COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

AUTOTHROTTLE SWITCH PACK ASSEMBLY

PART NUMBER 65C36725–1

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COMPONENT MAINTENANCE MANUAL

Revision No. 8
Jul 01/2009

To: All holders of AUTOTHROTTLE SWITCH PACK ASSEMBLY 22-35-05.

Attached is the current revision to this COMPONENT MAINTENANCE MANUAL

The COMPONENT MAINTENANCE MANUAL is furnished either as a printed manual, on microfilm, or digital products, or any combination of the three. This revision replaces all previous microfilm cartridges or digital products. All microfilm and digital products are reissued with all obsolete data deleted and all updated pages added.

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

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TEMPORARY REVISION AND SERVICE BULLETIN RECORD

BOEING SERVICE BULLETIN	BOEING TEMPORARY REVISION	OTHER DIRECTIVE	DATE OF INCORPORATION INTO MANUAL

All revisions to this manual will be accompanied by transmittal sheet bearing the revision number. Enter the revision number in numerical order, together with the revision date, the date filed and the initials of the person filing.

Revision		Filed	
Number	Date	Date	Initials

Revision		Filed	
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Revision		Filed		Revision		Filed	
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Temporary Revision		Inserted		Removed	
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Temporary Revision		Inserted		Removed	
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INTRODUCTION

1. General

A. The instructions in this manual supply the data necessary to do the maintenance functions together with the test, fault isolation, repair, and replacement of the defective parts.

B. This manual is divided into different parts:

(1) Title Page

(2) Transmittal Letter

(3) Highlights

(4) List of Effective Pages

(5) Table of Contents

(6) Temporary Revision & Service Bulletin Record

(7) Record of Revisions

(8) Record of Temporary Revisions

(9) Introduction

(10) Procedures & IPL Sections

C. Components that can be repaired have a different repair number for each specified repair. To find the repair number location of a component, look in the Repair-General procedure at the beginning of the REPAIR section. The Repair-General procedure also has an explanation of the True Position Dimension symbols used.

D. All dimensions, measures, quantities and weights included are in English units. When metric equivalents are given they will be in the parentheses that follow the English units.

E. The introduction to the Illustrated Parts List (IPL) shows how the IPL data is used.

F. Design changes, optional parts, configuration differences and Service Bulletin modifications may cause different part numbers. These part numbers are identified in the IPL with an alphabetical letter which is added to the end of the basic item number. This new item number is referred to as an alpha-variant. Throughout the manual, IPL basic item number references also apply to alpha-variants unless shown differently.

G. The tool reference numbers found in the individual procedures and in the Special Tools, Fixtures, and Equipment section are used to identify if a tool is a standard tool (STD-XXXX), a commercial tool (COM-XXXX), or a Special Tool (SPL-XXXX). This reference number is also used to distinguish between tools with similar names in the same procedure. These reference numbers are for use in the documentation only. They are not to be used for ordering tools.

AUTOTHROTTLE SWITCH PACK ASSEMBLY - DESCRIPTION AND OPERATION

1. **Description**

   A. The switch pack assembly consists of two arm assemblies, five switches, two wire bundle assemblies and a housing assembly.

2. **Operation**

   A. The switch pack assembly monitors the autothrottle assembly and sends output signals to the thrust management system.

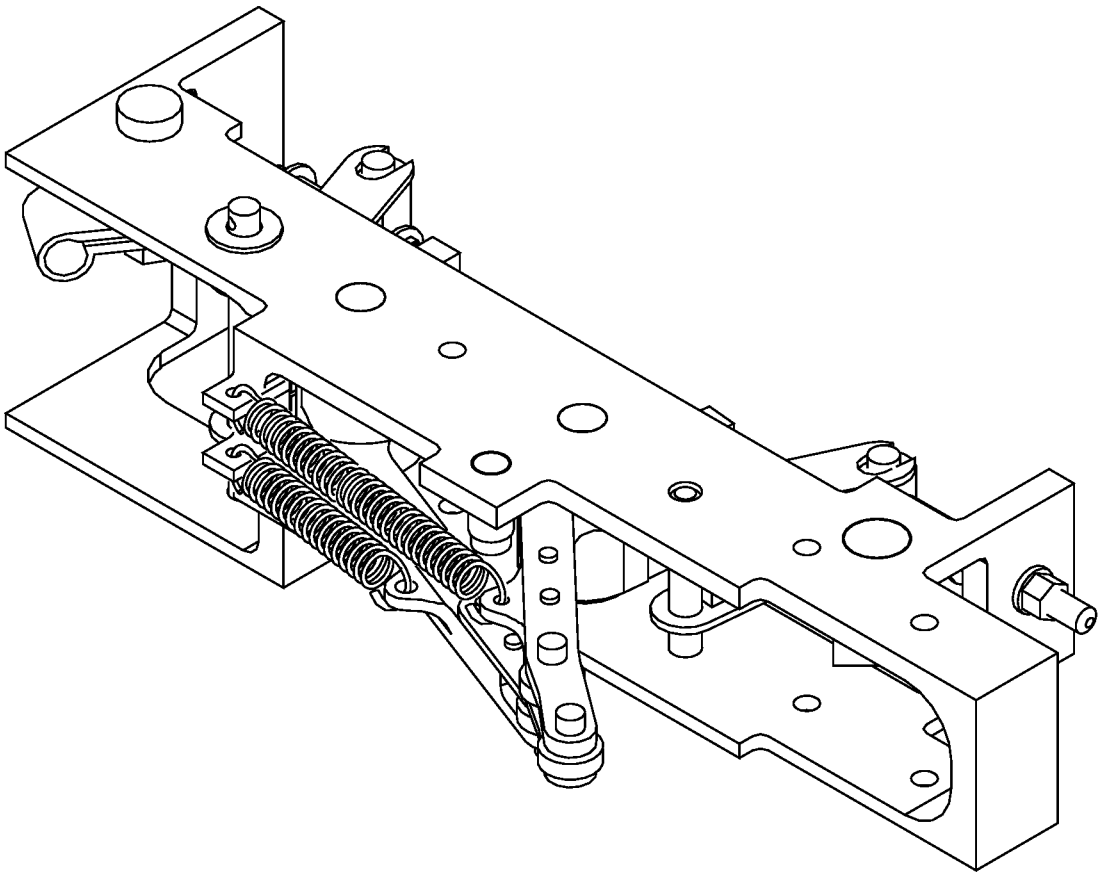
3. **Leading Particulars (Approximate)**

   A. Length – 9 inches plus two 12-inch long wire bundle assemblies

   B. Width – 5 inches

   C. Height – 3 inches

   D. Weight – 2 pounds



Autothrottle Switch Pack Assembly
Figure 1

TESTING AND FAULT ISOLATION

1. General

A. This procedure has the data necessary to do a test of the mechanism after an overhaul or for fault isolation.

B. Refer to the Standard Overhaul Practice Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to IPL Figure 1 for item numbers.

2. Testing and Fault Isolation

A. Tools/Equipment

NOTE: Equivalent substitutes may be used.

Reference	Description
COM-5700	Test Connector (Part #: A33003-23, Supplier: 81205) (Part #: BACC45FN14A15S, Supplier: 81205)
COM-5702	Test Connector (Part #: A33003-13, Supplier: 81205) (Part #: BACC45FN12A12S, Supplier: 81205)
STD-3946	Voltmeter - Simpson, Model 260

B. References

Reference	Title
CMM 22-32-34	AUTOTHROTTLE SWITCHPACK ASSEMBLY

C. Procedure

NOTE: For disassembly and assembly, refer to CMM 22-32-34.

(1) Continuity Test (IPL Figure 1, TESTING AND FAULT ISOLATION, Figure 101)

(a) For the top assembly in IPL Figure 1, mate BACC45FN14A15S receptacle, test connector, COM-5700, with P1 connector (300) and BACC45FN12A12S receptacle, test connector, COM-5702, with P2 connector (255).

(b) Activate switches (250, 295) by gently pressing appropriate arm assembly (75, 130).

(c) With model 260 simpson voltmeter, STD-3946, verify the arm assembly positions and the conditions between pins as shown in TESTING AND FAULT ISOLATION, Figure 101. The pin positions for receptacle are shown in TESTING AND FAULT ISOLATION, Figure 101.

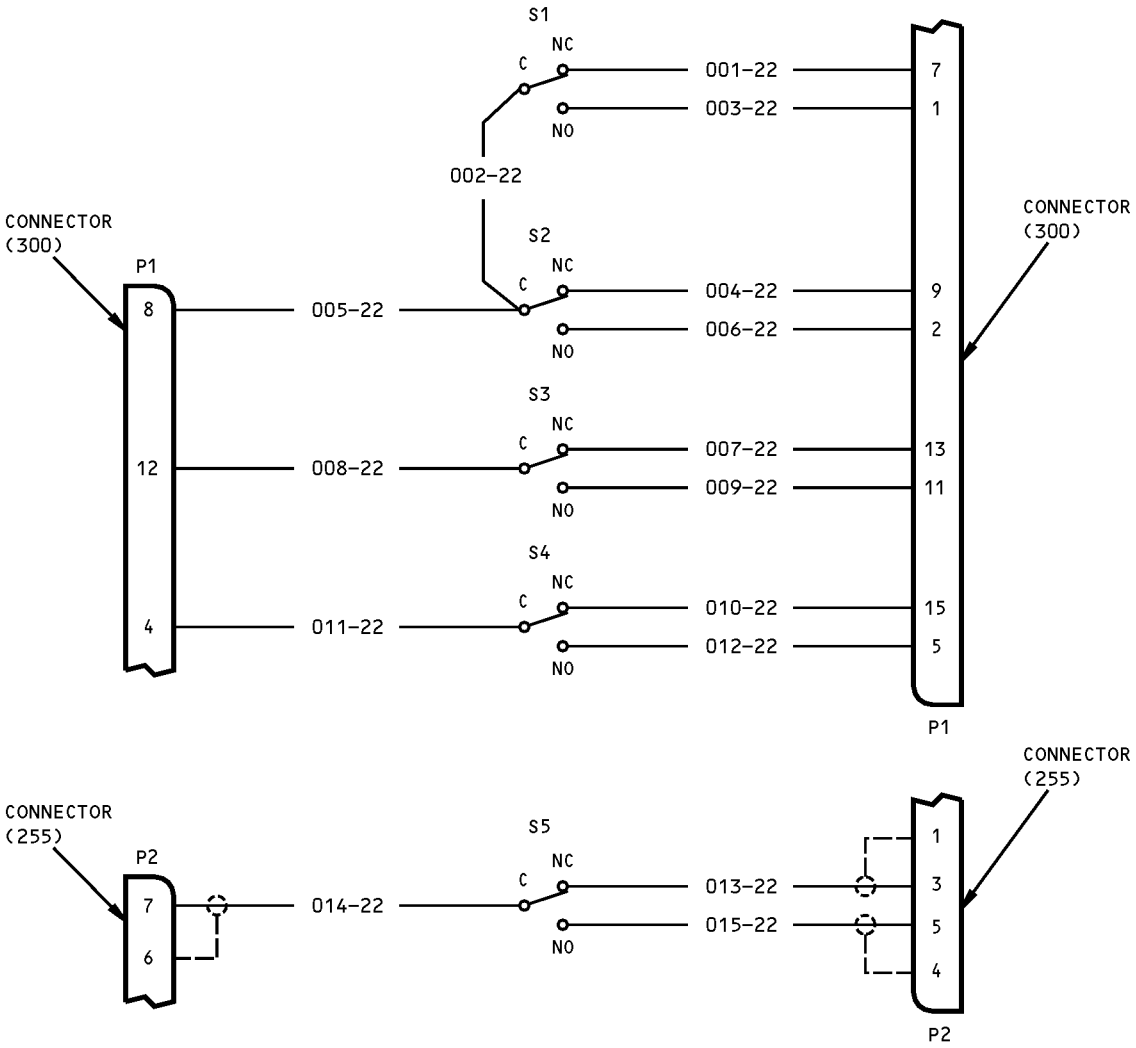
NOTE: Open circuit resistance is greater than 15,000 ohms. Cont. circuit resistance is less than 3 ohms.

