	54-40-14
NDT4155	747	4	54-40-14
NDT4156	747	4	54-40-14
NDT4157	747	4	54-40-14
NDT4162P	747	4	54-40-14
NDT4163P	747	4	54-40-14
NDT4164P	747	4	54-40-14
NDT4165P	747	4	54-40-14
NDT4175	747	6	53-10-41
NDT4176	747	6	53-10-41
NDT4178	747	4	54-40-05
NDT4179	747	4	53-40-04
NDT4180	747	6	57-10-37
NDT4182	747	4	54-40-16, 54-40-18
NDT4183	747	4	53-30-03
NDT4185	747	4	54-40-17
NDT4187	747	4	57-10-18
NDT4188	747	4	54-40-19
NDT4188G	747	4	54-40-19
NDT4189	747	4	54-40-20
NDT4190,A	747	6	53-10-34
NDT4191	747	4	54-40-21

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT4192	747	4	54-40-21
NDT4195 THRU NDT4199	747	6	54-40-14
NDT4200	747	4	57-10-20
NDT4201	747	6	54-40-07
NDT4202	747	6	54-40-13
NDT4203	747	6	54-40-10, 54-40-13
NDT4204	747	6	53-10-45
NDT4205	747	4	57-40-07
NDT4206	747	4	54-40-22
NDT4208	747	4	54-40-23
NDT4209	747	4	53-10-08
NDT4210	747	4	51-20-01
NDT4211	747	4	53-10-08
NDT4212	747	4	53-10-09
NDT4214	747	6	53-30-08
NDT4215	747	6	53-10-15
NDT4217	747	6	53-30-14
ANDT4218	747	6	53-10-51
NDT4219	747	4	53-10-11
NDT4220	747	6	53-30-13
NDT4221	747	6	53-30-12
NDT4222	747	6	54-40-15
ANDT4223	747	6	53-10-33
NDT4224	747	4	54-40-24
NDT4224	767	4	54-50-05
NDT4225	747	6	53-10-47
NDT4226	747	4	57-10-22
NDT4228	747	6	54-40-16
NDT4229	747	6	54-40-16
NDT4230	747	4	53-10-10
NDT4231	747	4	57-10-18
NDT4232	747	4	55-10-03
NDT4233	747	4	55-10-03
NDT4234	747	4	55-10-03

REFERENCE STANDARD BOEING PART NUMBER	AIRPLANE MODEL	MANUAL PART	PROCEDURE NUMBER
NDT4235	747	4	55-10-03
NDT4236	747	6	53-30-16
NDT4237	747	6	53-30-16
NDT4238	747	6	53-30-16
NDT4239	747	6	53-30-16
NDT4240	747	4	27-20-01
NDT4240P	747	4	27-20-01
NDT4241	747	4	53-30-04
NDT4243	747	6	57-10-31
NDT4244	747	4	53-10-12
NDT4245	747	4	54-40-25
NDT4246	747	6	53-10-34
NDT4248	747	4	53-10-13
NDT4249	747	6	53-30-19
NDT6036, G1, G2, P1, P2	767	4	57-20-04
ST8870D	737	6	78-30-01
ST8870-1, -4	787	1 1 4	51-05-01 51-04-00 51-00-05
ST8870-7, -8, -9	777 787 787	4 1 4	78-30-01 51-04-00 51-00-01, 51-00-02
ST8871	787	1 4	51-04-00 51-00-06, 51-00-07, 51-00-08, 51-00-09
ST8871B	787	4	51-00-07, 51-00-09

*[1] 707, 727, 737, 747

*[2] 757, 767

INSPECTION OF REPAIRS TO COMPOSITE STRUCTURES

1. Purpose

A. To find delaminations or disbonds in repaired metallic and nonmetallic composite structure.

B. This procedure has been written to help operators identify inspection procedures that can be used to examine repairs made to composite structure. Calibration disbond diameters for each inspection are given. This procedure does not stop the use of other inspection procedures. Different inspection procedures that have been evaluated and found to be acceptable by the airline can be used. Alternative inspection procedures must be applicable to the repair to be examined.

2. Equipment

NOTE: Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

A. Reference Handbook

(1) The Society of Automotive Engineers (SAE) has a handbook that can be referred to for more data related to the inspection of composite repairs. This handbook, the "Composite Repair NDT/NDI Handbook", document number ARP 5089, can be purchased from SAE at:

SAE

400 Commonwealth Drive

Warrendale, PA 15096-0001

USA

PHONE: [724] 776-4970

FAX: [724] 776-0790

B. Reference Standard

(1) To help with inspections of nonmetallic composite repairs, repair reference standards are available from Boeing. As an alternative, new Commercial Airplane Composite Repair Committee (CACRC) reference standards are also available from SAE. You can use these reference standards to cause example indications with bondtesters, pulse-echo instruments, through-transmission instruments, and tap testers. The reference standards are not calibration standards, which are used to set the instrument sensitivity. Refer to the procedures specified in Figure 9 for data about calibration standards.

(a) Boeing reference standards

1) You can make the reference standards shown in Figure 1 thru Figure 6 or make an order for them from composite reference standard manufacturers.

2) The repair reference standards are available in many configurations (see Figure 2). For general composite repair inspections, Boeing recommends the basic set of four reference standards below:

a) Reference standard C12-DIS-3C1N (carbon skins with honeycomb core and skin-to-core disbonds).

b) Reference standard C12-DEL-3C1N (carbon skins with honeycomb core and with interply delaminations).

c) Reference standard C12-PCS-3C1N (carbon skins with honeycomb core and with potting and core splice areas).

d) Reference standard C12-POT-3C1N (carbon skins with honeycomb core and skin-to-potting disbonds).

3) For solid laminate inspections, it is permitted to use the laminate step wedges specified in Part 4, 51-00-02.

NOTE: These laminate step wedges are cured in an autoclave. They have less ultrasonic attenuation than repaired laminate structure cured with a vacuum bag.

(b) Commercial Aircraft Composite Repair Committee (CACRC) reference standards

1) The CACRC committee has designed industry reference standards (see Figure 7 and Figure 8) applicable to aircraft from all manufacturers. You can make these reference standards or make an order for them from manufacturers of composite reference standards.

2) Drawings and instructions for CACRC reference standards can be purchased from the Society of Automotive Engineers (SAE). Use the document numbers specified below:

a) Aerospace Recommended Practice ARP5606 (composite honeycomb NDI reference standards)

b) Aerospace Recommended Practice ARP5605 (solid composite laminate NDI reference standards)

3. Preparation for Inspection

A. If you cannot get access on the part to do the inspection, remove it from the airplane.

B. Get the repair records that show the initial damage location, the repair dimensions and the type of repair.

C. Try to find out how the repair was made. Identify the thickness of the repair plies or doublers used, the location of core plugs and potting compound, and the surface area of the part where heat was applied.

D. Get the engineering drawings, if possible, that show the part structure in the repair area.

E. Examine the repair and use the flowchart in Figure 9 to identify the correct inspection procedure or procedures to use. Use the procedures specified in the flowchart to do the inspection.

4. Instrument Calibration

A. Use the calibration defect diameters shown in Figure 10 to calibrate your instrument. Refer to the procedures specified in Figure 9 for data about the reference standards to use.

5. Inspection Procedure

A. Do a scan of the repair area and the area around the repair as follows:

(1) Use one of the scan patterns shown in Figure 11. Use scan pattern 1 for inspection with through-transmission or low-frequency bondtest procedures. Use scan pattern 2 for inspection with pulse-echo or high-frequency bondtest procedures. For tap test inspections, refer to Part 1, 51-05-01 for the current scan pattern.

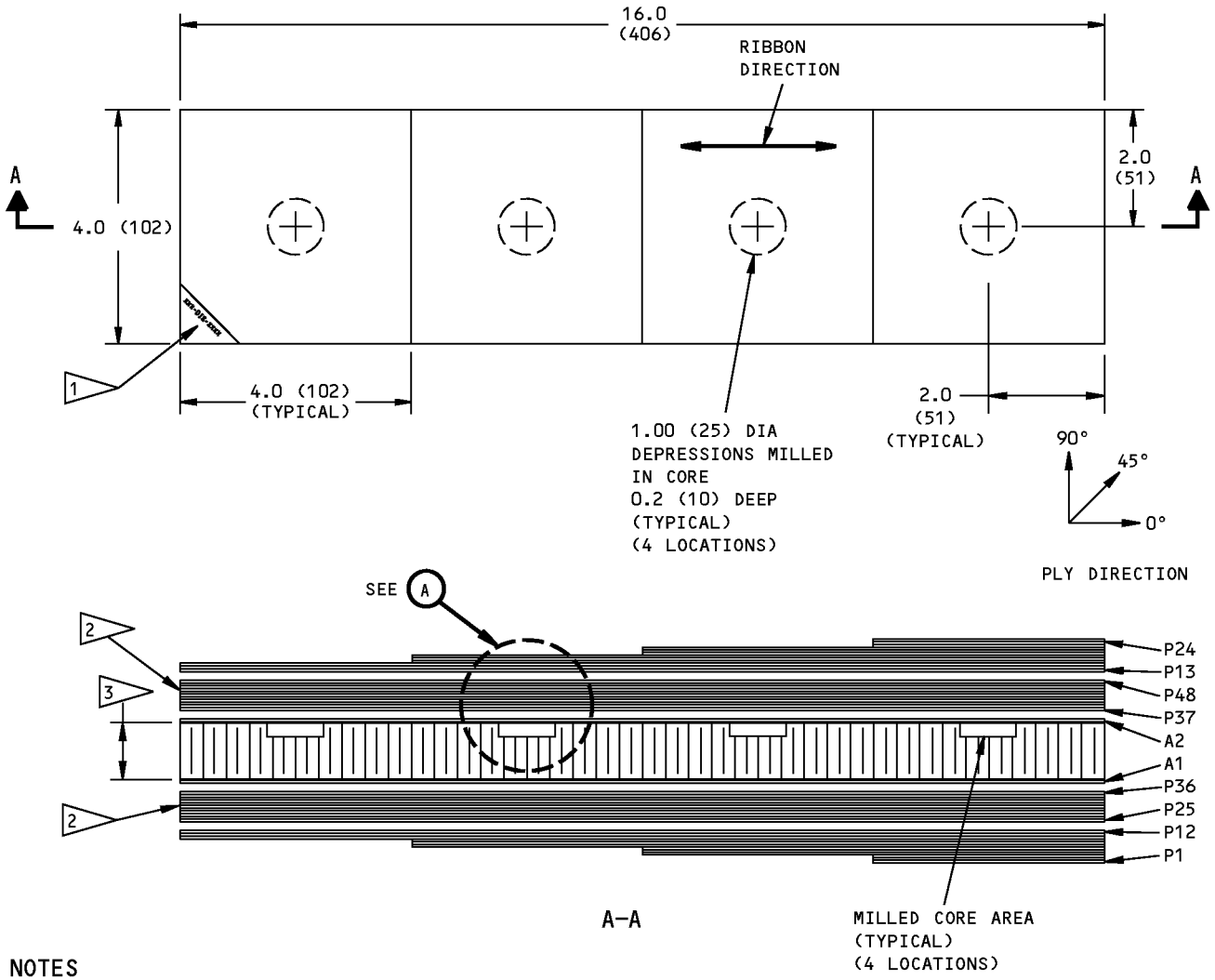
(2) Use scan increments that are one third of the defect's diameter when you do scan pattern 1 or 2. For example, to find 1-inch (25 mm) defects, do the scan in increments of 0.30 inch (8 mm) (see Figure 11). When possible, we recommend that you use a guide or a straightedge to control the movement of the transducer during these inspections.

(3) Examine at least 6 inches (152 mm) all around the area where heat was applied to be sure that the heat application did not damage the structure near the repair. See Figure 12.

6. Inspection Results

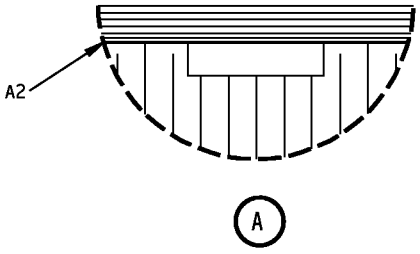
A. If you get disbond indications larger than what is permitted, you must examine the repair area some more. Disbonds in the repair area will cause responses that are almost the same as the response you got during calibration when you examined the calibration defect.

B. You can use other inspection procedures to examine the indication, but the procedure shown in the flowchart for the repair type must be the procedure you use to accept or reject the indication. For example, you cannot accept an indication with a bondtester that you have rejected with a through-transmission inspection.