(d) Replace faulty wire bundle assembly (225, 275) per REPAIR 2-1.

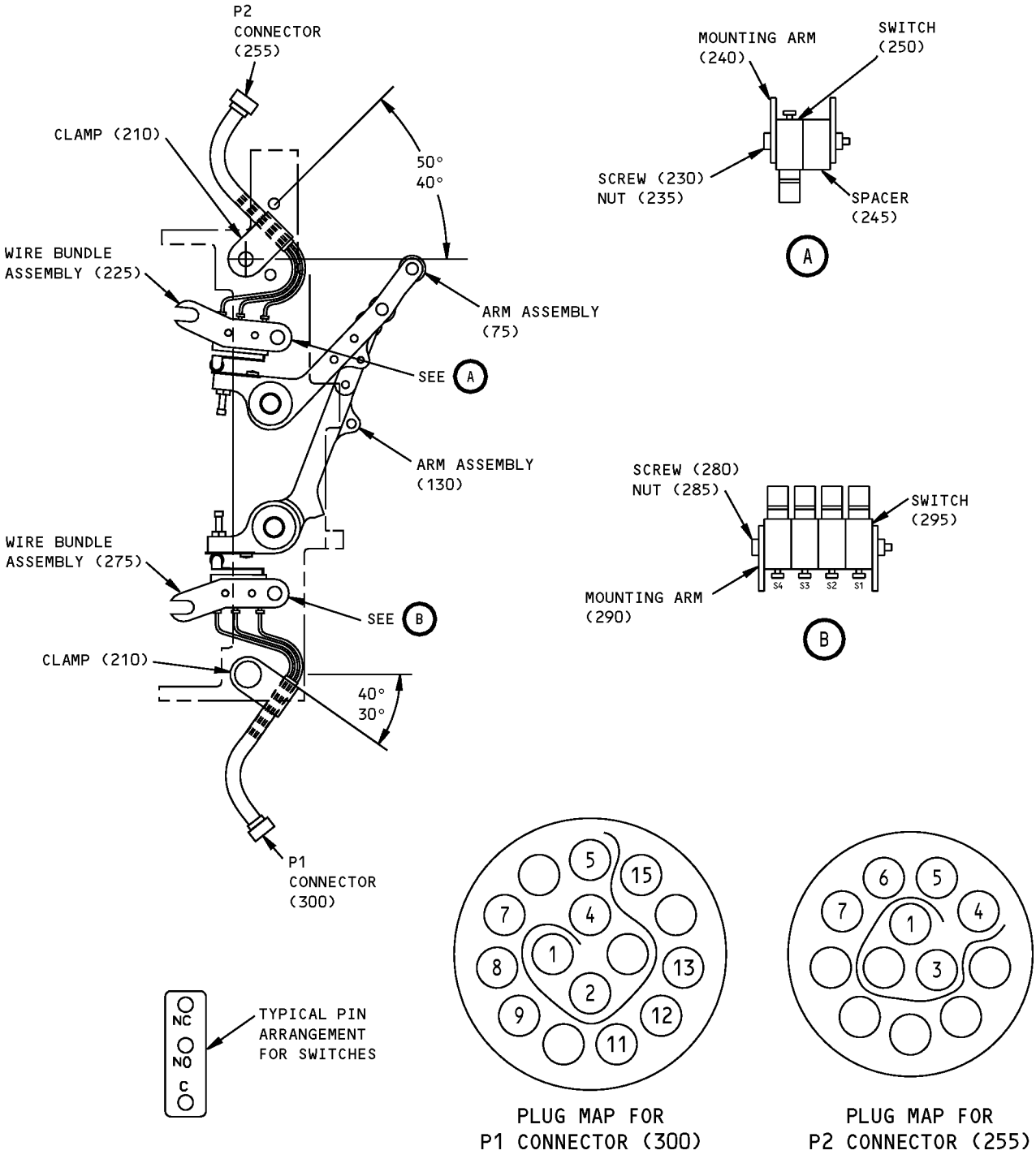
(e) For each switch (250, 290) with model 260 simpson voltmeter, STD-3946, verify its NO and NC condition with C pin. With actuator arm of each switch pressed, verify its reverse condition with C pin (TESTING AND FAULT ISOLATION, Figure 101).

NOTE: NO is normally open, NC is normally closed or CONT., and C is common pin.

(f) Replace faulty switch (250, 295) per REPAIR 2-1 (IPL Figure 1).



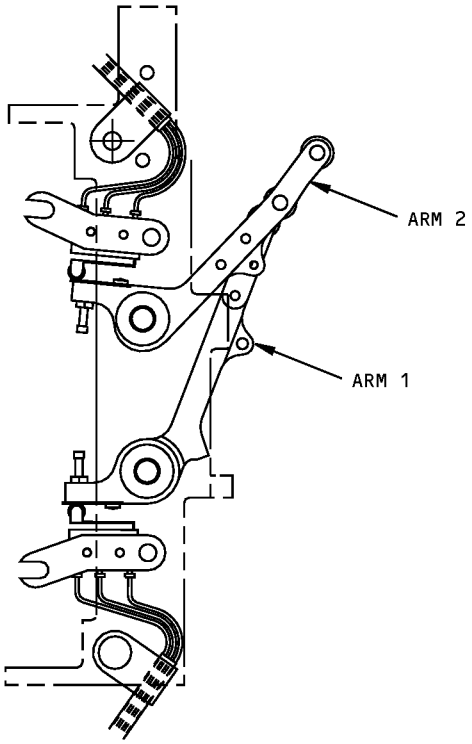
Continuity Test Table
Figure 101 (Sheet 1 of 3)



ITEM NUMBERS REFER TO IPL FIG. 1

ALL DIMENSIONS ARE IN INCHES

Continuity Test Table
Figure 101 (Sheet 2 of 3)



ARM ASSEMBLY	PLUG	PINS	SWITCH	LEVER CONDITION	
				DEPRESSED	RELEASED
65C36727-1	P1	7,8	S1	OPEN	CONT
65C36727-1	P1	1,8	S1	CONT	OPEN
65C36727-1	P1	8,9	S2	OPEN	CONT
65C36727-1	P1	2,8	S2	CONT	OPEN
65C36727-1	P1	12,13	S3	OPEN	CONT
65C36727-1	P1	11,12	S3	CONT	OPEN
65C36727-1	P1	4,15	S4	OPEN	CONT
65C36727-1	P1	4,5	S4	CONT	OPEN
65C36727-2	P2	5,7	S5	OPEN	CONT
65C36727-2	P2	3,7	S5	CONT	OPEN

ALL DIMENSIONS ARE IN INCHES

Continuity Test Table
Figure 101 (Sheet 3 of 3)

DISASSEMBLY

1. **General**

   A. This procedure has the data necessary to disassemble the switchpack assembly.

   B. Disassemble this component sufficiently to isolate the defects, do the necessary repairs, and put the component back to a serviceable condition.

   C. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

   D. Refer to IPL Figure 1 for item numbers.

2. **Parts Replacement**

   NOTE: The following parts are recommended for replacement. Unless otherwise specified, actual replacement of parts may be based on in-service experience.

   A. Cotter pin (5, 260)

3. **Disassembly (IPL Figure 1)**

   A. Remove springs (45, 50) from arm assemblies (75, 130) and housing assembly (315).

   B. Remove cotter pin (260), pin (265) and washer (270) from housing assembly (315).

   C. Remove bolts (55), shaft assemblies (60) and arm assemblies (75, 130) from housing assembly (315).

      NOTE: Do not disassemble arm assemblies (75, 130) unless necessary for repair or replacement.

   D. Remove cotter pins (5), bolts (10), nuts (20, 25), trunnions (35, 40), springs (30) and washers (15) from housing assembly (315).

      NOTE: Do not remove wires from switches unless necessary for repair or replacement.

      Do not disassemble housing assembly (315) unless necessary for repair or replacement.

      Do not remove wire bundle assembly (225, 275) or switches (250, 290) from housing assembly (315) unlesss necessary for repair or replacement.

CLEANING

1. General

A. This procedure has the data necessary to clean the switchpack assembly.

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to IPL Figure 1 for item numbers.

2. Cleaning

A. References

Reference	Title
SOPM 20-30-01	CLEANING AND RELUBRICATING BEARINGS
SOPM 20-30-03	GENERAL CLEANING PROCEDURES

B. Procedure

(1) Clean bearings (85, 140) as shown in SOPM 20-30-01.

(2) Use standard industry procedures and refer to SOPM 20-30-03 to clean all parts.

CHECK

1. General

A. This procedure has the data necessary to find defects in the material of the specified parts.

B. Refer to FITS AND CLEARANCES for the design dimension and wear limits.

C. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

D. Refer to IPL Figure 1 for item numbers.

2. Check

A. References

Reference	Title
SOPM 20-20-01	MAGNETIC PARTICLE INSPECTION
SOPM 20-20-02	PENETRANT METHODS OF INSPECTION

B. Procedure

(1) Use standard industry procedures to do a visual check of all the parts for defects. Do the penetrant or magnetic particle check if the visual check shows possible damage or if you suspect possible damage on the parts listed below:

(2) Do a magnetic particle check (SOPM 20-20-01) of these parts:

(a) Bolt (10)

(b) Nut (25)

(3) Do a penetrant check (SOPM 20-20-02) of these parts:

(a) Trunnion (35, 40)

(b) Shaft (70)

(c) Retainer (95)

(d) Arm (125, 180, 240)

(e) Mounting Arm (290)

(f) Housing (325)

(4) Check springs (30, 45, 50) per (CHECK, Figure 501).

(5) Check bearings (85, 140) in arm assemblies (75, 130) for serviceability by turning bearings by hand. Serviceable bearings should spin freely when spun by hand. Replace unserviceable bearings per REPAIR 3-1.

Item No.	Test Length (inches)	Allowable Load Limits (pounds)
30	0.356 to 0.436	3.20
45	1.81 to 1.97	4.41
50	3.47 to 3.71	7.25

Spring Check Data
Figure 501

REPAIR

1. General

A. Instructions for repair, refinish, and replacement of the specified subassembly parts are included in each REPAIR when applicable:

Table 601:

PART NUMBER	NAME	REPAIR
—	MISCELLANEOUS PARTS REFINISH	1-1
65C36725	WIRE BUNDLE ASSEMBLY	2-1
65C36726	HOUSING ASSEMBLY	3-1, 3-2
65C36727	ARM ASSEMBLY	4-1, 4-2
69-78677	SHAFT ASSEMBLY	5-1
BAC27TCT	MARKER	6-1

2. Dimensioning Symbols

A. Standard True Position Dimensioning Symbols used in the applicable repair procedures are shown in REPAIR-GENERAL, Figure 601.

—	STRAIGHTNESS
▱	FLATNESS
⊥	PERPENDICULARITY (OR SQUARENESS)
//	PARALLELISM
○	ROUNDNESS
⌭	CYLINDRICITY
⌒	PROFILE OF A LINE
⌓	PROFILE OF A SURFACE
◎	CONCENTRICITY
⌯	SYMMETRY
∠	ANGULARITY
↗	RUNOUT
↗↗	TOTAL RUNOUT
⌴	COUNTERBORE OR SPOTFACE
⌵	COUNTERSINK
⌖	THEORETICAL EXACT POSITION OF A FEATURE (TRUE POSITION)
Ø	DIAMETER
S Ø	SPHERICAL DIAMETER
R	RADIUS
SR	SPHERICAL RADIUS
()	REFERENCE
BASIC (BSC) OR [DIM]	A THEORETICALLY EXACT DIMENSION USED TO DESCRIBE SIZE, SHAPE OR LOCATION OF A FEATURE. FROM THIS FEATURE PERMISSIBLE VARIATIONS ARE ESTABLISHED BY TOLERANCES ON OTHER DIMENSIONS OR NOTES.
[-A-]	DATUM
Ⓜ	MAXIMUM MATERIAL CONDITION (MMC)
Ⓛ	LEAST MATERIAL CONDITION (LMC)
Ⓢ	REGARDLESS OF FEATURE SIZE (RFS)
Ⓟ	PROJECTED TOLERANCE ZONE
FIM	FULL INDICATOR MOVEMENT

EXAMPLES

[— | 0.002]	STRAIGHT WITHIN 0.002
[⊥ | 0.002 | B]	PERPENDICULAR TO DATUM B WITHIN 0.002
[// | 0.002 | A]	PARALLEL TO DATUM A WITHIN 0.002
[○ | 0.002]	ROUND WITHIN 0.002
[⌭ | 0.010]	CYLINDRICAL SURFACE MUST LIE BETWEEN TWO CONCENTRIC CYLINDERS, ONE OF WHICH HAS A RADIUS 0.010 INCH GREATER THAN THE OTHER
[⌒ | 0.006 | A]	EACH LINE ELEMENT OF THE SURFACE AT ANY CROSS SECTION MUST LIE BETWEEN TWO PROFILE BOUNDARIES 0.006 INCH APART RELATIVE TO DATUM A
[⌓ | 0.020 | A]	SURFACES MUST LIE WITHIN PARALLEL BOUNDARIES 0.020 INCH APART AND EQUALLY DISPOSED ABOUT TRUE PROFILE
[◎ | Ø 0.0005 | C]	CONCENTRIC TO DATUM C WITHIN 0.0005 DIAMETER
[⌯ | 0.010 | A]	SYMMETRICAL WITH DATUM A WITHIN 0.010
[∠ | 0.005 | A]	ANGULAR TOLERANCE 0.005 WITH DATUM A
[⌖ | Ø 0.002 Ⓢ | B]	LOCATED AT TRUE POSITION WITHIN 0.002 DIA RELATIVE TO DATUM B, REGARDLESS OF FEATURE SIZE
[⊥ | Ø 0.010 Ⓜ | A] 0.510 Ⓟ	AXIS IS TOTALLY WITHIN A CYLINDER OF 0.010 INCH DIAMETER, PERPENDICULAR TO DATUM A, AND EXTENDING 0.510 INCH ABOVE DATUM A, MAXMIUM MATERIAL CONDITION
[2.000] OR 2.000 BSC	THEORETICALLY EXACT DIMENSION IS 2.000

True Position Dimensioning Symbols
Figure 601

MISCELLANEOUS PARTS REFINISH - REPAIR 1-1

1. General

A. This procedure has the data necessary to refinish the parts which are not given in the specified repairs.

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to IPL Figure 1 for item numbers.

2. Refinish of Other Parts

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00259	Primer - Chemical And Solvent Resistant Finish, Epoxy Resin	BMS10-11, Type I

B. References

Reference	Title
SOPM 20-30-02	STRIPPING OF PROTECTIVE FINISHES
SOPM 20-41-01	DECODING TABLE FOR BOEING FINISH CODES
SOPM 20-60-02	FINISHING MATERIALS

C. General

(1) Instructions for the repair of the parts listed in REPAIR 1-1, Table 601 is for repair of the initial finish.

D. Procedure

NOTE: For stripping of protective finishes, refer to SOPM 20-30-02. For the decoding table for Boeing finish codes, refer to SOPM 20-41-01. For finishing materials, refer to SOPM 20-60-02.

(1) Refer to REPAIR 1-1, Table 601 for refinish details.

Table 601: REFINISH DETAILS

IPL FIG. & ITEM	MATERIAL	FINISH
IPL Fig. 1		
Bolt (10	15-5 PH Steel 180-200 ksi	Cadmium plate (F-15.02).
Nut (25)	4340 Steel 125-145 ksi	Cadmium plate (F-15.06).
Trunnion (35,40)	Al alloy	Chromic acid anodize (F-17.02).
Retainer (95)	Al alloy	Chromic acid anodize and apply primer, C00259 (F-18.13).

Table 601: REFINISH DETAILS (Continued)

IPL FIG. & ITEM	MATERIAL	FINISH
Pad (105,160)	17-7 PH Steel 150-170 ksi	Passivate (F-17.25, which replaces F-17.09).
Support (150)	Al alloy	Chromic acid anodize (F-17.02) and apply primer, C00259 (F-20.02).
Bolt (220)	A286 CRES 95 ksi	Cadmium plate (F-15.06).
Mounting arm (240, 290)	Al alloy	Chromic acid anodize (F-17.02) and apply primer, C00259 (F-20.02) except omit primer on 0.1915-0.1935 in diameter hole.

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WIRE BUNDLE ASSEMBLY - REPAIR 2-1

65C36725–2, –3

1. General

A. This procedure has the data necessary to replace the switches (250, 295) on the wire bundle assembles (225, 275).

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedures.

C. Refer to IPL Figure 1 for item numbers.

2. Wire Bundle Replacement

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00259	Primer - Chemical And Solvent Resistant Finish, Epoxy Resin	BMS10-11, Type I

B. References

Reference	Title
SOPM 20-11-02	REPAIR OF ELECTRICAL CONNECTORS
SOPM 20-11-03	REPAIR OF ELECTRICAL TERMINATIONS AND ELECTRICAL BONDING AREAS
SOPM 20-12-01	SOLDERING ELECTRICAL CONNECTIONS
SOPM 20-60-02	FINISHING MATERIALS

C. Procedure

NOTE: For repair of electrical connectors, refer toSOPM 20-11-02. For repair of electrical terminations and electrical bonding areas, refer to SOPM 20-11-03. For soldering electrical connectors, refer to SOPM 20-12-01. For finishing materials, refer to SOPM 20-60-02.

(1) Wire Bundle Assembly Replacement for 65C36725-2 (275) (IPL Figure 1, REPAIR 2-1, Figure 601).

(a) Remove screw (190), washers (195), nut (200), plug (205), clamp (210) and spacer (215) from housing assembly (315).

(b) Remove cotter pin (260), drilled shank pin (265), washer (270) and wire bundle assembly (275) from housing assembly (315).

(c) Remove screws (280), nuts (285), mounting arm (290) and switches (295) from wire bundle assembly (275).

(d) Install switches (295) on mounting arm (290) of wire bundle assembly (275) with screws (280) and nuts (285).

(e) Install wire bundle assembly (275) in housing assembly (315) with cotter pin (260), drilled shank pin (265) and washer (270).

(f) Position wire bundle assembly (275) as shown in REPAIR 2-1, Figure 601 and install clamp (210) and plug (205) on housing assembly (315) with screw (190), washers (195), nut (200) and spacer (215).

(g) Adjust switches (295) per ASSEMBLY section.

(h) Test per TESTING AND FAULT ISOLATION section.

(2) Wire Bundle Assembly Replacement for 65C36725-3 (225) (IPL Figure 1, REPAIR 2-1, Figure 601).

(a) Remove bolt (185), washer (195), nut (200), plug (205) and clamp (210) from housing assembly (315).

(b) Remove bolt (220) and wire bundle assembly (225) from housing assembly (315).

(c) Remove screws (230), nuts (235), mounting arm (240), spacer (245) and switch (250) from wire bundle assembly (225).

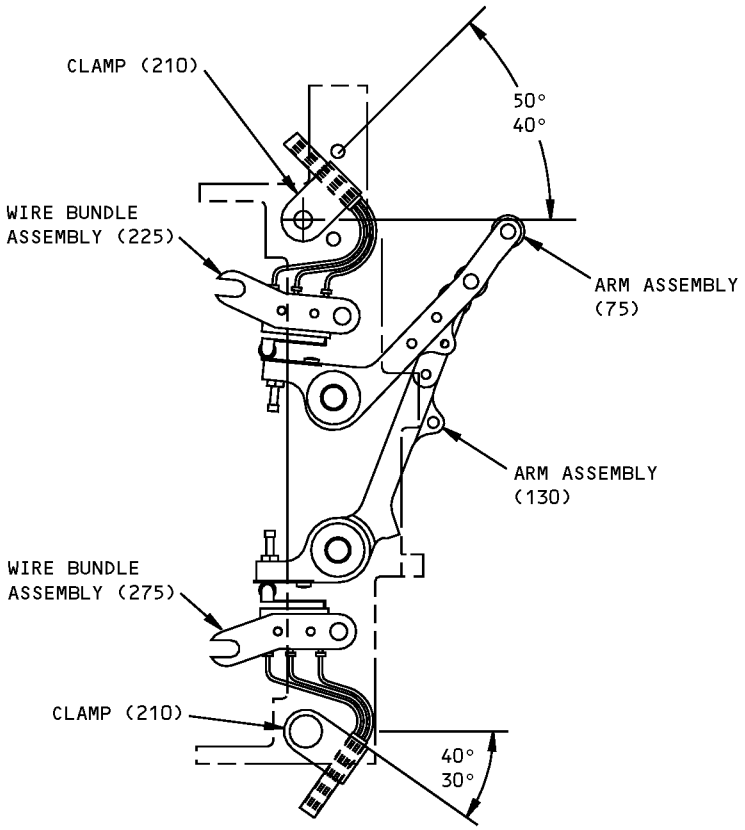
(d) Install spacer (245) and switch (250) on mounting arm (240) of wire bundle assembly (225) with screws (230) and nuts (235).

(e) Install wire bundle assembly (225) in housing asembly (315) with bolt (220). Install bolt (220) such that the upper and lower sides of the housing assembly (315) are deflected no more than 0.005 inch total. The head end and threaded end shall not protrude beyond the housing (335) more than 0.005 inch on each side. Apply wet primer, C00259 on the threads of bolt (220) prior to installation.

(f) Position wire bundle assembly (225) as shown in REPAIR 2-1, Figure 601 and install clamp (210) and plug (205) on housing assembly (315) with screw (185), washer (195) and nut (200).

(g) Adjust switch (250) per ASSEMBLY section.

(h) Test per TESTING AND FAULT ISOLATION section.



ITEM NUMBERS REFER TO IPL FIG. 1

ALL DIMENSIONS ARE IN INCHES

Wire Routing
Figure 601

HOUSING ASSEMBLY - REPAIR 3-1

65C36725–1

1. General

A. This procedure has the data necessary to replace the insert (320) on the housing assemblies (315).

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to REPAIR-GENERAL, Figure 601 for the Standard True Position Dimensioning Symbols shown in the repair.