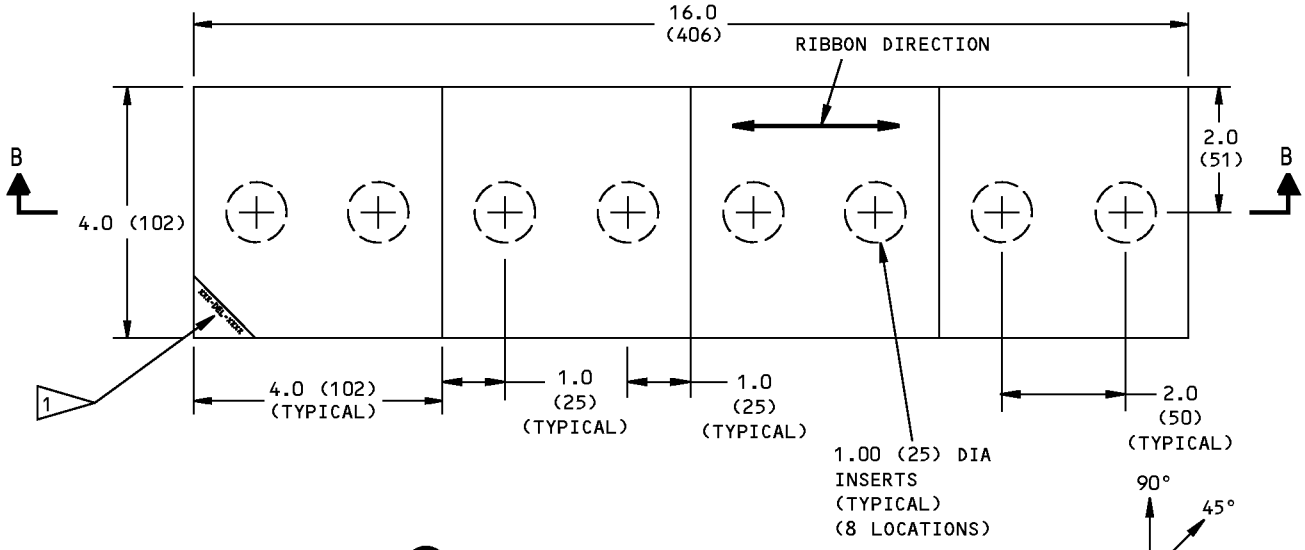
NOTES

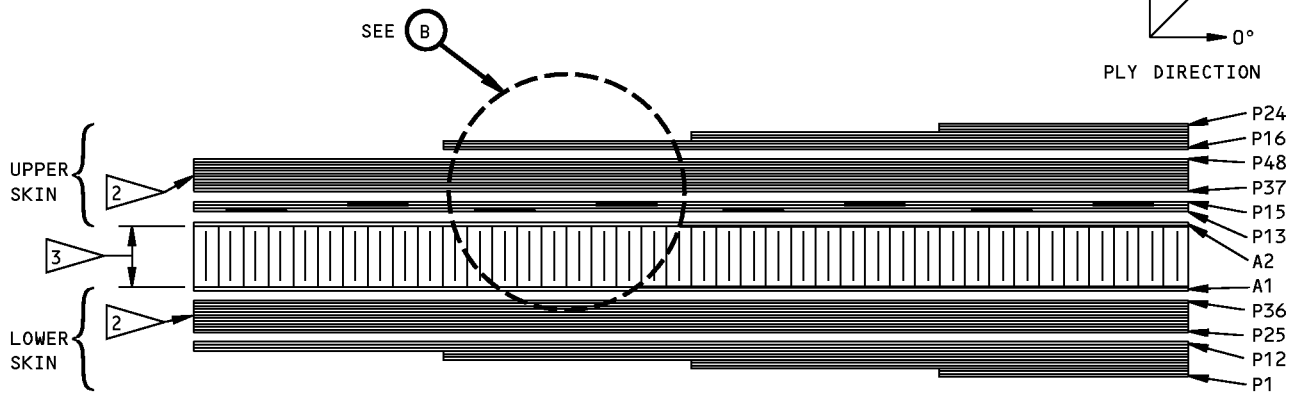
- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE DEFECTS FOR THIS REFERENCE STANDARD:
  1. CUT THE HONEYCOMB WITH A 1.00 (25) TREPPANING TOOL. THEN MILL THE CORE TO A DEPTH OF 0.2 (5) WITH A CIRCULAR SANDING DISK IN A DRILL PRESS.
  2. SECONDARY BOND THE MILLED CORE TO THE PRE-CURED SKINS. MAKE SURE THAT THE MILLED SIDE OF THE HONEYCOMB IS ON THE TOOL (SO THE ADHESIVE FILM STAYS AGAINST THE SKIN).
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.



XXX-DIS-XXXX SERIES REFERENCE STANDARD

Reference Standards
Figure 1 (Sheet 1 of 5)

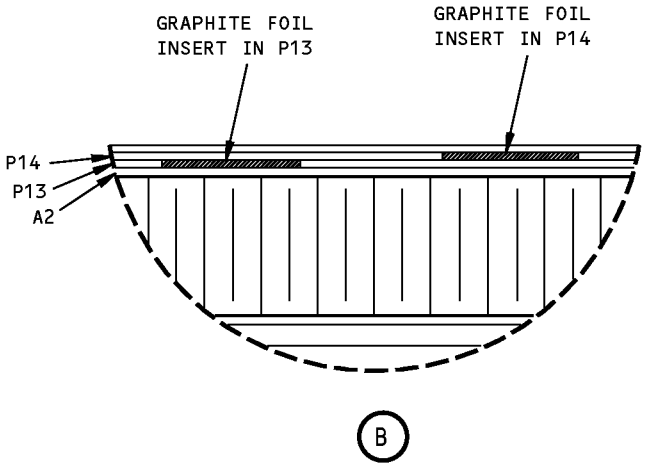




B–B

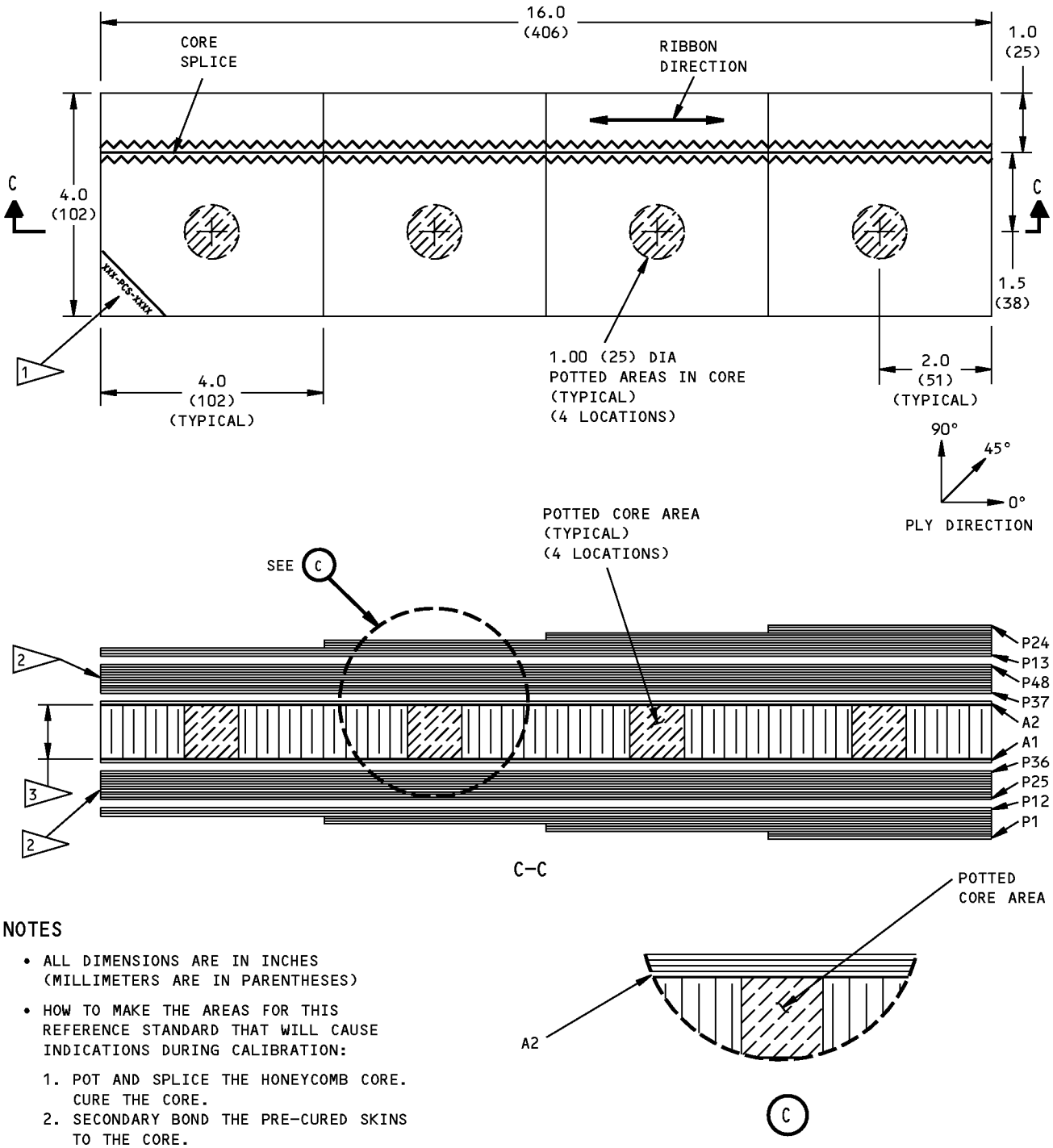
NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE DEFECTS FOR THIS REFERENCE STANDARD:
  1. PUT THE DEFECTS IN THE UPPER SKIN WHEN YOU PRE-CURE THE SKINS.
  2. USE 0.010 (0.25) GRAPHITE FOIL INSERTS FOR THE DEFECTS IF THE REFERENCE STANDARD HAS CARBON SKINS. CUT 1.0 (25) HOLES IN PLIES 13 AND 14 TO ACCEPT THE INSERTS. (REFER TO 4)
  3. DIP THE INSERTS IN A RELEASE AGENT BEFORE YOU PUT THEM IN THE PLY LAYUP. USE TWEEZERS TO HOLD THE INSERTS.
  4. USE 0.001 (0.03) CLEAR PARTING FILM INSERTS IF THE REFERENCE STANDARD HAS FIBERGLASS SKINS. PUT INSERTS BETWEEN P13 AND P14 AND BETWEEN P14 AND P15.
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.



XXX-DEL-XXXX SERIES REFERENCE STANDARD

Reference Standards
Figure 1 (Sheet 2 of 5)

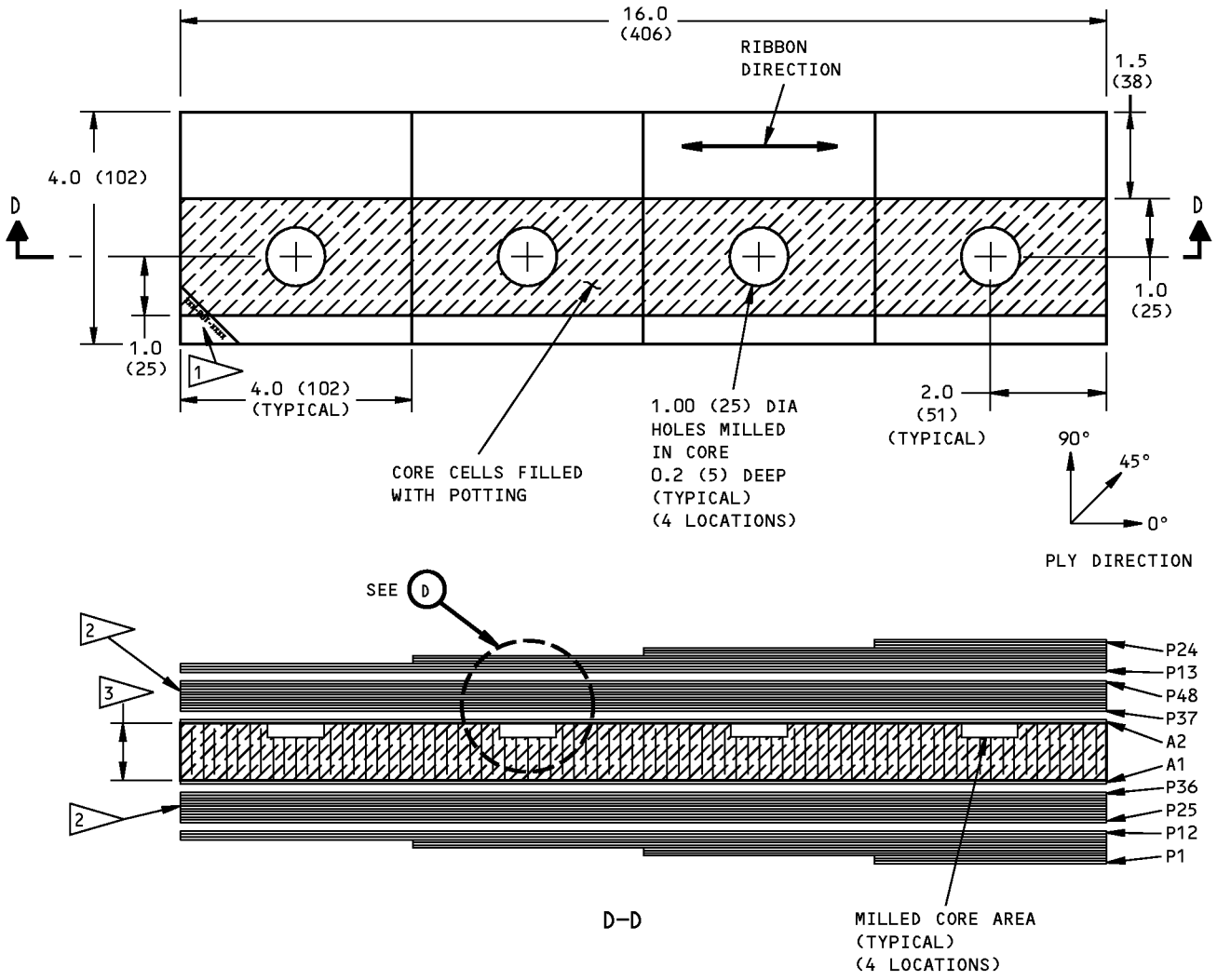


NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE AREAS FOR THIS REFERENCE STANDARD THAT WILL CAUSE INDICATIONS DURING CALIBRATION:
  1. POT AND SPLICE THE HONEYCOMB CORE. CURE THE CORE.
  2. SECONDARY BOND THE PRE-CURED SKINS TO THE CORE.
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.

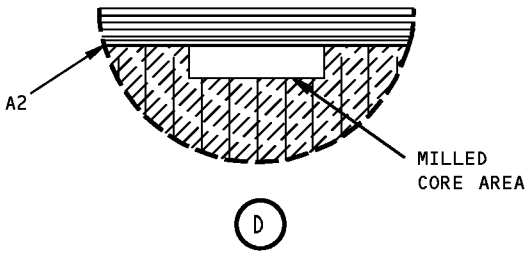
XXX-PCS-XXXX REFERENCE STANDARD

Reference Standards
Figure 1 (Sheet 3 of 5)



NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- HOW TO MAKE THE DEFECTS FOR THIS REFERENCE STANDARD:
  1. POT THE HONEYCOMB CORE. CURE THE CORE.
  2. MILL 1.0 (25) DIAMETER HOLES IN THE POTTED AREA IN THE CORE TO A DEPTH OF 0.2 (5).
  3. SECONDARY BOND THE MILLED CORE TO THE PRE-CURED SKINS. MAKE SURE THAT THE MILLED SIDE OF THE CORE IS ON THE TOOL (SO THE ADHESIVE FILM STAYS AGAINST THE SKIN).
- SEE FIGURE 1 (SHEET 5) FOR INSTRUCTIONS ABOUT HOW TO MAKE THIS REFERENCE STANDARD.