D. Refer to IPL Figure 1 for item numbers.

2. Bearing Replacement

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00259	Primer - Chemical And Solvent Resistant Finish, Epoxy Resin	BMS10-11, Type I

B. References

Reference	Title
SOPM 20-50-22	HOW TO INSTALL THREADED INSERTS
SOPM 20-60-02	FINISHING MATERIALS

C. Procedure

NOTE: For finishing materials, refer to SOPM 20-60-02

(1) Replace the inserts (320).

(a) Remove the inserts (320) from the housing (325).

(b) Install the inserts with the wet primer, C00259 in the housing (325) per SOPM 20-50-22 except the insert is to be installed a minimum of 1/2 turn below the top and bottom surface of the tapped hole.

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HOUSING - REPAIR 3-2

65C36726–2

1. General

A. This procedure has the data necessary to refinish the housing (325).

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to REPAIR-GENERAL, Figure 601 for the Standard True Position Dimensioning Symbols shown in the repair.

D. Refer to IPL Figure 1 for item numbers.

E. General repair details:

(1) Material: Aluminum alloy

2. Plate Refinish

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00259	Primer - Chemical And Solvent Resistant Finish, Epoxy Resin	BMS10-11, Type I

B. References

Reference	Title
SOPM 20-30-02	STRIPPING OF PROTECTIVE FINISHES
SOPM 20-41-01	DECODING TABLE FOR BOEING FINISH CODES
SOPM 20-60-02	FINISHING MATERIALS

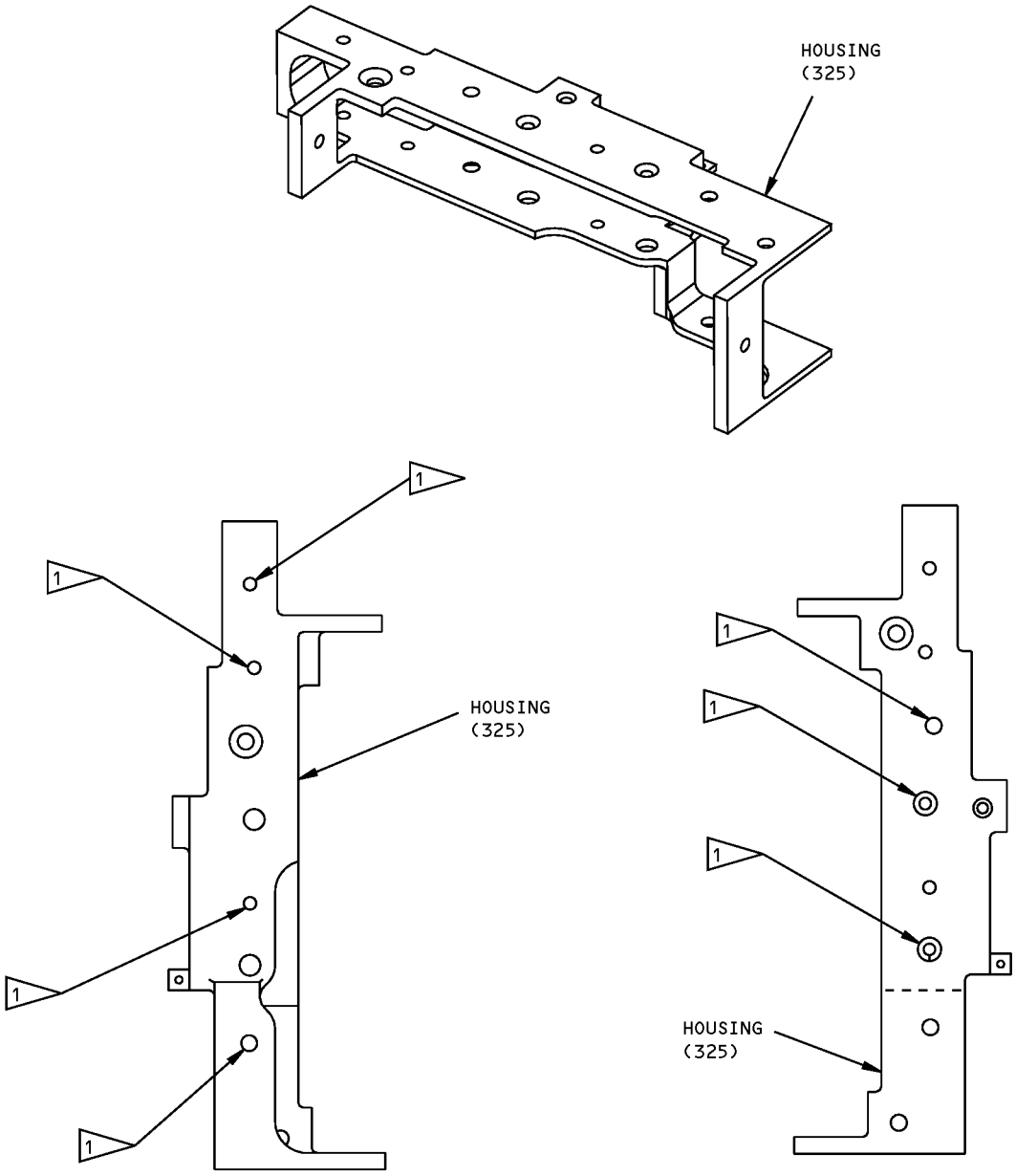
C. Procedure (REPAIR 3-2, Figure 601)

NOTE: For stripping of protective finishes, refer to SOPM 20-30-02. For the decoding table for Boeing finish codes, refer to SOPM 20-41-01. For finishing materials, refer to SOPM 20-60-02.

(1) Put a finish on the housing (325).

(a) Chromic acid anodize (F-17.04).

(b) Apply primer, C00259 (F-20.03) except as shown differently in REPAIR 3-2, Figure 601.



REFINISH

HOUSING (325) -- CHROMIC ACID ANODIZE (F-17.04) AND BMS 10-11, TYPE 1 PRIMER (F-20.03) EXCEPT AS SHOWN DIFFERENTLY

1 NO PRIMER IN THE HOLE

ITEM NUMBERS REFER TO IPL FIG. 1

Housing
Figure 601

ARM ASSEMBLY - REPAIR 4-1

65C36727–1, –2

1. General

A. This procedure has the data necessary to replace the bearings (85, 140), pads (105, 160) and bushings (120, 175) on arm assemblies (75, 130).

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to REPAIR-GENERAL, Figure 601 for the Standard True Position Dimensioning Symbols shown in the repair.

D. Refer to IPL Figure 1 for item numbers.

E. General repair details:

(1) Material: Aluminum alloy

2. Bearing Replacement (IPL Figure 1, REPAIR 4-1, Figure 601)

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00308	Compound - Corrosion Preventive, Petrolatum Hot Application	MIL-C-11796

B. References

Reference	Title
SOPM 20-60-04	MISCELLANEOUS MATERIALS

C. Procedure

NOTE: For miscellaneous materials, refer to SOPM 20-60-04.

(1) Remove Rivet (80, 135) and bearing (85, 140).

(2) Clean new bearing (85, 140) to remove all grease. No lubrication is required.

(3) Position replacement bearing between the arm (125, 180), retainer (95) or support (150). Install rivet (80, 125) with corrosion preventive compound, C00308 on all surfaces.

(4) Check that the bearing turns freely after replacement.

3. Pad Replacement (IPL Figure 1, REPAIR 4-1, Figure 601)

A. Material:

(1) 17-7PH CRES, 150-170 ksi

B. Procedure (REPAIR 4-1, Figure 601)

(1) Remove screws (100, 155) and pads (105, 160) from arm assemblies (75, 130).

(2) Do not remove or adjust screw (110, 165) or nut (115, 170). Screw (110, 165) is for switch adjustment in ASSEMBLY.

(3) Install new pads (105, 160) and screws (100, 155) on arm (125, 180).

4. Bushing Replacement (IPL Figure 1REPAIR 4-1, Figure 601)

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
A00247	Sealant - Pressure And Environmental - Chromate Type	BMS 5-95

B. References

Reference	Title
SOPM 20-50-03	BEARING AND BUSHING REPLACEMENT
SOPM 20-60-04	MISCELLANEOUS MATERIALS

C. Procedures

NOTE: For miscellaneous materials, refer to SOPM 20-60-04.

(1) Remove bushing (120, 175).

(2) Install new bushing per SOPM 20-50-03 except use wet sealant, A00247.

5. Retainer or Support Replacement (IPL Figure 1, REPAIR 4-1, Figure 601)

A. Procedure

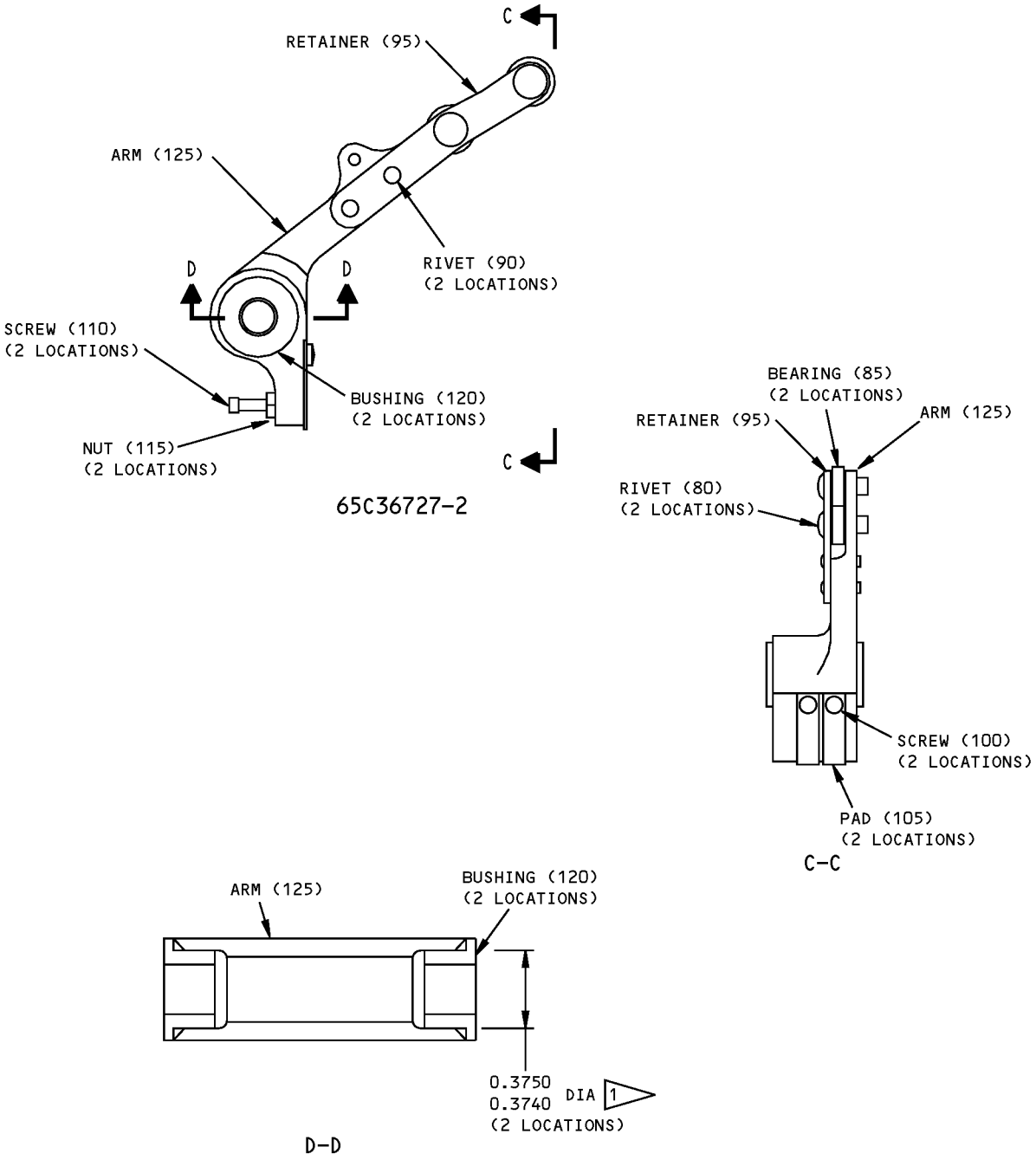
(1) Remove bearing (85, 140) per REPAIR 4-1, Paragraph 2.C.(1).