XXX-POT-XXXX SERIES REFERENCE STANDARD

Reference Standards
Figure 1 (Sheet 4 of 5)

PROCEDURE TO MAKE THE REFERENCE STANDARDS:

CORE

1. Identify your core properties (see Fig. 2).
2. Get the correct core material (see Fig. 3).
3. Cut the core to the correct dimensions (see Fig. 4).
4. Prepare and cure the core if necessary (see Fig. 1).

SKINS

1. Identify your skin properties (see Fig. 2).
2. Get the correct skin material (see Fig. 3).
3. Cut the plies to the correct dimensions (see Fig. 4).
4. Cut two peel ply layers (see Fig. 4).
5. Lay up the plies and peel ply for the upper and the lower skins (note, for XXX-DEL-XXXX reference standards, see Fig. 1, Sheet 2 for insert locations).
6. Cure the two skin assemblies on a stepped tool with a vacuum bag. Use an oven (recommended) or heat blankets. 5

SKIN-TO-CORE ASSEMBLY

1. Get the correct adhesive film (see Fig. 3).
2. Cut two adhesive layers A1 and A2 (see Fig. 4).
3. Remove the peel ply from the skins.
4. Secondary bond the skins to the core. Use a stepped tool and a vacuum bag.
5. After the assembly is cured, put a 0.50 inch (13 mm) by 0.50 inch (13 mm) square of foam tape on each step of the reference standard. The tape is used as an attenuation reference during the ultrasonic inspection. 6
6. Do an ultrasonic inspection of the honeycomb sandwich assembly. See Fig. 6 for the acceptance limits.

NOTES

A = Adhesive Film
P = Plies

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCES:

INCHES	MILLIMETERS
X.XX = ±0.025	X.X = ±0.5
X.X = ±0.050	X = ±1.0

1 LABEL EACH REFERENCE STANDARD WITH THE CORRECT CODE AS SPECIFIED IN FIG. 2.

2 ADD THESE EXTRA PLIES FOR X24-XXX-XXXX SERIES REFERENCE STANDARDS ONLY.

3 MAKE A SELECTION OF THE CORE DEPTH FROM FIG. 2.

4 YOU CAN GET 0.010 (0.25) GRAPHITE FOIL FROM:

- EGC INTERPRISES INC.
  7315 INDUSTRIAL PARKWAY
  MENTOR, OHIO 44060, U.S.A.
  TEL. 800-324-0211

(ASK FOR GTB SHEET MATERIAL)

5 IT IS RECOMMENDED THAT YOU USE THE COATED FIBERGLASS RELEASE FILM ON THE TOOL IF YOU MAKE FIBERGLASS REFERENCE STANDARDS. YOU CAN GET THIS FILM FROM:

- AIRTECH INTERNATIONAL
  2542 EAST DEL AMO BLVD
  P.O. BOX 6207
  CARSON, CA 90749
  PHONE: (213) 603-9683
  PRODUCT NAME: A012
- CHEMFAB
  HI-TEMP MATERIALS GROUP
  509 EAST STATE PARKWAY
  SCHAUMBURG, IL 60173
  PHONE: (708) 490-9800
  PRODUCT NAME: 350-10S

6 USE VINYL FOAM TAPE, PART NUMBER 4416, MADE BY THE 3M COMPANY, OR AN EQUIVALENT TAPE THAT DOES NOT TRANSMIT ULTRASOUND.

MANUFACTURING PROCEDURE FOR THE REPAIR REFERENCE STANDARD

Reference Standards
Figure 1 (Sheet 5 of 5)

PROPERTY	AVAILABLE OPTIONS (CHOOSE ONE)	IDENTIFICATION CODE
SKIN MATERIAL	CARBON	C
	FIBERGLASS	F
SKIN THICKNESS	3,6,9 AND 12 PLIES	12
	15,18,21 AND 24 PLIES	24
INDICATION GENERATOR	SKIN-TO-CORE DISBONDS	DIS
	INTERPLY DELAMINATIONS	DEL
	POTTING AND CORE SPLICE	PCS
	SKIN-TO-POTTING DISBONDS	POT
CORE DENSITY (GRADE)	2.0 LBS (GRADE 2.0)	2
	3.0 LBS (GRADE 3.0)	3
	4.0 LBS (GRADE 4.0)	4
	5.0 LBS (GRADE 5.0)	5
	6.0 LBS (GRADE 6.0)	6
	9.0 LBS (GRADE 9.0)	9
	12.0 LBS (GRADE 12.0)	12
CORE DEPTH	0.25 INCH	A
	0.5 INCH	B
	1 INCH	C
	1.5 INCH	D
	2 INCH	E
	2.5 INCH	F
	3 INCH	G
CORE CELL SIZE (TYPE)	0.125 (TYPE V)	1
	0.187 (TYPE I)	2
	0.25 (TYPE II)	3
CORE MATERIAL (CLASS)	NOMEX (CLASS 4)	N
	GLASS REINFORCED (CLASS 1)	G

EXAMPLE: PART NUMBER C12-DEL-3C2N IS A 3 PLY TO 12 PLY INTERPLY DELAMINATION REFERENCE STANDARD WITH 3.0 LB DENSITY, 1 INCH THICK CORE. THE SKIN IS MADE OF CARBON MATERIAL. THE CORE IS NOMEX AND HAS A CELL SIZE OF 0.187.

Reference Standard Options
Figure 2

MATERIAL	BOEING SPECIFICATION
CARBON SKIN FIBERGLASS SKIN	BMS 8-256, TYPE IV, CLASS 2, 3K-70-PW (350°F CURE) BMS 8-139, CLASS 1 OR 2, GRADE 2, TYPE 1581 (350°F CURE)
HONEYCOMB CORE	BMS 8-124 (SEE FIG. 2 FOR GRADE TYPE AND CLASS)
ADHESIVE FILM	BMS 5-129, GRADE 5 (250°F CURE) BMS 8-245, GRADE 3 (250°F CURE). FIBERGLASS STEP WEDGES ONLY 1
PEEL PLY (DRY)	BURLEASE CODE 51789 (BURLINGTON CO.) OR EQUIVALENT
POTTING	BMS 5-28, TYPE 7
CORE SPLICE	BMS 5-90, TYPE III, CLASS 250, GRADE 100

1 BMS 8-245 MAKES A SATISFACTORY BOND IF YOU CURE IT AT 250°F (121°C) AS SPECIFIED IN THE STRUCTURAL REPAIR MANUAL SECTION FOR GLASS FABRIC 250°F CURE REPAIRS. USE BMS 8-245 BECAUSE IT WILL NOT BLEED THROUGH THE FIBERGLASS SKINS.

Material Specifications
Figure 3

PLY NUMBER	CUT SIZE (BEFORE CURE)	TRIMMED SIZE (AFTER CURE)	PLY DIRECTION
P1,P3	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	0 OR 90 DEGREES
P2	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	+ OR - 45 DEGREES
P4,P6	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	+ OR - 45 DEGREES
P5	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	0 OR 90 DEGREES
P7,P9	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	0 OR 90 DEGREES
P8	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	+ OR - 45 DEGREES
P10,P12	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P11	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
P13,P15	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P14	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
P16,P18	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	0 OR 90 DEGREES
P17	6.0 (152) X 13.0 (330)	4.0 (102) X 12.0 (305)	+ OR - 45 DEGREES
P19,P21	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	+ OR - 45 DEGREES
P20	6.0 (152) X 9.0 (229)	4.0 (102) X 8.0 (203)	0 OR 90 DEGREES
P22,P24	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	0 OR 90 DEGREES
P23	6.0 (152) X 5.0 (127)	4.0 (102) X 4.0 (102)	+ OR - 45 DEGREES
P25,P27,P29,P31,P33,P35	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
P26,P28,P30,P32,P34,P36	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P37,P39,P41,P43,P45,P47	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	+ OR - 45 DEGREES
P38,P40,P42,P44,P46,P48	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	0 OR 90 DEGREES
A1,A2	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	N.A.
PEEL PLY	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	N.A.
HONEYCOMB CORE	6.0 (152) X 18.0 (457)	4.0 (102) X 16.0 (406)	N.A.

NOTE: N.A. = NOT APPLICABLE

Adhesive, Core and Ply Dimensions
Figure 4

THIS FIGURE WAS DELETED DURING THE
SEPTEMBER 15, 1996 REVISION

Acceptance Limits for the Ultrasonic Inspection of the Pre-Cured Skins Before the Peel Ply is Removed
Figure 5

REFERENCE STANDARD	ACCEPTANCE LIMITS
XXX-DIS-XXXX	THE ULTRASONIC ATTENUATION OF THE DEFECT AREAS MUST BE AT LEAST 12 dB LARGER THAN THE ATTENUATION OF HONEYCOMB AREAS WITHOUT DEFECTS. 1
XXX-POT-XXXX	THE ULTRASONIC ATTENUATION OF THE DEFECT AREAS MUST BE AT LEAST 6 dB LARGER THAN THE ATTENUATION OF HONEYCOMB AREAS WITHOUT DEFECTS. THE ULTRASONIC ATTENUATION OF THE POTTED AREAS MUST BE AT LEAST 6 dB LESS THAN THE ATTENUATION OF THE ADJACENT HONEYCOMB AREAS WITHOUT DEFECTS. 1
XXX-PCS-XXXX	THE ULTRASONIC ATTENUATION OF THE POTTED AREAS MUST BE AT LEAST 6 dB LESS THAN THE ATTENUATION OF THE ADJACENT HONEYCOMB AREAS WITHOUT DEFECTS. 1
XXX-DEL-XXXX	THE ULTRASONIC ATTENUATION OF THE DEFECT AREAS MUST BE AT LEAST 6 dB LARGER THAN THE ATTENUATION OF THE ADJACENT HONEYCOMB AREAS WITHOUT DEFECTS. 1

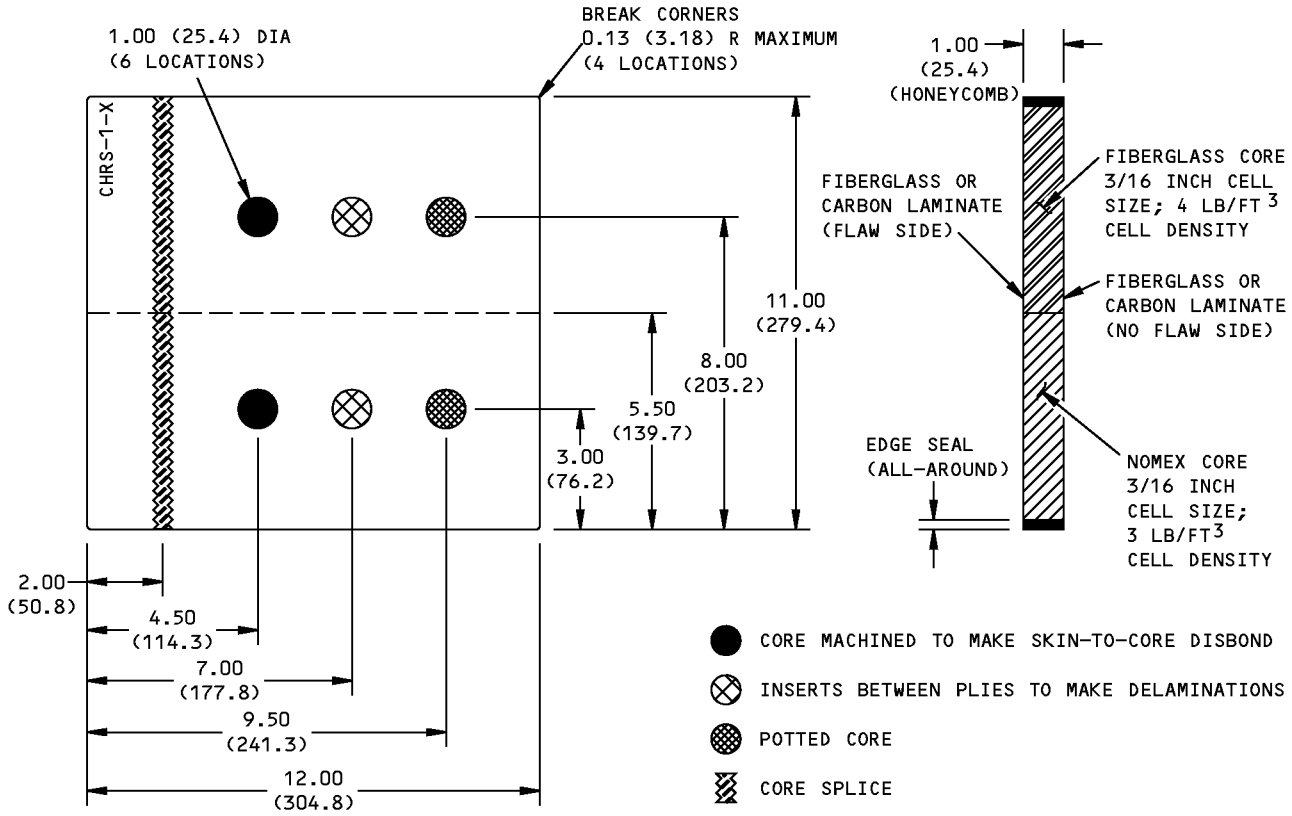
NOTES

THE ULTRASONIC ATTENUATION OF HONEYCOMB AREAS WITHOUT DEFECTS MUST BE AT LEAST 12 dB LESS THAN THE ATTENUATION OF THE FOAM TAPE ON THE REFERENCE STANDARD.

ULTRASONIC INDICATIONS OUTSIDE THE DEFECT AREAS MUST BE NO LARGER THAN 0.50 INCH (13 mm) IN DIAMETER. AN ULTRASONIC INDICATION IS AN AREA WITH ULTRASONIC ATTENUATION THAT IS AT LEAST 6 dB LARGER THAN THE ATTENUATION OF THE ADJACENT AREAS WITHOUT DEFECTS.

1 USE A 1 MHz THROUGH-TRANSMISSION ULTRASONIC INSPECTION SYSTEM.

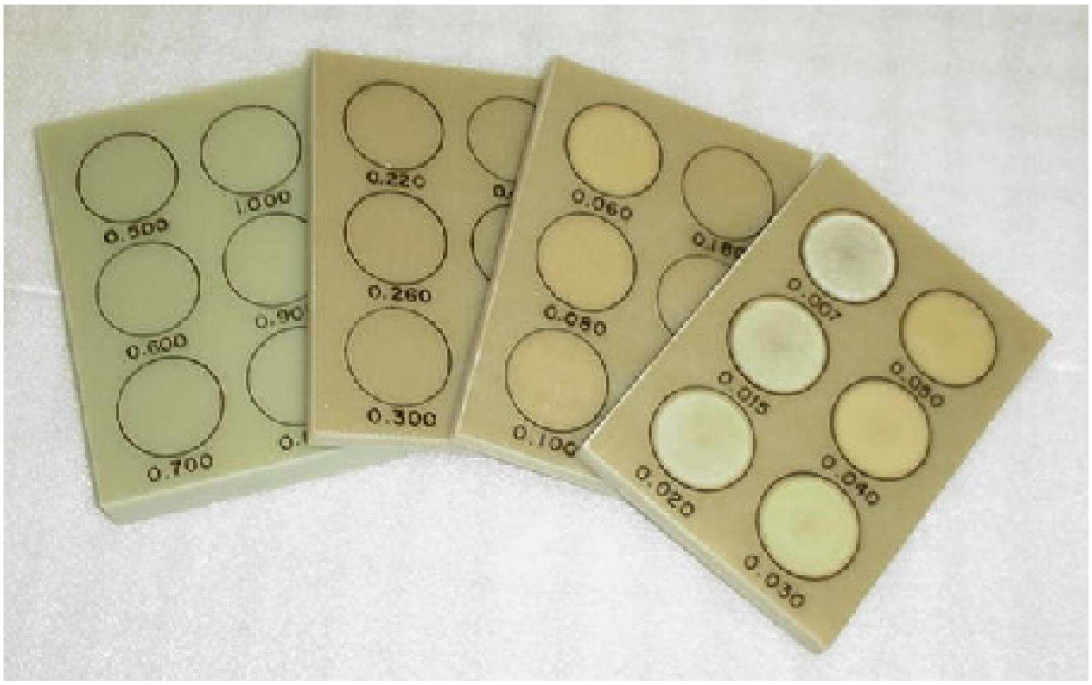
Acceptance Limits for the Ultrasonic Inspection of the Reference Standards
Figure 6



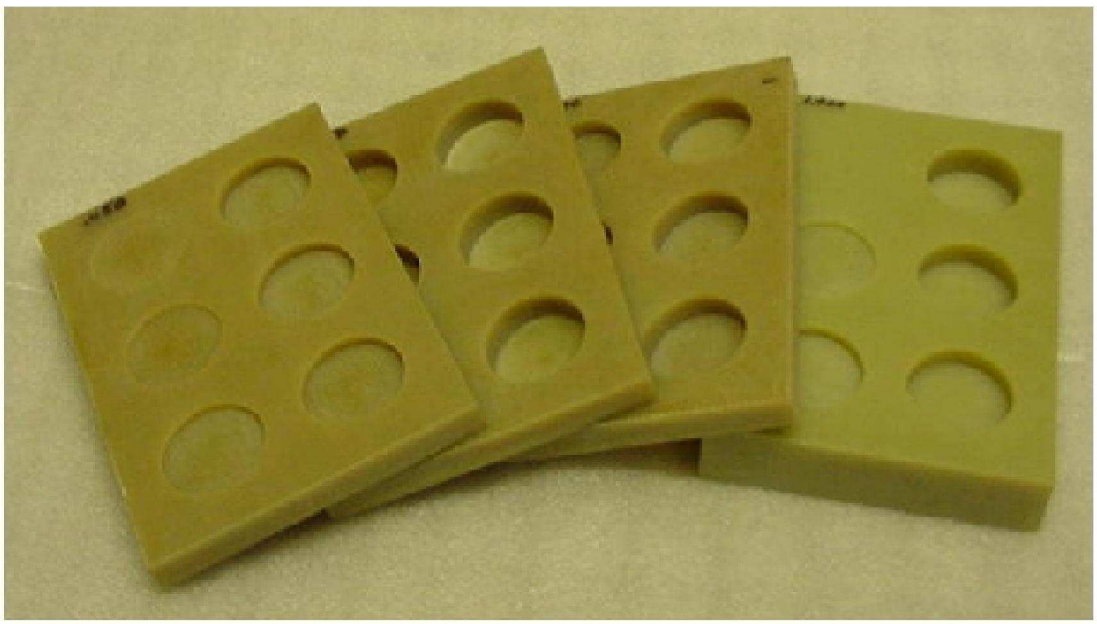
NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES).
- THERE ARE FOUR SPECIMENS MADE WITH THIS DESIGN, EACH WITH A DIFFERENT SKIN THICKNESS. THE NUMBER OF PLIES FOR THE DIFFERENT SKIN THICKNESSES ARE 3, 6, 9 AND 12. ONE SIDE WILL CONTAIN FLAW INSERTS AND THE OTHER SIDE WILL HAVE NO FLAWS
- REFERENCE STANDARDS ARE AVAILABLE WITH CARBON SKINS OR FIBERGLASS SKINS

CACRC Composite Honeycomb Reference Standards
Figure 7

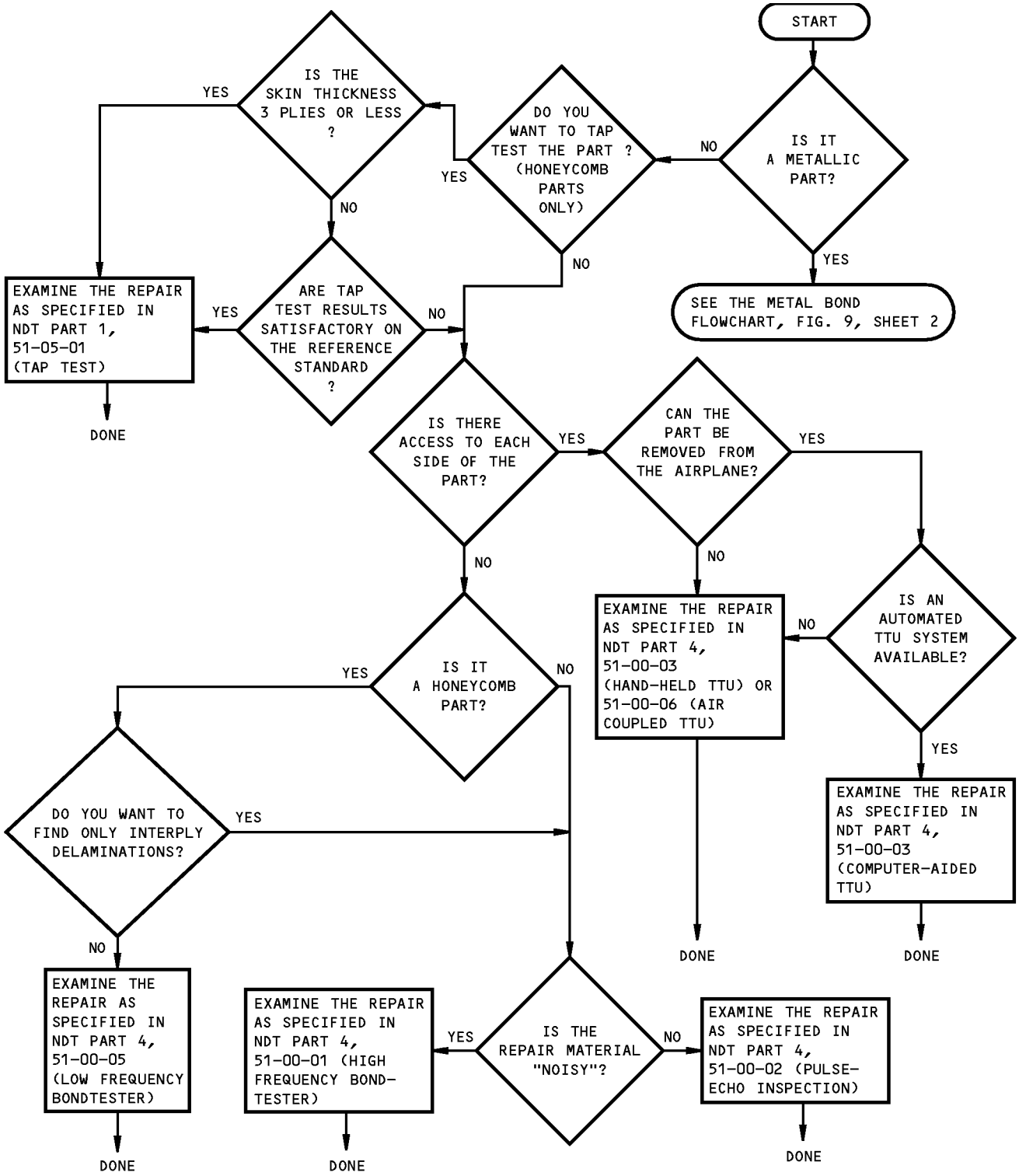


FRONT SIDE

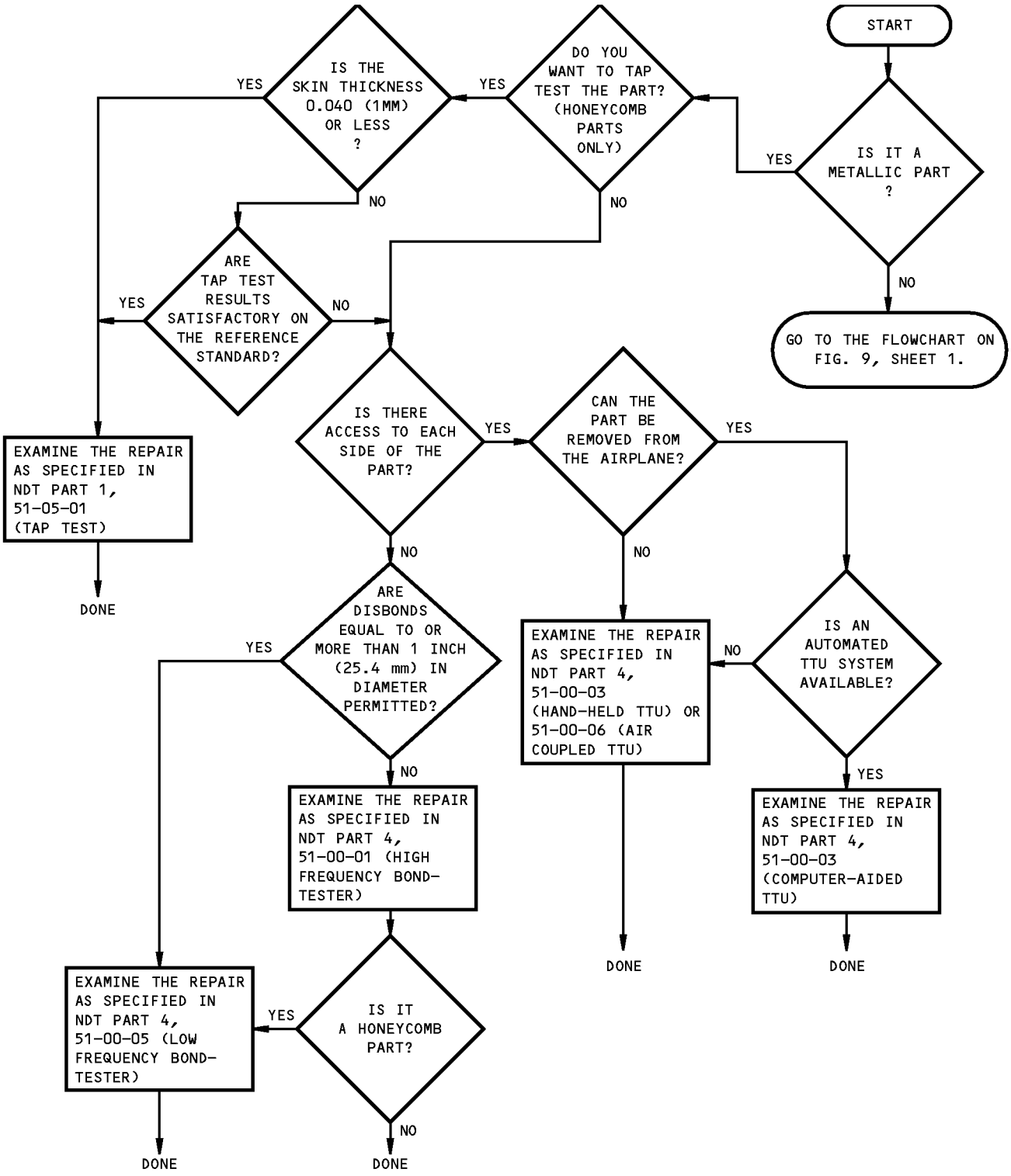


BACK SIDE

CACRC Composite Laminate Reference Standards
Figure 8



Repair Inspection Flowchart
Figure 9 (Sheet 1 of 2)