(2) Remove rivets (90, 145) and retainer (95) or support (150) from the arm assembly (75, 130).

(3) Position the new retainer (95) or support (150) to the arm (125, 180) and match drill rivet holes.

(4) Install rivets (90, 145).

(5) Install bearing (85, 140) per REPAIR 4-1, Paragraph 2.C.(2) thru REPAIR 4-1, Paragraph 2.C.(4).



ITEM NUMBERS REFER TO IPL FIG. 1

ALL DIMENSIONS ARE IN INCHES

Arm Assembly - Replacement Detail
Figure 601

ARM - REPAIR 4-2

65C36727–3, –4

1. General

A. This procedure has the data necessary to refinish the arm (180, 290).

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to IPL Figure 1 for item numbers.

D. General repair details:

(1) Material: Aluminum alloy

2. Crank Refinish

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00259	Primer - Chemical And Solvent Resistant Finish, Epoxy Resin	BMS10-11, Type I

B. References

Reference	Title
SOPM 20-30-02	STRIPPING OF PROTECTIVE FINISHES
SOPM 20-41-01	DECODING TABLE FOR BOEING FINISH CODES
SOPM 20-60-02	FINISHING MATERIALS

C. Procedure (REPAIR 4-2, Figure 601)

NOTE: For stripping of protective finishes, refer to SOPM 20-30-02. For the decoding table for Boeing finish codes, refer to SOPM 20-41-01. For finishing materials, refer to SOPM 20-60-02.

(1) Put a finish on the arm (180).

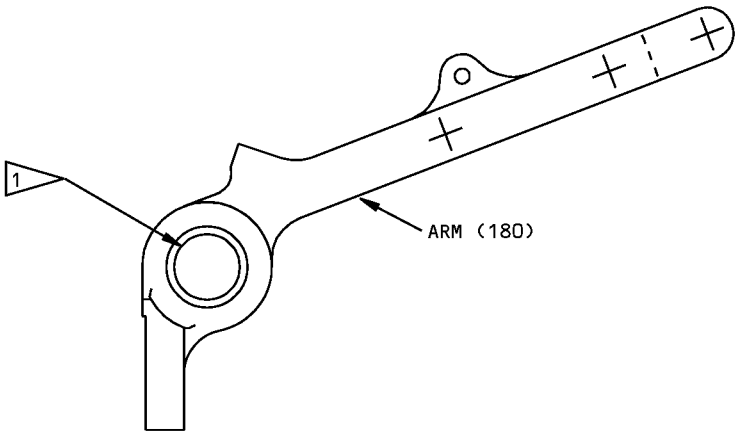
(a) Chromic acid anodize (F-17.04).

(b) Apply primer, C00259 (F-20.02) except omit primer in 0.4600-0.4750 hole.

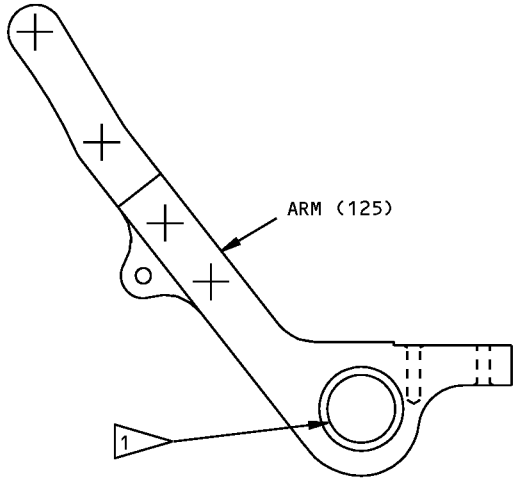
(2) Put a finish on the arm (290).

(a) Chromic acid anodize (F-17.02).

(b) Apply primer, C00259 (F-20.03) except omit primer in 0.4600-0.4750 hole.



65C36727-3



65C36727-4

REFINISH

ARM (125,180) -- CHROMIC ACID ANODIZE
(F-17.04) AND APPLY BMS 10-11, TYPE 1
PRIMER (F-20.03) UNLESS SHOWN DIFFERENTLY

1 NO PRIMER IN THE HOLE

Arm - Refinish Detail
Figure 601

SHAFT ASSEMBLY - REPAIR 5-1

69-78677–1

1. General

A. This procedure has the data necessary to repair and refinish the shaft (70).

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to IPL Figure 1 for item numbers.

D. General repair details:

(1) Material: Aluminum alloy

2. Shaft Refinish

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00259	Primer - Chemical And Solvent Resistant Finish, Epoxy Resin	BMS10-11, Type I

B. References

Reference	Title
SOPM 20-30-02	STRIPPING OF PROTECTIVE FINISHES
SOPM 20-41-01	DECODING TABLE FOR BOEING FINISH CODES
SOPM 20-50-22	HOW TO INSTALL THREADED INSERTS
SOPM 20-60-02	FINISHING MATERIALS

C. Procedure (REPAIR 5-1, Figure 601)

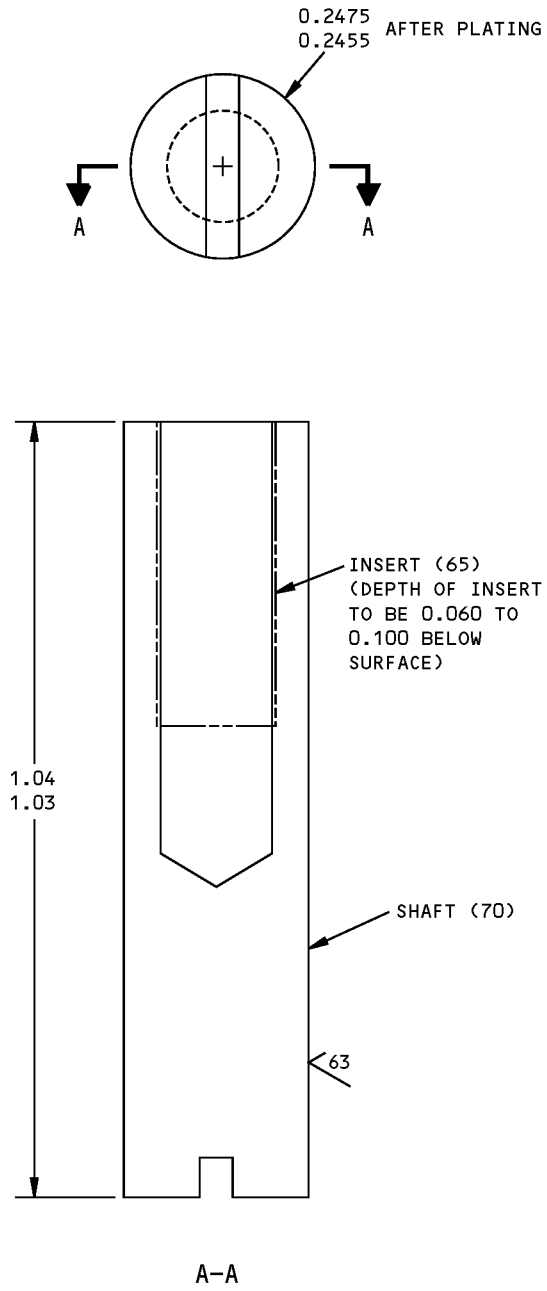
NOTE: For stripping of protective finishes, refer to SOPM 20-30-02. For the decoding table for Boeing finish codes, refer to SOPM 20-41-01. For finishing materials, refer to SOPM 20-60-02.

(1) Remove insert (65) from shaft assembly (60).

(2) Put a finish on the shaft (70).

(a) Chromic acid anodize (F-17.02).

(3) Install a new insert (65) per SOPM 20-50-22 with wet primer, C00259.



REFINISH

SHAFT (70) - CHROMIC ACID ANODIZE (F-17.02)

ALL DIMENSIONS ARE IN INCHES

69-78677-1 Shaft Assembly - Replacement Detail
Figure 601

MARKER - REPAIR 6-1

BAC2TCT0012, BAC2TCT0013, BAC2TCT0014, BAC2TCT0015, BAC2TCT0016

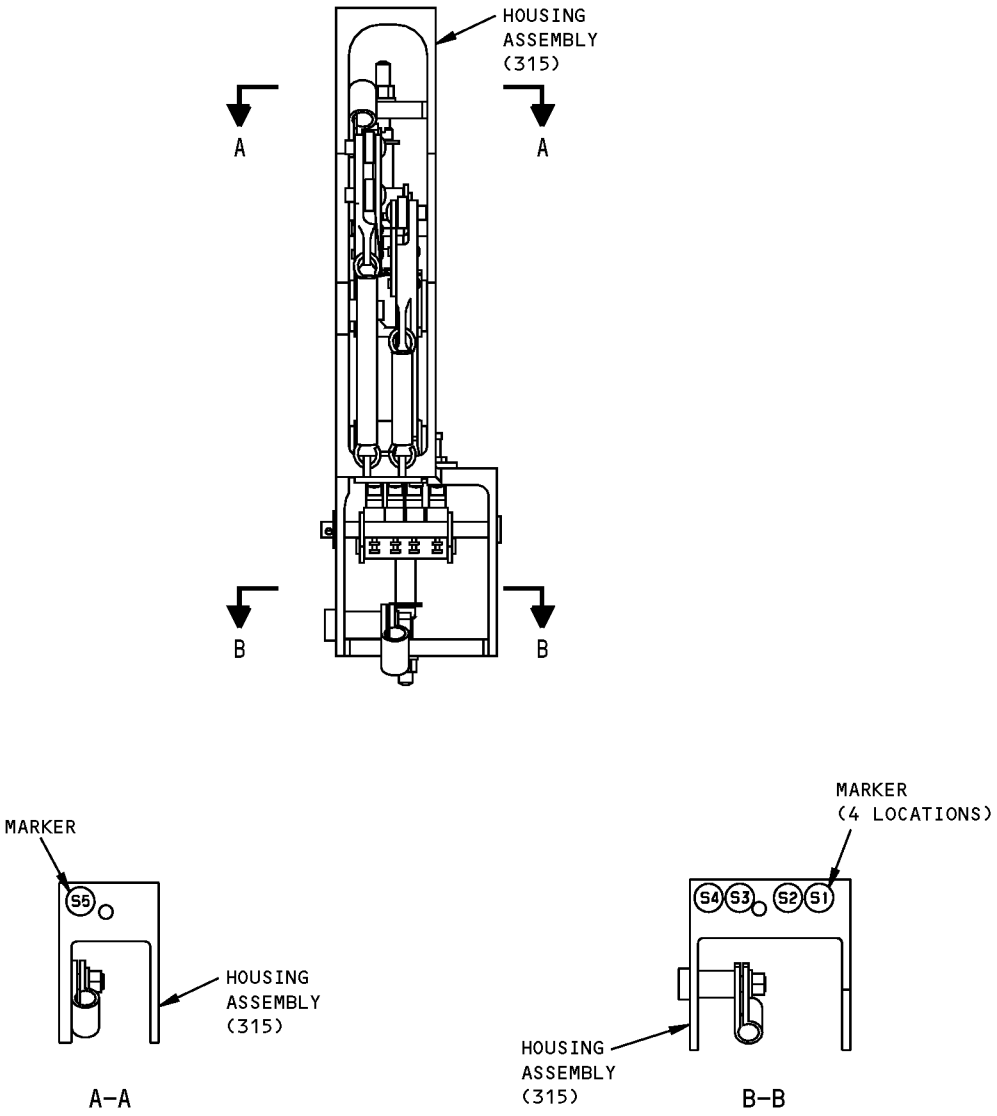
1. Marker Replacement (IPL Figure 1, REPAIR 6-1, Figure 601)

A. References

Reference	Title
SOPM 20-50-05	APPLICATION OF ALUMINUM FOIL AND OTHER MARKERS

B. Procedure

(1) Install marker (325 thru 350) to position shown in REPAIR 6-1, Figure 601 (SOPM 20-50-05).