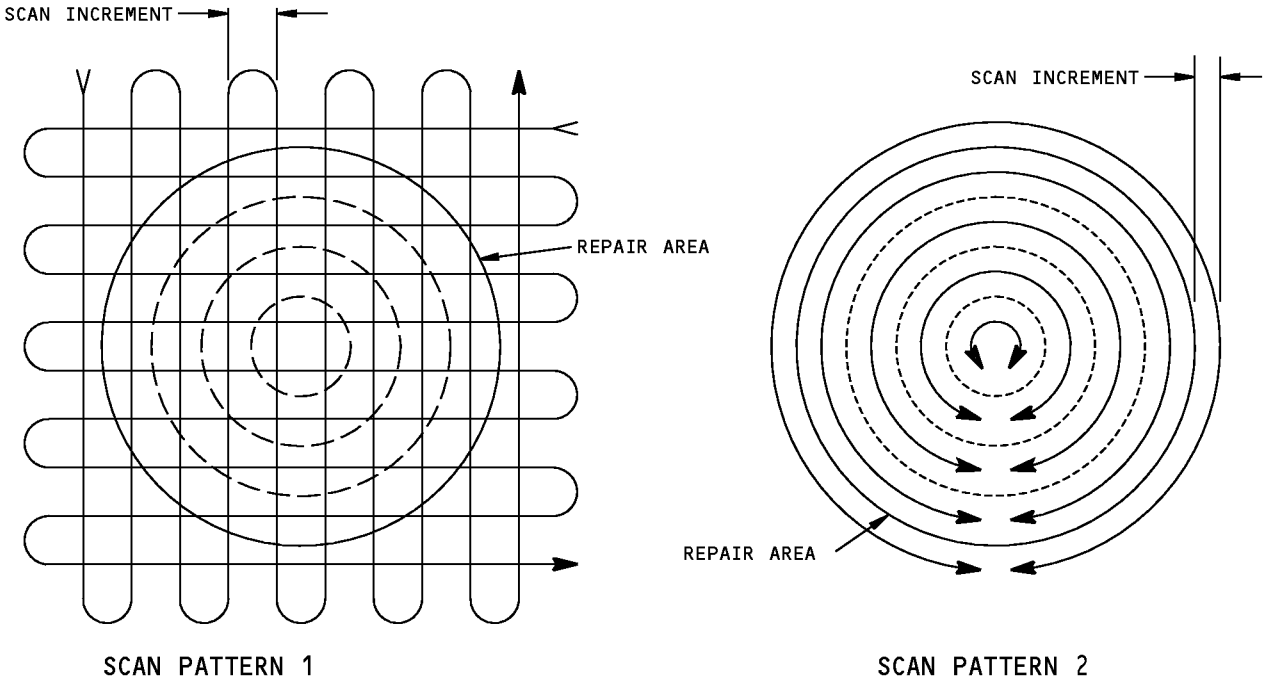
Repair Inspection Flowchart
Figure 9 (Sheet 2 of 2)

INSPECTION PROCEDURE	CALIBRATION DEFECT DIAMETERS 1	
	METAL AND NON-METAL LAMINATES (DELAMINATION)	METAL AND NON-METAL HONEYCOMB SANDWICH (SKIN-TO-CORE DISBOND)
THROUGH-TRANSMISSION ULTRASONIC	0.50 INCH (12.7 mm)	0.50 INCH (12.7 mm)
LOW FREQUENCY BONDTESTER (NO COUPLANT)	1.00 INCH (25.4 mm)	1.00 INCH (25.4 mm)
HIGH FREQUENCY BONDTESTER (COUPLANT)	0.50 INCH (12.7 mm)	NOT RECOMMENDED
PULSE-ECHO ULTRASONIC	0.50 INCH (12.7 mm)	NOT RECOMMENDED
TAP TEST	NOT RECOMMENDED	1.00 INCH (25.4 mm) 2

1 THESE ARE THE DEFECT DIAMETERS TO BE USED FOR CALIBRATION. THEY ARE NOT ACCEPTANCE LIMITS. REFER TO THE STRUCTURAL REPAIR MANUAL (SRM) OR YOUR ENGINEERING GROUP FOR ACCEPTANCE LIMITS FOR REPAIRS.

2 REFERENCE STANDARDS ARE NOT NECESSARY WHEN THE SKIN THICKNESS IS LESS THAN OR EQUAL TO 3 PLIES FOR NONMETALLIC STRUCTURE OR LESS THAN OR EQUAL TO 0.040 INCH FOR METALLIC STRUCTURE. REFER TO NDT PART 1, 51-05-01 FOR TAP TEST REFERENCE STANDARD DATA.

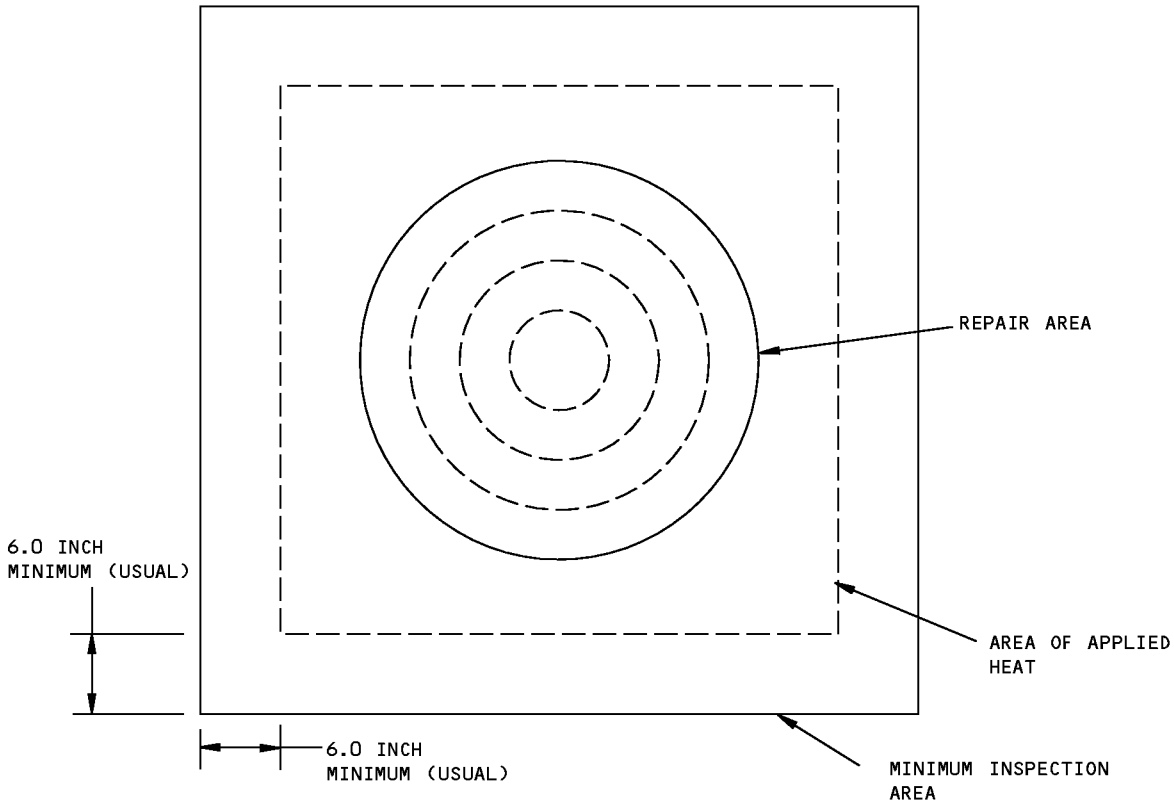
Calibration Defect Diameters for the Inspection of Repairs
Figure 10



NOTES:

- Use scan pattern 1 for inspection with through-transmission or low-frequency bondtest equipment.
- Use scan pattern 2 for inspection with pulse-echo or high-frequency bondtest equipment.
- Use a scan increment that is one-third of the defect diameter.

Scan Patterns
Figure 11



Inspection Area
Figure 12

NDT EXAMINATION OF COMPOSITE STRUCTURE FOR IMPACT DAMAGE

1. Introduction

A. This procedure provides general NDT procedures to determine the presence and extent of impact damage.

B. There are four methods used to detect the degree of damage to graphite/epoxy structures.

(1) Visual -- the areas are visually inspected for obvious physical damage.

(2) Pulse-Echo Ultrasonics -- the laminate and skin-over-core are inspected by pulse-echo ultrasonics for delaminations occurring between the plies.

(3) Bondtest Ultrasonics -- skin-to-core bond integrity is inspected with the use of bondtesters.

(4) Radiography -- X-ray is used to detect damage to internal structure.

2. Preparation for Inspection

A. Identify impact damaged areas.

(1) A thorough visual examination will find the obvious surface damage which occurs with impact damage (see Figure 1). This damage can be defined as:

(a) Cracked, crazed and chipped paint.

(b) Indentations on structure surface.

(c) Cracked or fractured plies.

(d) Partial loss of ply build-up.

(e) Total ply loss showing internal damage to honeycomb core structure.

(2) Examine surface area of part for discrepant conditions as defined in Paragraph 2.A.(1).

(3) Mark areas noted in Paragraph 2.A.(2) on part.

B. Part preparation instructions are given in the referenced procedures used in the investigative process.

3. Inspection Methods

A. Pulse-Echo Ultrasonics

(1) Pulse-echo ultrasonics will detect interply delamination in laminates and skin-over-core where access conditions for inspection are limited to a single side.

(2) See Part 4, 51-00-02, "Inspection of Laminated Structures" for a general inspection procedure of solid laminates and skin-over-core up to 0.250-inch thick.

(3) Include in pulse-echo inspection coverage, 5.0 inches of assumed good structure around each discrepant area noted in Paragraph 2.A.(3). Inspect by sliding the transducer from good area into discrepant area. If discrepant area is found to be larger than previously noted, determine new boundary and mark part. Re-inspect until a 5.0-inch good area is encountered around discrepant area.

B. Bondtest Ultrasonics

(1) Bondtesters can detect skin-to-core disbonds where access conditions for inspection are limited to a single side.

(2) See Part 4, 51-00-05, "Bondline Delamination Inspection in Honeycomb Structure," for a general inspection procedure of honeycomb structure.

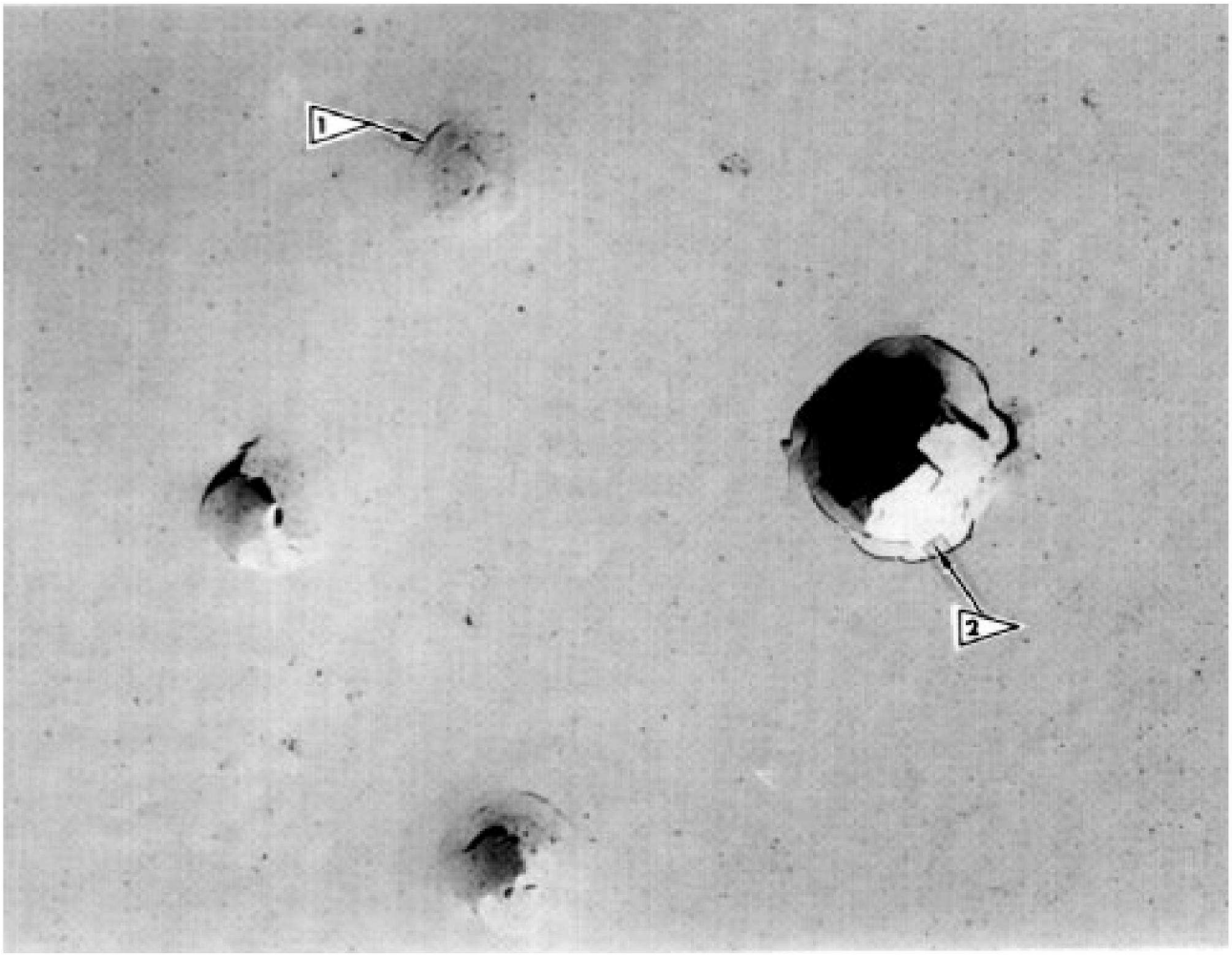
(3) Include in bondtest inspection coverage, 5.0 inches of assumed good structure around each discrepant area noted in Paragraph 3.A.(3). Inspect by sliding the probe from good area into discrepant area excluding any area found to have interply delaminations. If discrepant area is found to be larger than previously noted, determine new boundary and mark part. Re-inspect until a 5.0 inch good area is encountered around discrepant area.

C. Radiography

(1) X-ray of composite structure can detect broken structure when there is a displacement of internal members, the presence of water in honeycomb, and crushed or damaged core.

(2) See Part 2, 51-00-02, "Subsurface Fracture in Composite Structure," Part 2, 51-00-01, "X-Ray Inspection for Water in Honeycomb Structure," Part 2, 51-00-03, "Inspection of Honeycomb Structure," for general X-ray inspection procedures.

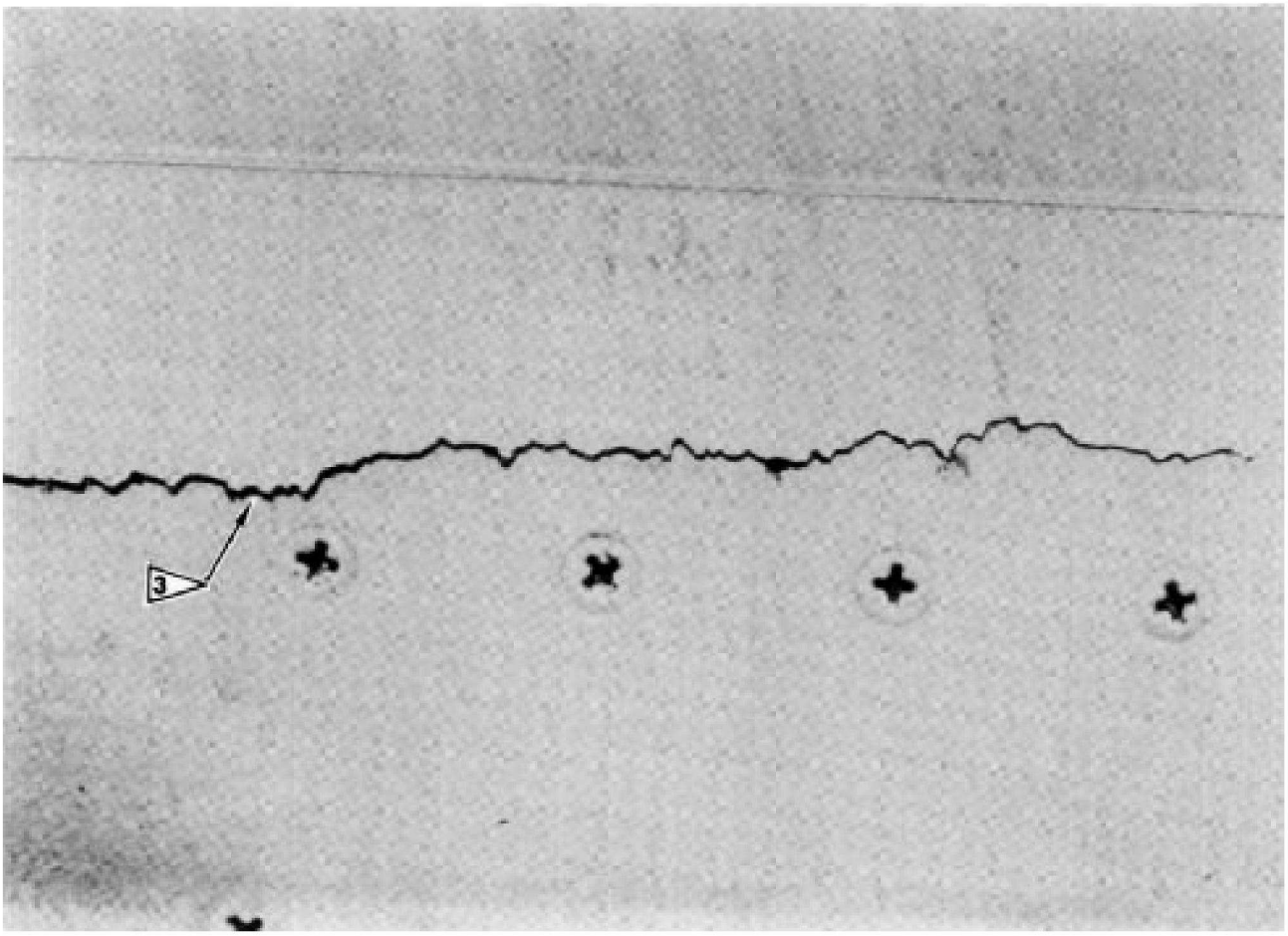
(3) Include in X-ray inspection coverage 5.0 inches of assumed good structure around each discrepant area noted in Paragraph 3.B.(3). If discrepant area is found to be larger than previously noted, determine new boundary and mark part. Re-inspect until a 5.0 inch good area is encountered around discrepant area.



NOTES

1. CRACKED, CRAZED AND CHIPPED PAINT
2. INDENTATIONS ON STRUCTURE SURFACE

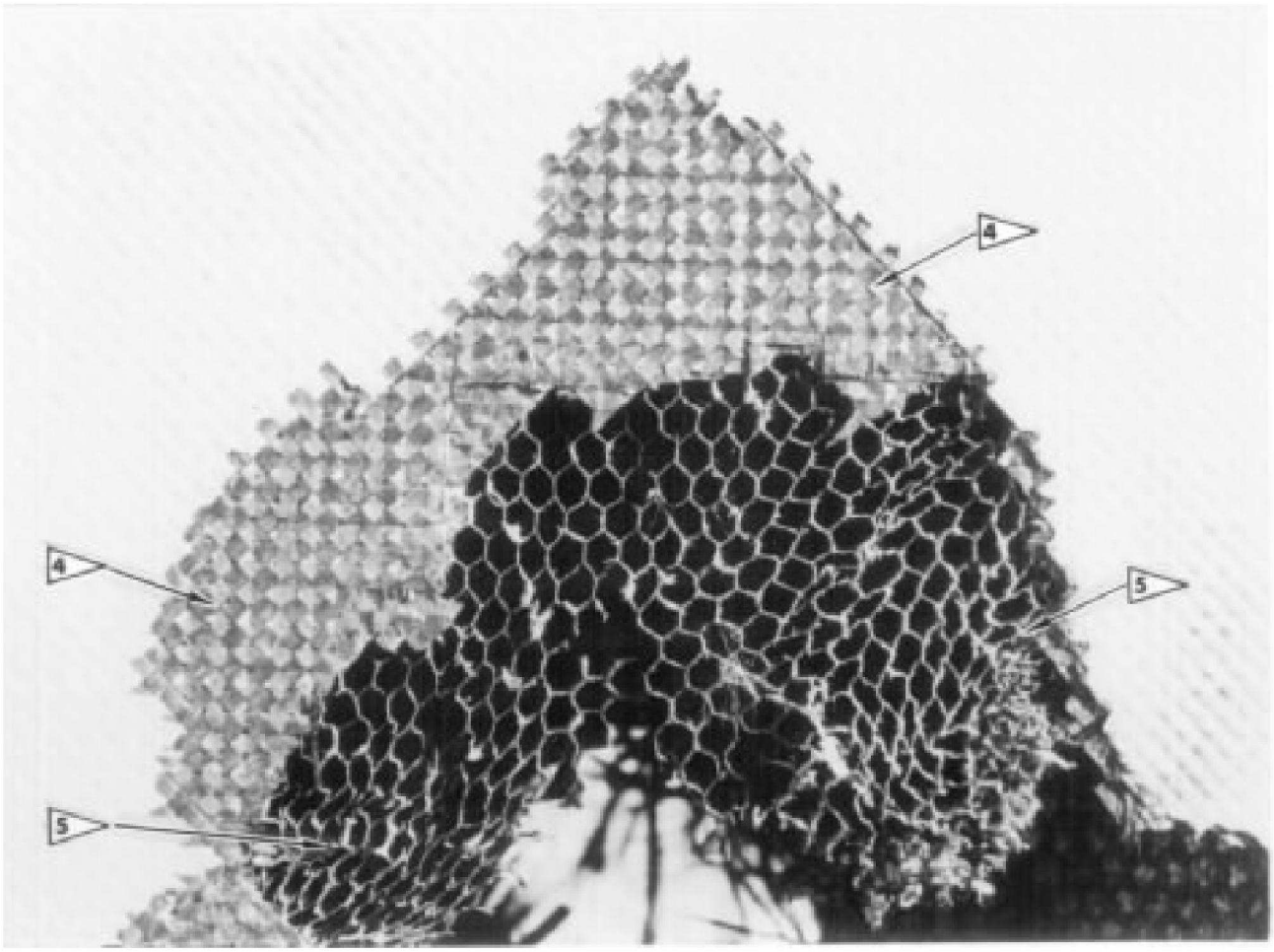
Typical Impact Damage
Figure 1 (Sheet 1 of 3)



NOTES

3 CRACKED OR FRACTURED PLIES

Typical Impact Damage
Figure 1 (Sheet 2 of 3)



NOTES

4 PARTIAL LOSS OF PLY BUILD-UP

5 TOTAL PLY LOSS SHOWING INTERNAL DAMAGE TO HONEYCOMB STRUCTURE

Typical Impact Damage
Figure 1 (Sheet 3 of 3)

NDT EXAMINATION OF COMPOSITE STRUCTURE FOR LIGHTNING STRIKE DAMAGE

1. Introduction

A. This procedure provides general NDT procedures to determine the presence and extent of lightning strike damage.

B. There are four methods used to detect the degree of damage to graphite/epoxy structures.

(1) Visual -- The areas are visually inspected for obvious physical damage.

(2) Pulse-Echo Ultrasonics -- The laminate and skin-over-core are inspected by pulse-echo ultrasonics for delaminations occurring between the plies.

(3) Bondtest Ultrasonics -- Skin-to-core bond integrity is inspected by the use of bondtesters.

(4) Radiography -- X-ray is used to detect damage to internal structure.

2. Preparation for Inspection

A. Identify lightning strike damaged areas.

(1) A thorough visual examination will find the characteristic surface damage which occurs during lightning strike (see Figure 1). This damage can be defined as:

(a) Blistered, chipped, scorched and discolored paint.

(b) Frayed fibers, particularly around metal attachments and fasteners. Damaged fasteners may show pull-through.

(c) Noticeable delaminations where plies are pulled away from surface of part.

(d) Partial loss of ply build-up.

(e) Total ply loss showing internal damage to honeycomb core structure.

(2) Examine surface area of part for discrepant conditions as defined Paragraph 2.A.(1).

NOTE: Note lightning strike entry and exit points. Pay particular attention to composite structure around metal fittings, attachments and fasteners in general path between lightning entry and exit points.

(3) Mark areas noted in Paragraph 2.A.(2) on part.

B. Part preparation instructions are given in specific procedures used in the investigative process.

3. Inspection Methods

A. Pulse-Echo Ultrasonics

(1) Pulse-echo ultrasonics will detect interply delaminations in laminates and skin-over-core where access conditions for inspection are limited to a single side.

(2) See Part 4, 51-00-02, "Inspection of Laminated Structures" for a general inspection procedure of solid laminates and skin-over-core up to 0.250-inch thick.

(3) Include in pulse-echo inspection coverage 5.0 inches of assumed good structure around each discrepant area noted in Paragraph 2.A.(3) and around all metal fittings and attachments on part. Inspect by sliding the transducer from good area into discrepant area. If discrepant area is found to be larger than previously noted, determine new boundary and mark part. Re-inspect until a 5.0-inch good area is encountered around discrepant area.

B. Bondtest Ultrasonics

(1) Bondtesters can detect skin-to-core disbonds where access conditions for inspection are limited to a single side.

(2) See Part 4, 51-00-05, "Bondline Delamination Inspection in Honeycomb Structure," for a general inspection procedure of honeycomb structure.

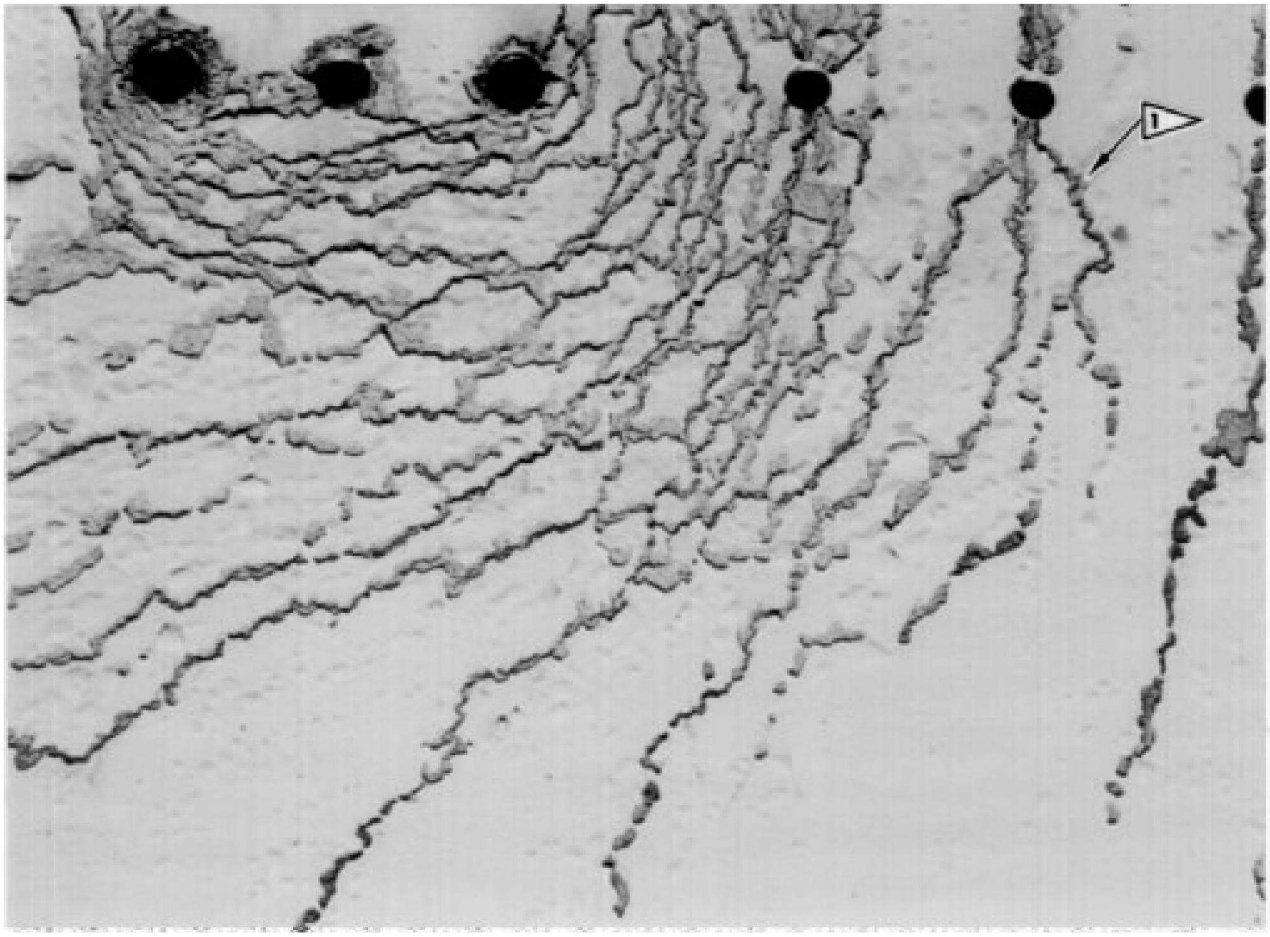
(3) Include in bondtest inspection coverage, 5.0 inches of assumed good structure around each discrepant area noted in Paragraph 3.A.(3). Inspect by sliding the probe from good area into discrepant area excluding any area found to have interply delaminations. If discrepant area is found to be larger than previously noted, determine new boundary and mark part. Re-inspect until a 5.0-inch good area is encountered around discrepant area.