ITEM NUMBERS REFER TO IPL FIG. 1

Marker - Replacement Detail
Figure 601

ASSEMBLY

1. General

A. This procedure has the data necessary to assemble the switch pack assembly.

B. Refer to the Standard Overhaul Practices Manual (SOPM) for the SOPM subjects identified in this procedure.

C. Refer to IPL Figure 1 for item numbers.

2. Assembly

A. Consumable Materials

NOTE: Equivalent substitutes may be used.

Reference	Description	Specification
C00259	Primer - Chemical And Solvent Resistant Finish, Epoxy Resin	BMS10-11, Type I

B. References

Reference	Title
SOPM 20-50-01	BOLT AND NUT INSTALLATION
SOPM 20-60-02	FINISHING MATERIALS
SOPM 20-60-04	MISCELLANEOUS MATERIALS

C. Procedure

NOTE: For bolt and nut installation, refer to SOPM 20-50-01. For finishing materials, refer to SOPM 20-60-02. For miscellaneous materials, refer to SOPM 20-60-04.

(1) Install arm assemblies (75, 130), bolt (55) and shaft assemblies (60) in housing assembly (315). Apply wet primer, C00259 on the threads of bolt (55) prior to installation. Ensure that arm assembliles (75, 130) rotate freely.

(2) Install springs (45, 50) between arm assemblies (75, 130) and housing assembly (315).

NOTE: If necessary to install wire bundle assembly (225, 275) or switches (250, 295) on housing (315) see REPAIR 2-1.

(3) Install bolts (10), washers (15), nuts (20), springs (30), trunnions (35, 40) and nuts (25) to housing assembly (315).

(4) Adjust switches (295) as follows:

NOTE: On arm assembly (130) there are four sets of switches. The switches must be adjusted to actuate within 0.00-0.02 inch of each other. Measure the arm assembly (130) roller travel (tangential ±5 degrees) as shown in ASSEMBLY, Figure 701.

(a) Before measuring switch actuation, verify that the pad (160) for each switch is flush against the machined surface of the arm assembly (130) as shown in ASSEMBLY, Figure 701.

(b) Rotate carefully the arm assemblies (130) to actuate the switches (295) being adjusted and note which switch actuates first.

NOTE: To determine which switch actuates first, it is best measured with two ohmeters or other visual/audible continuity measuring devices.

(c) Measure and record the actuation point of each switch to determine if they are within 0.00-0.02 inch requirement.

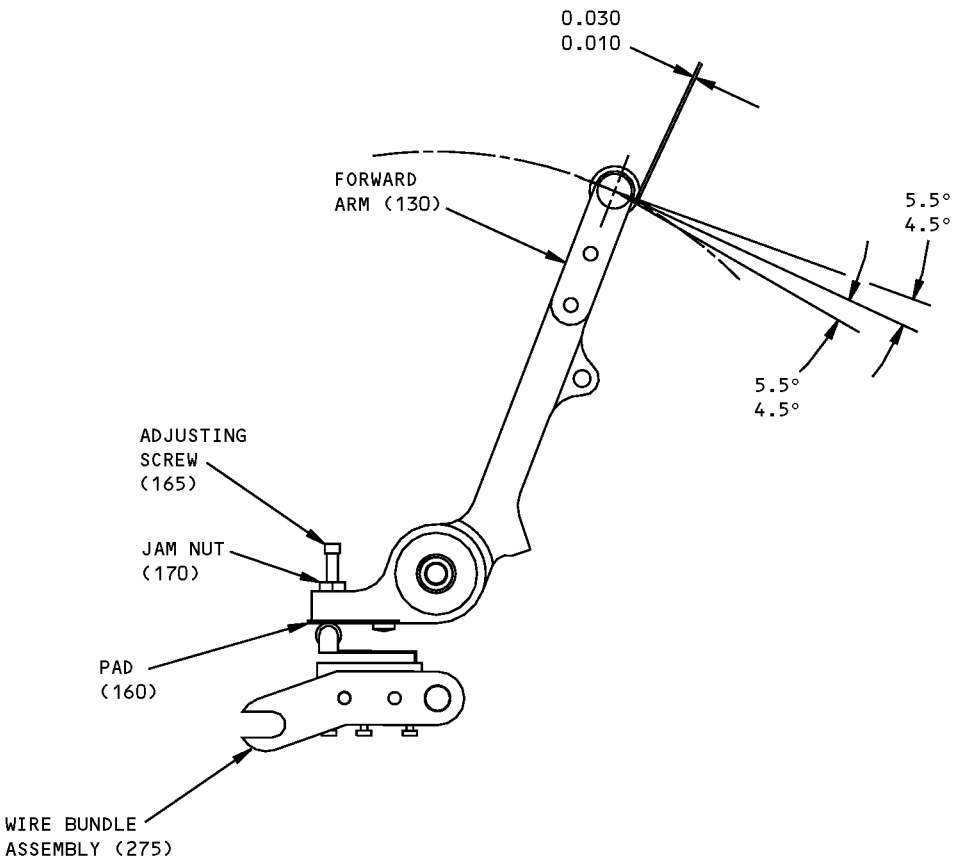
(d) If switch adjustment is required, turn the screws (165) on top of the arm assembly. Turning the screw causes a slight bend in the pad (160), which adjusts an individual switch's actuation point. Turn the screw that corresponds to the switches that actuate so that the switches actuate within 0.00-0.02 inch of the switch that activated first.

(e) Tighten the jam nuts (170) to 3-5 in-lbs.

(f) After completing the switch adjustment, adjust the adjusting bolts (10) such that the threads extend past the housing (325) 0.40-0.50 inch by the placement of washers (15).

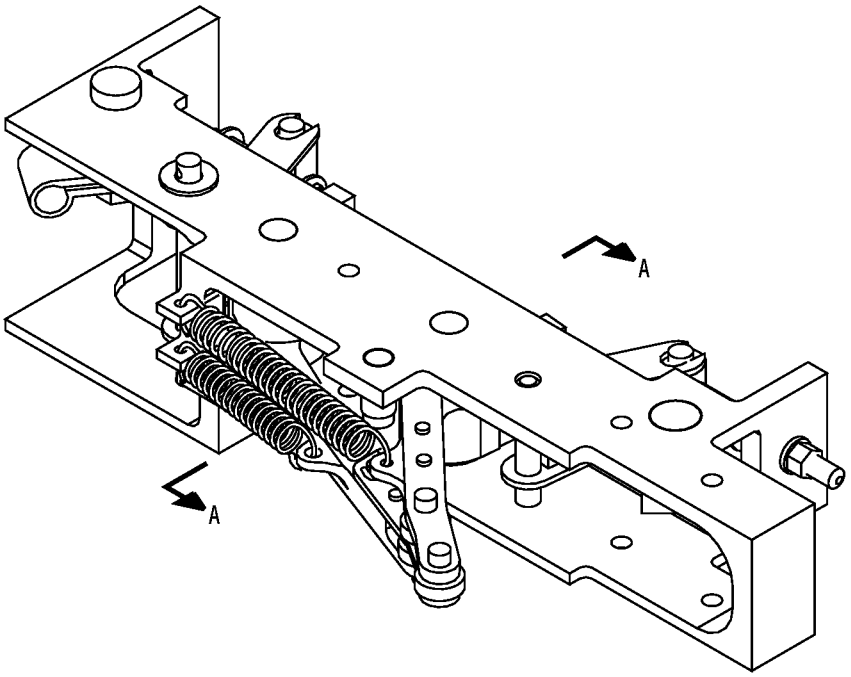
(g) Install the nuts (20) finger-tight.

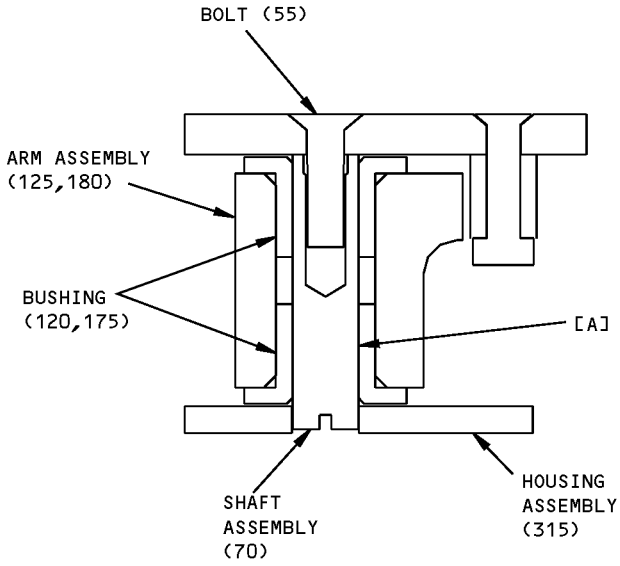
(h) Lock the position of the nuts (25) with the cotter pins (5).



ITEM NUMBERS REFER TO IPL FIG. 1

65C36725-1 Switch Pack Assembly
Figure 701





A-A

ITEM NUMBERS REFER TO IPL FIG. 1

Fits and Clearances
Figure 801 (Sheet 1 of 2)

REF LETTER	REF IPL FIG. 1, MATING ITEM NO.	DESIGN DIMENSION*				SERVICE WEAR LIMIT*		
		DIMENSION		ASSEMBLY CLEARANCE		DIMENSION		MAXIMUM CLEARANCE
		MIN	MAX	MIN	MAX	MIN	MAX	
[A]	ID 120,175	0.2505	0.2515	0.0030	0.0060			
	OD 70	0.2455	0.2475					

* ALL DIMENSIONS ARE IN INCHES

Fits and Clearances
Figure 801 (Sheet 2 of 2)

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. General

A. This section lists the special tools, fixtures, and equipment necessary for maintenance.

NOTE: Equivalent substitutes may be used.