C. Radiography

(1) X-ray of composite structure can detect broken structure when there is a displacement of internal members, the presence of water in honeycomb, and crushed or damaged core.

(2) See Part 2, 51-00-02, "Subsurface Fracture in Composite Structure," Part 2, 51-00-01, "X-Ray Inspection for Water in Honeycomb Structure," Part 2, 51-00-03, "Inspection of Honeycomb Structure," for general X-ray inspection procedures.

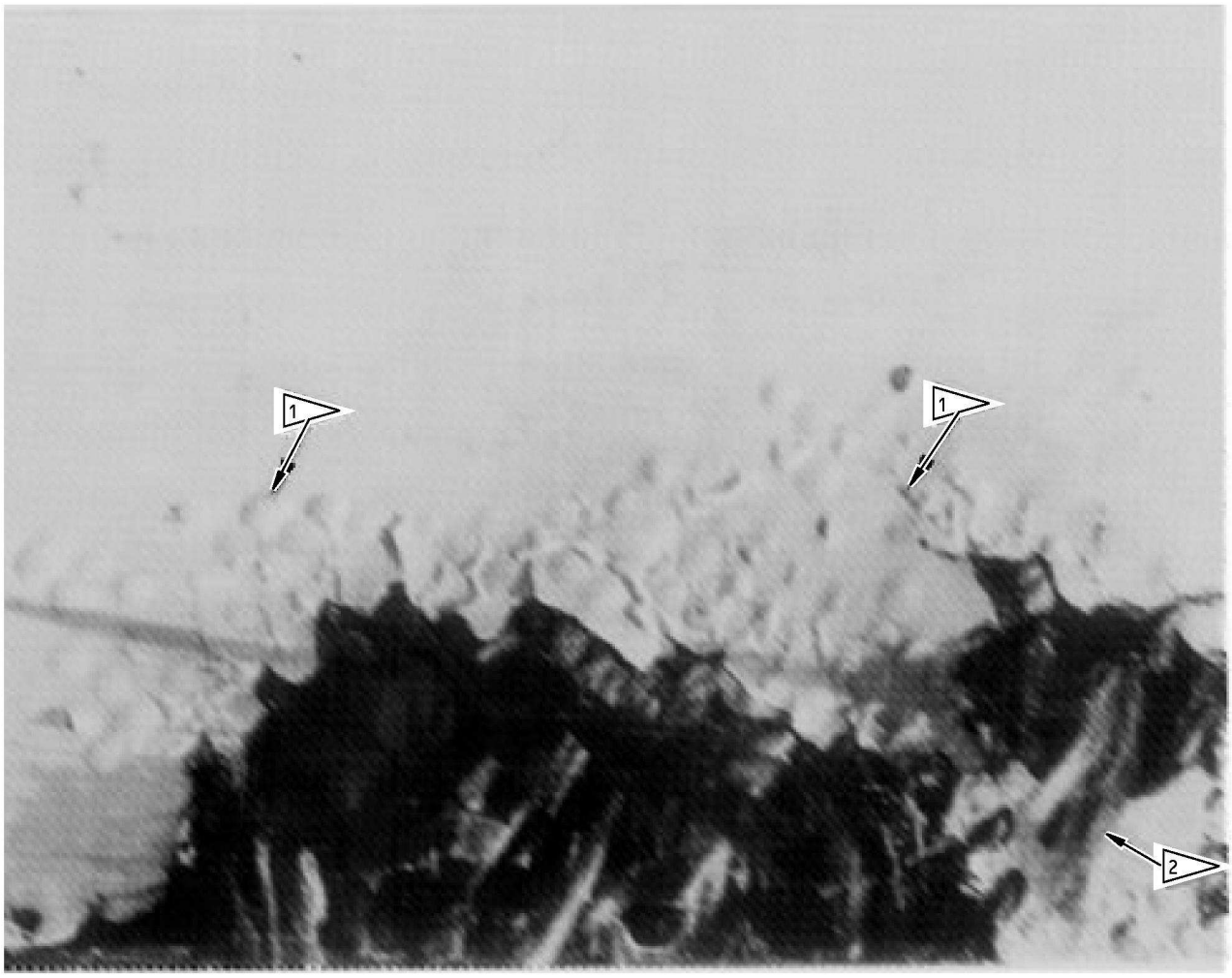
(3) Include in X-ray inspection coverage, 5.0 inches of assumed good structure around each discrepant area noted in Paragraph 3.B.(3). If discrepant area is found to be larger than previously noted, determine new boundary and mark part. Re-inspect until a 5.0-inch good area is encountered around discrepant area.



NOTES

1 BLISTERED, CHIPPED, SCORCHED AND DISCOLORED PAINT

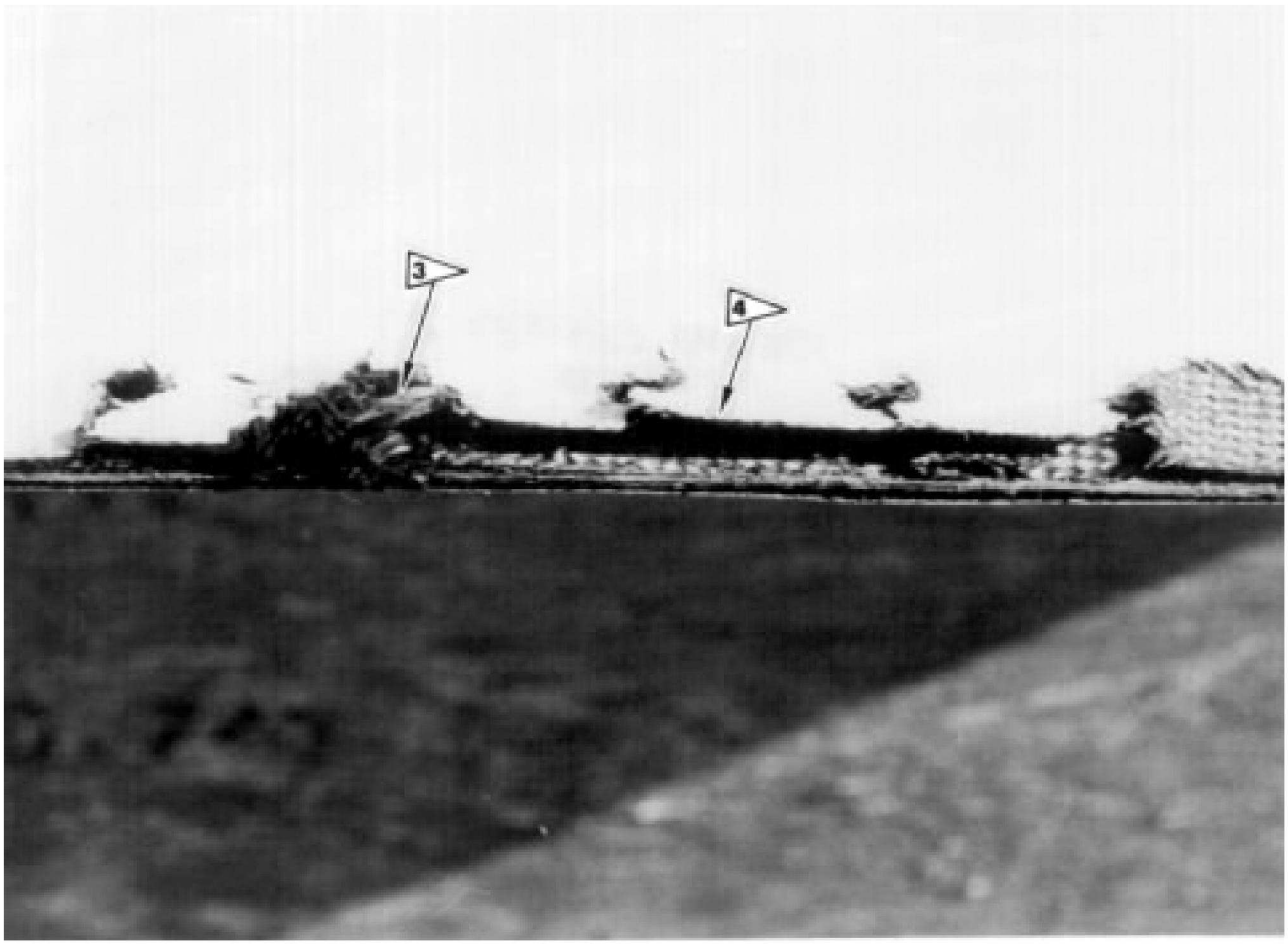
Typical Lightning Strike Damage
Figure 1 (Sheet 1 of 4)



NOTES

2 FRAYED FIBERS

Typical Lightning Strike Damage
Figure 1 (Sheet 2 of 4)

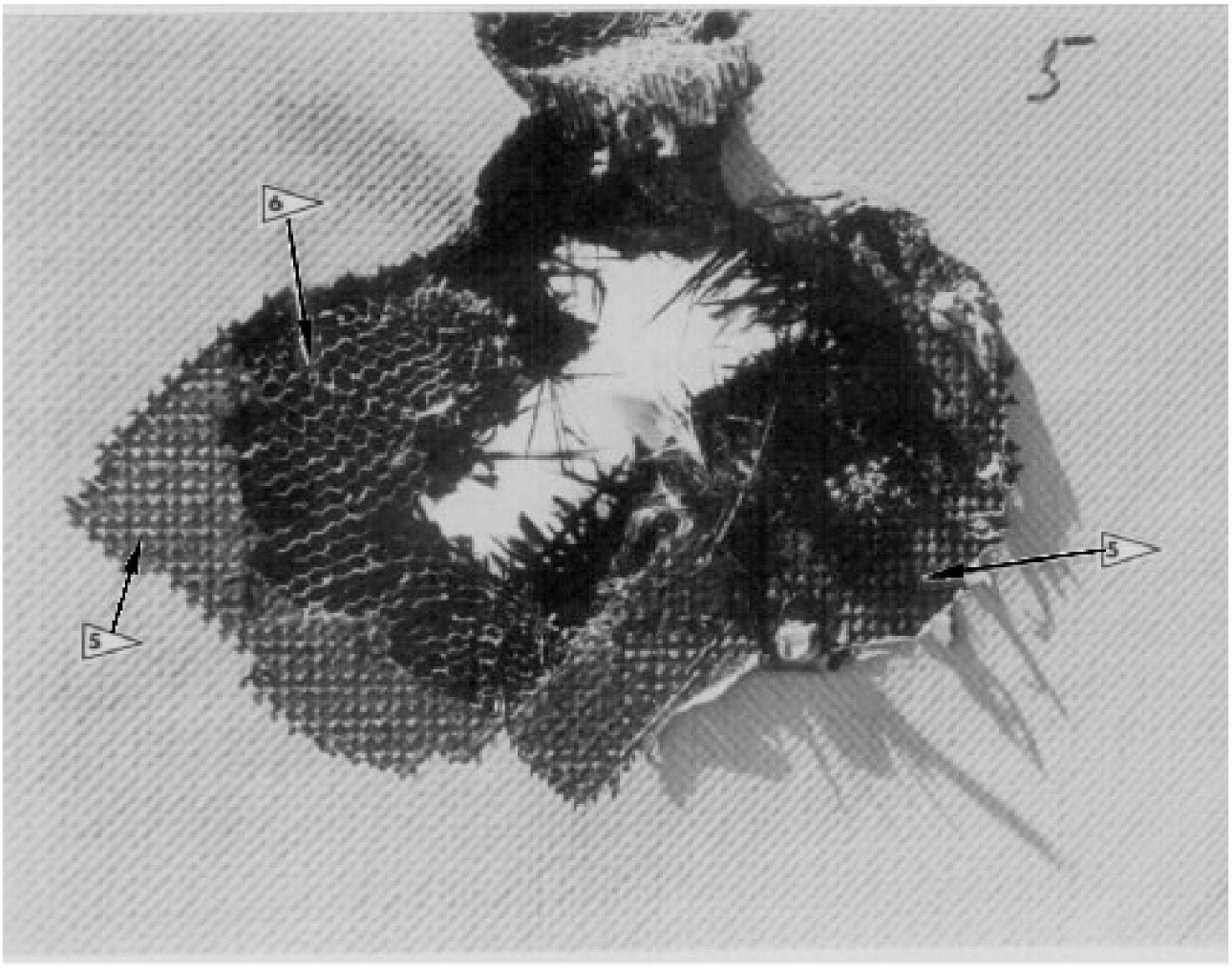


NOTES

3 FRAYED FIBERS AROUND METAL FASTENERS

4 NOTICEABLE DELAMINATIONS WHERE PLIES ARE PULLED AWAY FROM SURFACE OF PART

Typical Lightning Strike Damage
Figure 1 (Sheet 3 of 4)



NOTES

5 PARTIAL LOSS OF PLY BUILD-UP

6 TOTAL PLY LOSS SHOWING INTERNAL DAMAGE TO HONEYCOMB STRUCTURE

Typical Lightning Strike Damage
Figure 1 (Sheet 4 of 4)

INSTALLATION OF RIVETS INTO REFERENCE STANDARDS

1. Purpose

A. Use this procedure to install rivets into the reference standards.

B. This procedure was taken from Boeing Specification BAC5004-1 and the applicable model Structural Repair Manual section on rivet installation. Refer to these documents for more data.

2. Installation of Solid Rivets

A. Use Figure 1 to identify the correct rivet length. To make a selection of the rivet length, use the rivet diameter and the grip length (reference standard stack-up thickness).

B. Solid rivets can be installed with an applicable squeeze-riveting tool or a rivet gun and bucking bar. 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 correct tools for each type of rivet that you install.

(1) Do not over-drive the rivets as this can cause cracks.

(2) If a rivet gun and a bucking bar are used, they must be large enough to drive the rivets quickly. Three to four seconds of drive time is best. Seven seconds is the maximum. It is recommended that bucking bars be very smooth when you install all types of rivets.

3. Inspection of Installed Rivets

A. Do the inspections that follow after you install the rivets.

(1) Measure the button dimensions as shown in Figure 2.

(a) Out-of-round and tipped rivet buttons are permitted if the hole is visible. See Figure 2, Detail I for an example of a clinched rivet.

(b) Clinched or bent-over buttons are not permitted if the hole is visible. See Figure 2, Detail I for an example of a clinched rivet.

(c) Bell-shaped buttons are caused by incomplete driving and are not permitted. See Figure 2, Detail II for an example of a bell-shaped button.

(2) Examine the rivet heads and buttons to make sure there are no cracks.

(a) A deformed manufactured head caused by the die is permitted if there are no sharp discontinuities in the deformed surface.

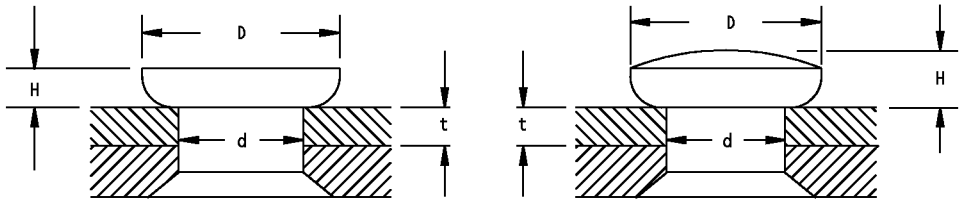
(3) Look for gaps under the rivet heads as shown in Figure 3.

B. Remove rivets that do not meet the conditions specified in Paragraph 3.A. and install new rivets.

GRIP (T) RANGES FOR RIVET LENGTHS AND DIAMETERS							RIVET LENGTH L	
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	SIZE	DASH NO.
0.035							3/16	-3
0.036 0.093	0.068						1/4	-4
0.094 0.152	0.069 0.127	0.107	0.078	0.058			5/16	-5
0.153 0.211	0.128 0.185	0.108 0.166	0.079 0.136	0.059 0.117	0.087	0.038	3/8	-6
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	7/16	-7
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	1/2	-8
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	9/16	-9
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	5/8	-10
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	11/16	-11
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	3/4	-12
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	13/16	-13
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	7/8	-14

GRIP RANGES AND RECOMMENDED RIVET LENGTHS FOR STANDARD ALUMINUM SOLID RIVETS

Selection of Rivet Lengths
Figure 1

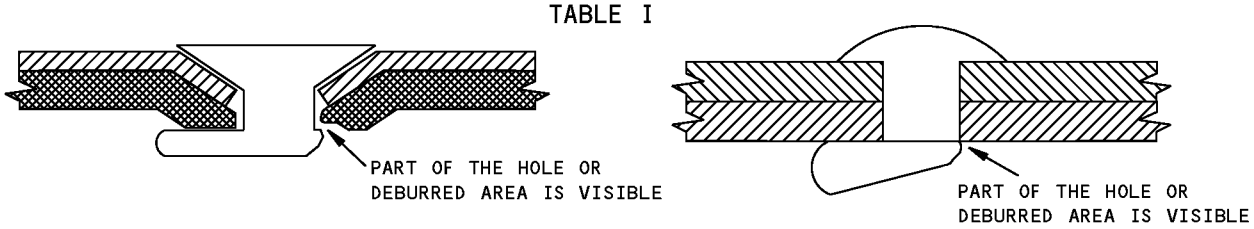


STANDARD FLAT DRIVEN HEAD

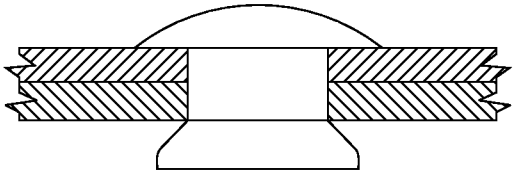
UNIVERSAL DRIVEN HEAD

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 NAS1097	ALL OTHER RIVETS	ALL RIVETS
	1.3d	1.4d	MINIMUM	MINIMUM	MAXIMUM RECOMMENDED
1/16	0.081	0.088	0.025	0.025	0.040
3/32	0.122	0.131	0.038	0.038	0.060
1/8	0.165	0.175	0.050	0.050	0.080
5/32	0.203	0.219	0.050	0.062	0.100
3/16	0.245	0.264	0.060	0.075	0.120
7/32	0.285	0.311	0.070	0.085	0.140
1/4	0.325	0.350	0.080	0.100	0.160
9/32	0.365	0.397	0.090	0.110	0.180
5/16	0.406	0.438	0.125	0.125	0.200
11/32	0.450	0.481	0.135	0.135	0.210
3/8	0.488	0.525	0.150	0.150	0.210
13/32	0.530	0.569	0.165	0.165	0.215

TABLE I

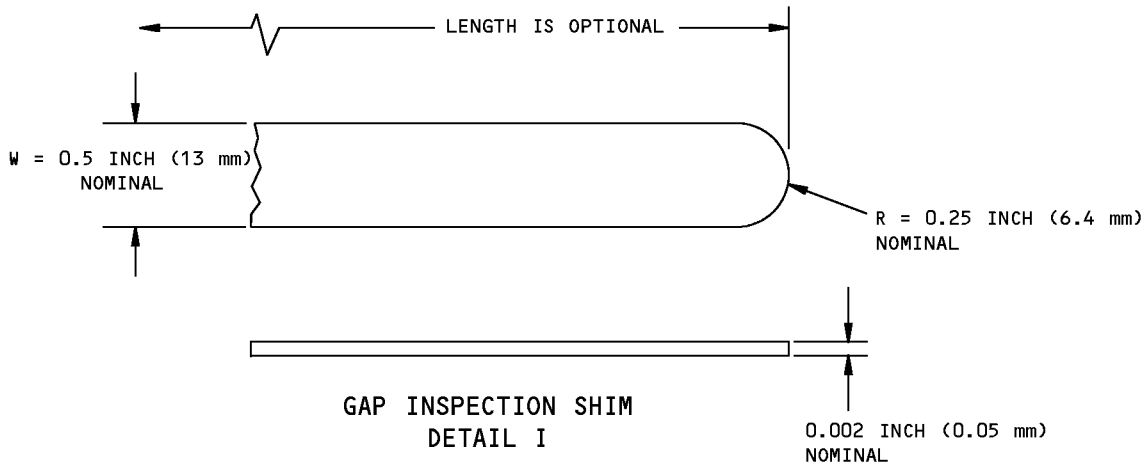


CLINCHED RIVETS ARE NOT PERMITTED
DETAIL I



BELL-SHAPED RIVETS ARE NOT PERMITTED
DETAIL II

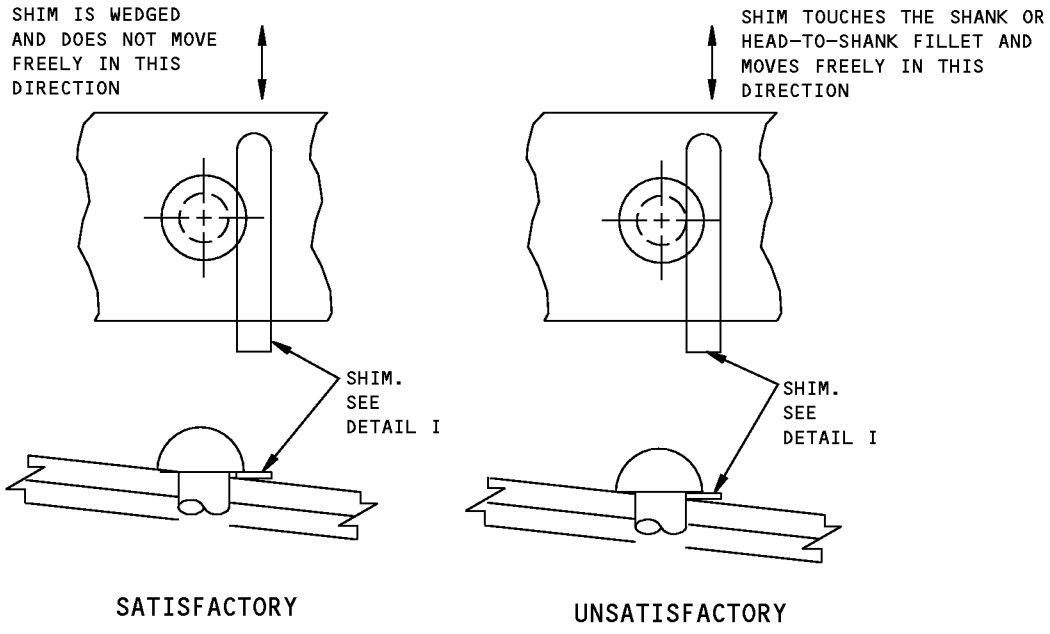
Dimensions for Driving Solid Shank Rivets
Figure 2



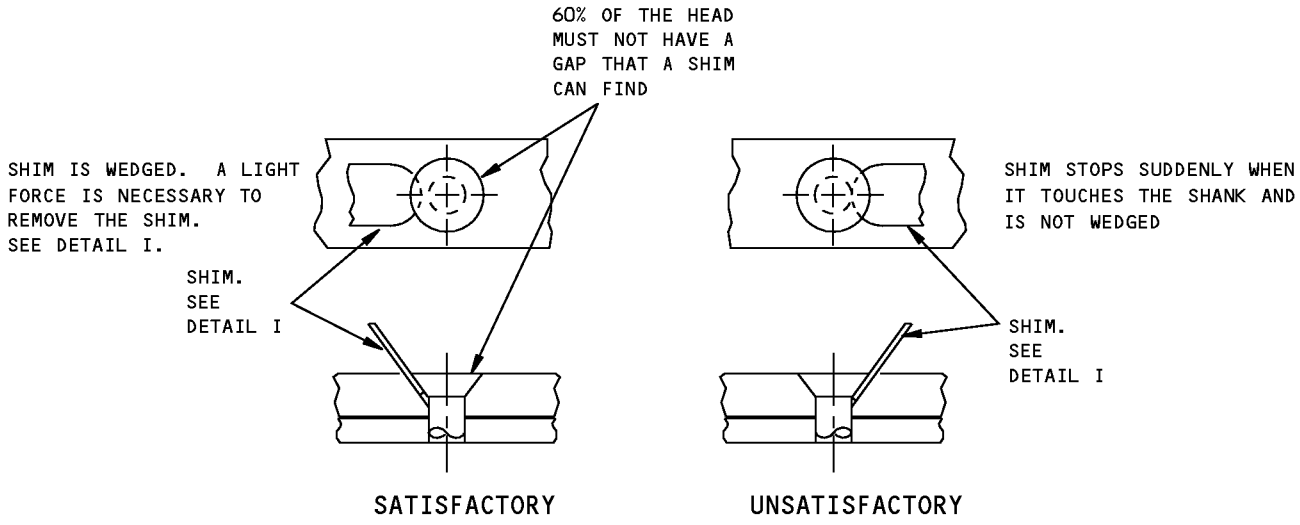
INSPECTION	GAP ANALYSIS
PROTRUDING HEADS	• SEE DETAIL II
FLUSH HEADS	• SEE DETAIL III
FLUSH DRIVEN BUTTONS (ALL RIVETS)	• SEE DETAIL IV

TABLE I

Gap Analysis for Rivet Heads and Buttons
Figure 3 (Sheet 1 of 3)

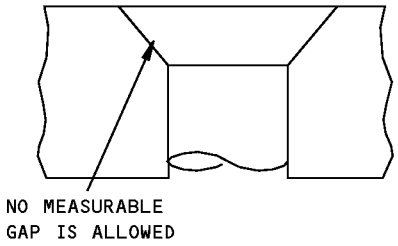


PROTRUDING HEAD GAP INSPECTION METHOD
DETAIL II



GAP INSPECTION METHOD FOR FLUSH HEAD NON-FLUID-TIGHT RIVETS
DETAIL III

Gap Analysis for Rivet Heads and Buttons
Figure 3 (Sheet 2 of 3)



GAP INSPECTION METHOD FOR
FLUSH DRIVEN BUTTONS (ALL RIVETS)
DETAIL IV

Gap Analysis for Rivet Heads and Buttons
Figure 3 (Sheet 3 of 3)