Commercial Tools

Reference	Description	Part Number	Supplier
COM-5700	Test Connector	A33003-23	81205
		BACC45FN14A15S	81205
COM-5702	Test Connector	A33003-13	81205
		BACC45FN12A12S	81205

Tool Supplier Information

CAGE Code	Supplier Name	Supplier Address
81205	THE BOEING COMPANY	17930 INTERNATIONAL BLVD. SOUTH SEATAC, WA 98188-4321 Telephone: 206-662-6650 Facsimile: 206-662-7145

ILLUSTRATED PARTS LIST

1. Introduction

A. The Illustrated Parts List (IPL) contains an illustration and a list of component parts you can repair or replace. The Illustrated Parts Catalog (IPC) shows how to use the Boeing part number system.

B. This shows how parts are related: The relation of each item to its next higher assembly (NHA) is shown in the NOMENCLATURE column. Use the indenture system that follows:

1 2 3 4 5 6 7

. Assembly

. Attaching parts for assembly

. . Detail parts for assembly

. . Subassembly

. . Attaching parts for subassembly

. . . Detail parts for subassembly

. . . Sub-subassembly

. . . Attaching parts for subassembly

. . . . . Details parts for sub-subassembly

Detail Installation Parts (Included only if installation parts may be sent to the shop as part of assembly)

C. Each top assembly is given one use code letter (A, B, C, etc.) in the USAGE CODE column. All subsequent component parts in the list can have one or more of the use code letters to show effectivity to top assemblies. A component part without a use code applies to all top assemblies.

D. An alphabetical letter is added after the item number for optional parts, parts changed by a Service Bulletin, configuration differences (except left-handed and right-handed parts), last engineering releases, and parts added between item numbers in a sequence. The alphabetical letter will not be shown on the illustration for equivalent parts of the same part number.

E. Color-coded parts are identified with a single digit alpha following the dash number or with ''SP'' suffix. If the ''SP'' suffix is used, it represents consolidation of all color codes applicable for a given usage which are not separately listed. Orders for color-coded parts should include the registry number of the airplane for which the parts are ordered.

F. If a part number is 15 characters long but will not fit in the part number column, the part number will be displayed with a ''~'' at the end of the line and will be continued on the next line. The ''~'' denotes that the part number continues on the next line.

G. Parts changed by a Service Bulletin are shown by PRE SB XXXX and POST SB XXXX added to the NOMENCLATURE column.

(1) When a new top assembly is added by a Service Bulletin, PRE SB XXXX and POST SB XXXX will be added at the top assembly level only. The configuration differences at the detail part level are shown by use code letters.

(2) When the top assembly part number is not changed by the Service Bulletin, PRE SB XXXX and POST SB XXXX will be added at the detail level.

H. Interchangeable Parts

Optional (OPT)	The part is optional to and interchangeable with other parts that have the same item number.
Replaces, Replaced by and not interchangeable with (REPLACES, REPLACED BY AND NOT INTCHG/W)	The part replaces and is not interchangeable with the initial part.
Replaces, Replaced by (REPLACES, REPLACED BY)	The part replaces and is interchangeable with, or is an alternative to, the initial part.

VENDOR CODES

Code	Name
15653	ALCOA GLOBAL FASTENERS INC DIV KAYNAR PRODUCTS 800 S STATE COLLEGE BLVD FULLERTON, CALIFORNIA 92831-3001 FORMERLY VK6405 MICRODOT AEROSP LTD; FORMERLY KAYNAR TECH FORMERLY FAIRCHILD FASTENERS KAYNAR DIV
62554	SIMMONDS MECAERO FASTENERS INC 1734 SEQUOIA AVENUE ORANGE, CALIFORNIA 92668
72962	HARVARD INDUSTRIES INC 3 WERNER WAY SUITE 210 LEBANON, NEW JERSEY 08833 FORMERLY ESNA V7A079 FORMERLY ELASTIC STOP NUT IN UNION, NJ
75345	KIRKHILL RUBBER CO 300 EAST CYPRESS STREET BREA, CALIFORNIA 92821-4097 FORMERLY L.A. STANDARD RUBBER CO V84914
83086	NEW HAMPSHIRE BALL BEARING, INC HITECH DIVISION 172 JAFFREY ROAD PETERBOROUGH, NEW HAMPSHIRE 03458
84914	Replaced: [V84914] LOS ANGELES STD RUBBER CO by Code: Name and Address below 75345: KIRKHILL RUBBER CO 300 EAST CYPRESS STREET BREA, CALIFORNIA 92821-4097 FORMERLY L.A. STANDARD RUBBER CO V84914

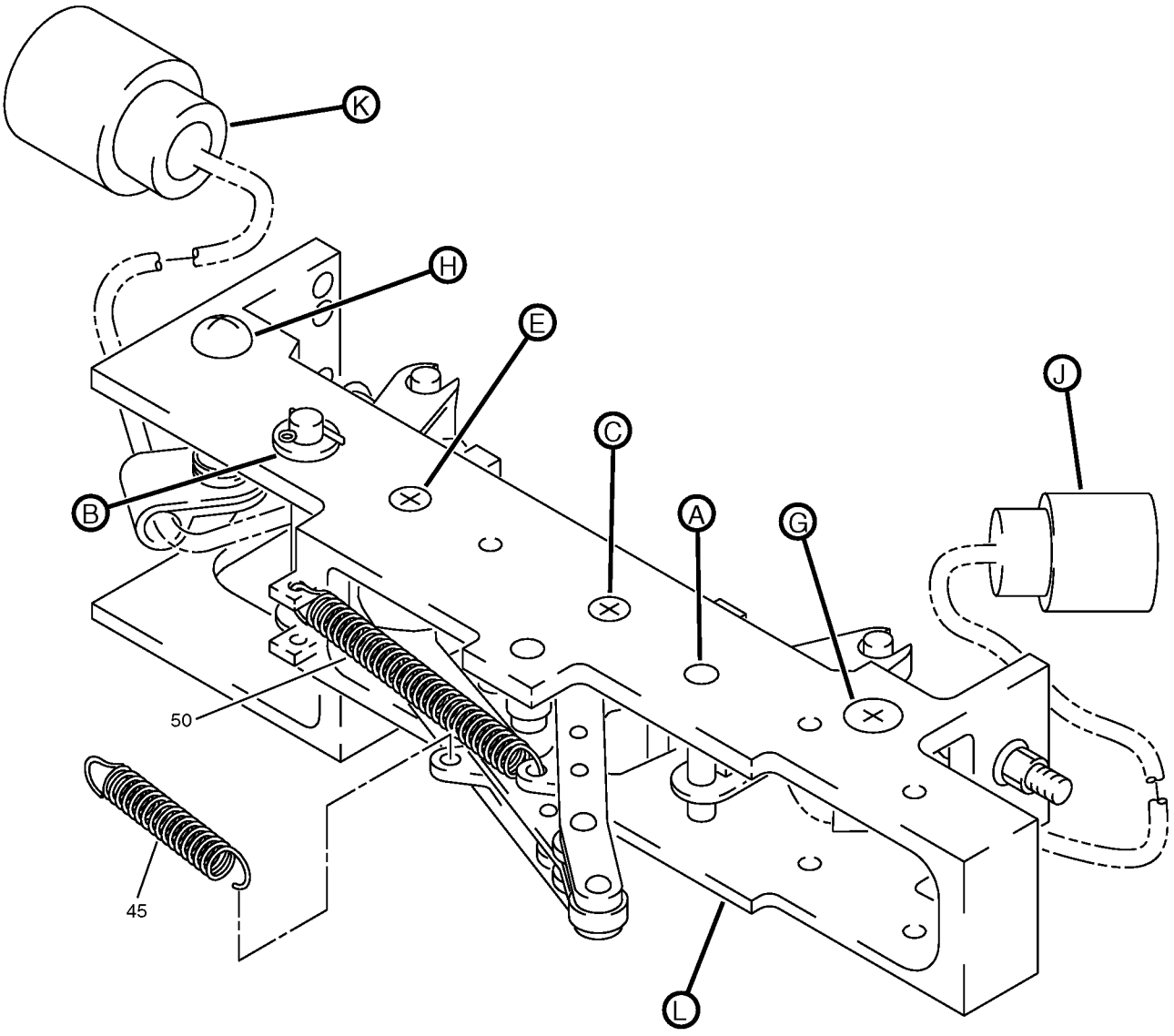
Code	Name
91929	HONEYWELL INC MICRO SWITCH DIV 11 WEST SPRING STREET FREEPORT, ILLINOIS 61032 FORMERLY MICRO SWITCH A DIV OF HONEYWELL FORMERLY V74059 AND V40228
95272	STILLMAN SEL CORP 6020 AVENIDA ENCINAS CARLSBAD, CALIFORNIA 92009-1001 FORMERLY SARGENT IND

NUMERICAL INDEX

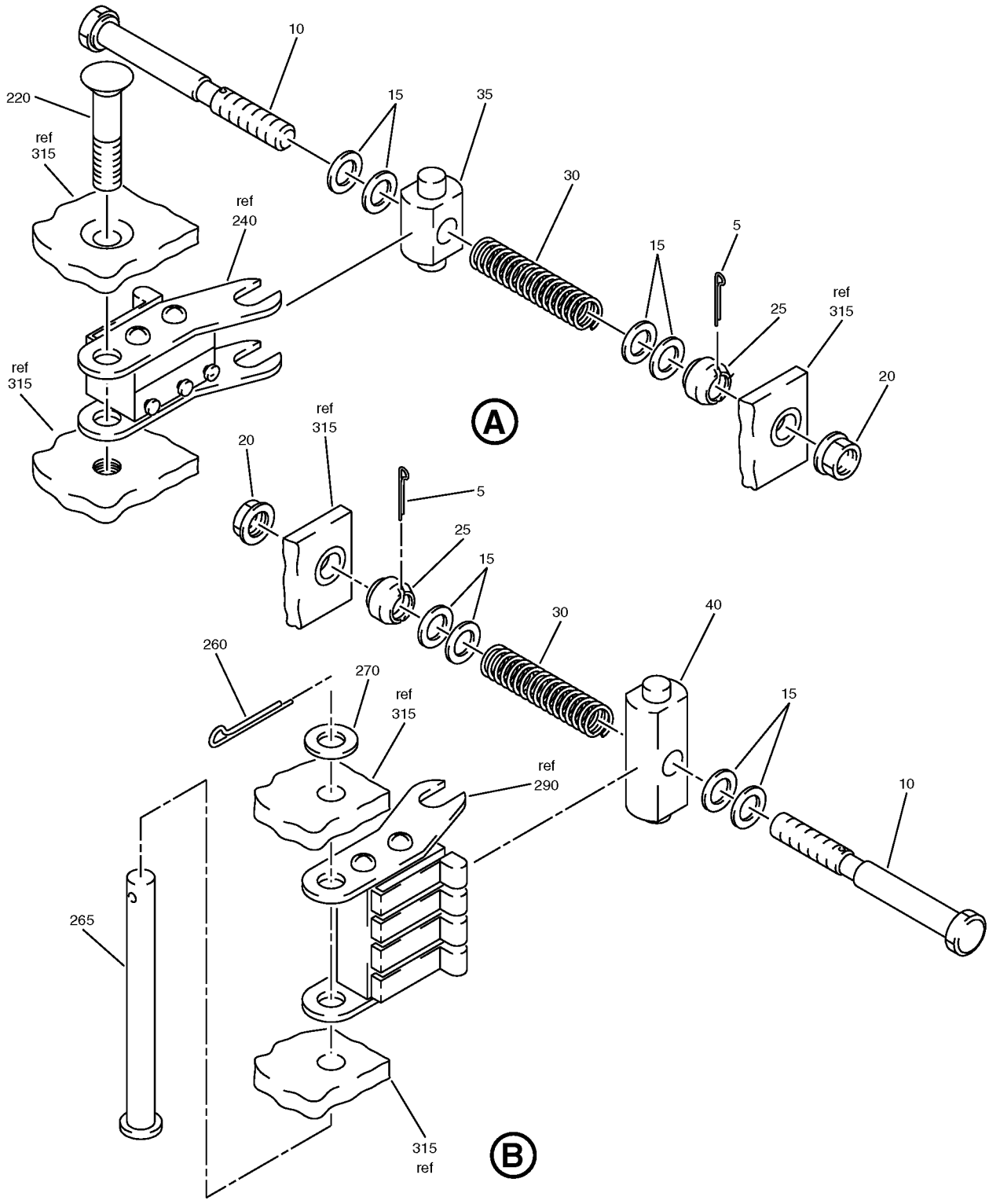
PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	UNITS PER ASSEMBLY
10-60516-361		1	120	2
		1	175	2
141SM2T2		1	250	1
		1	295	4
253T2137-4		1	80	2
		1	135	1
4841		1	205	2
65C36725-1		1	1A	RF
65C36725-2		1	275	1
65C36725-3		1	225	1
65C36726-1		1	315	1
65C36726-2		1	325	1
65C36727-1		1	130	1
65C36727-2		1	75	1
65C36727-3		1	180	1
65C36727-4		1	125	1
69-78676-1		1	95	1
69-78677-1		1	60	2
69-78677-2		1	70	1
69-78678-1		1	220	1
69-78679-1		1	40	1
69B81750-3		1	150	1
69B81752-2		1	240	2
		1	290	2
69B81753-5		1	35	1
69B81754-6		1	10	2
69B81938-1		1	25	2
69B82746-4		1	105	2
		1	160	4
69B82747-1		1	245	1
92-1660-256		1	235	2
		1	285	2
92-1660-26		1	235	2
		1	285	2

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	UNITS PER ASSEMBLY
BAC27TCT0012		1	350	1
BAC27TCT0013		1	345	1
BAC27TCT0014		1	340	1
BAC27TCT0015		1	335	1
BAC27TCT0016		1	330	1
BACB30LH3-4		1	185	1
BACB30LU06-3		1	55	2
BACC10DK4		1	210	2
BACC45FT12A12P		1	255	1
BACC45FT14A15P		1	300	1
BACN10DN26		1	235	2
		1	285	2
BACN10YR08CD		1	20	2
BACN10YR3CD		1	200	2
BACP20BA1		1	205	2
BACR15BA4AD		1	305	1
BACR15BB3D		1	90	2
		1	145	2
BACR15BB4AD		1	305A	1
BACS12BE02-21		1	280	2
BACS12BG02P3		1	100	2
		1	155	4
BCREF11098		1	85	2
		1	140	1
H52732-08CD		1	20	2
H52732-3CD		1	200	2
MS20392-2C63		1	265	1
MS21209C0625		1	65	1
MS21209C0810		1	320	2
MS24585C95		1	30	2
MS24586C47		1	45	1
MS24586C70		1	50	1
MS24665-132		1	260	1
MS24665-5		1	5	2
MS35214-9		1	230	2

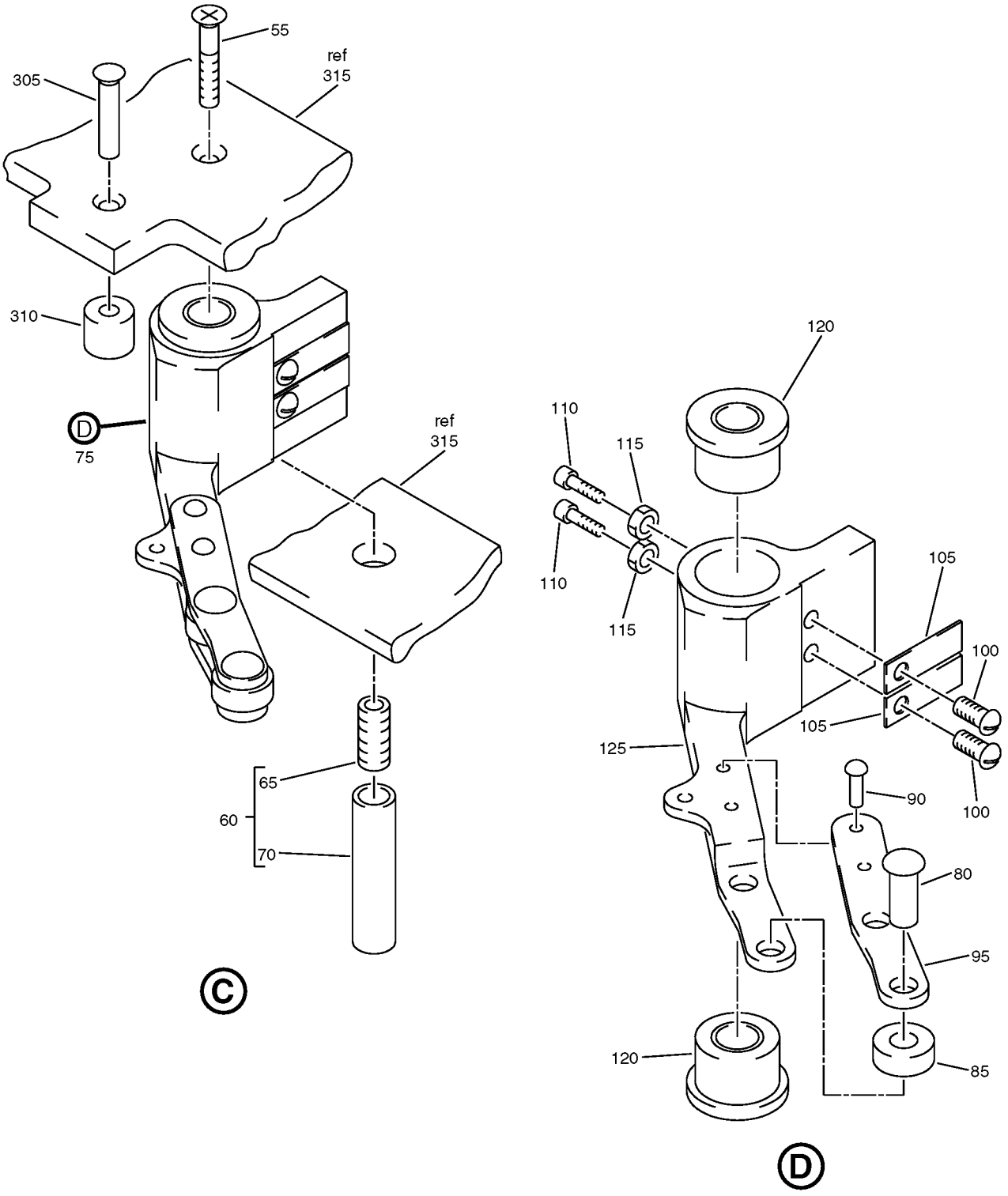
PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	UNITS PER ASSEMBLY
MS35649-222		1	115	2
		1	170	4
N2088		1	205	2
NAS1149D0332K		1	195	3
		1	270	1
NAS1149DN832K		1	15	8
NAS1352-02-8P		1	110	2
		1	165	4
NAS42DD4-20FC		1	310	1
NAS42DD6B28FC		1	215	1
NAS623-3-10		1	190	1
PLH508CD		1	20	2
PLH53CD		1	200	2
S618CE		1	85A	2
		1	140A	1
SSR1-618EEHA7P25LDP		1	85	2
		1	140	1
SZ7105		1	205	2



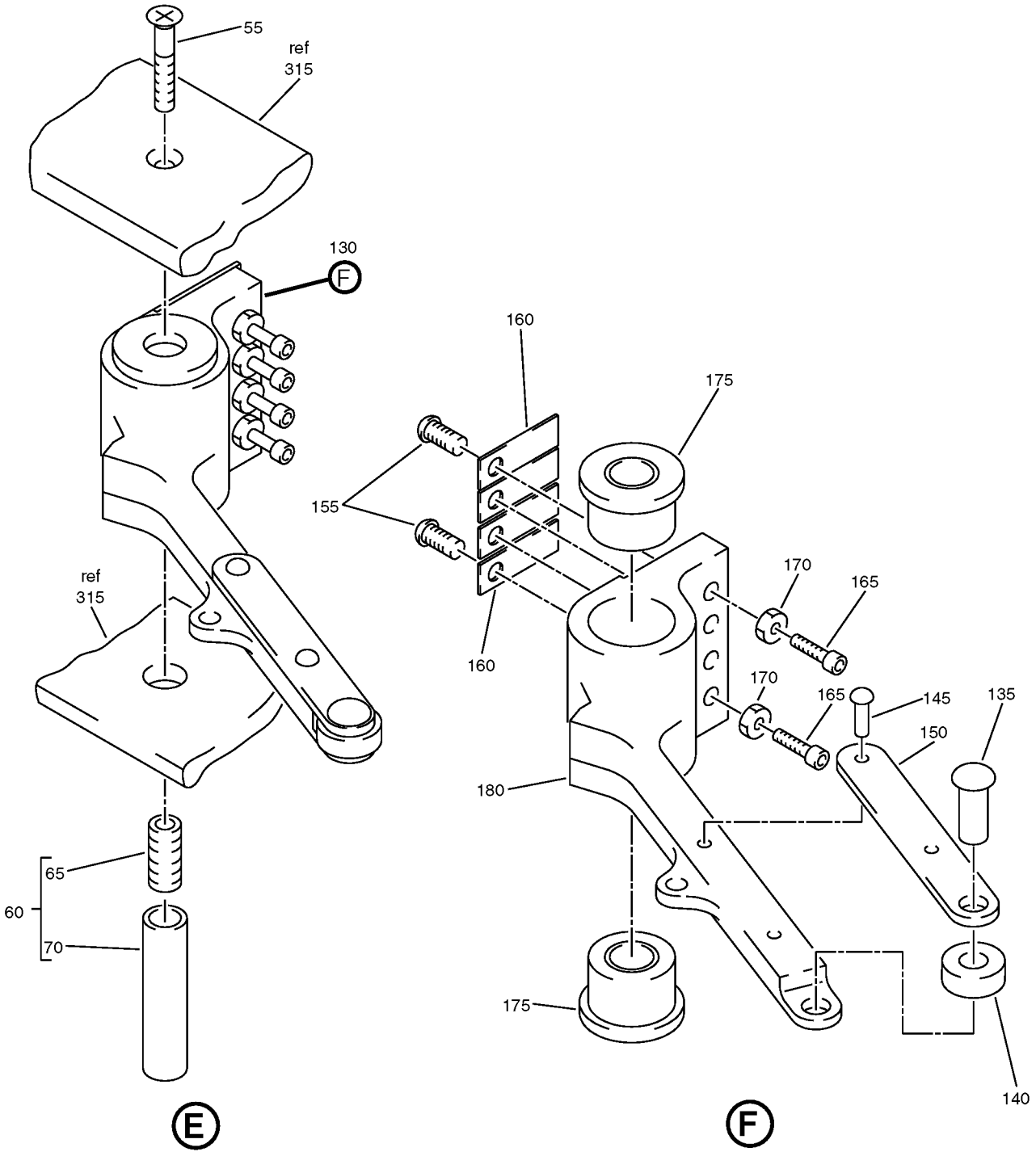
Autothrottle Switch Pack Assembly
IPL Figure 1 (Sheet 1 of 7)



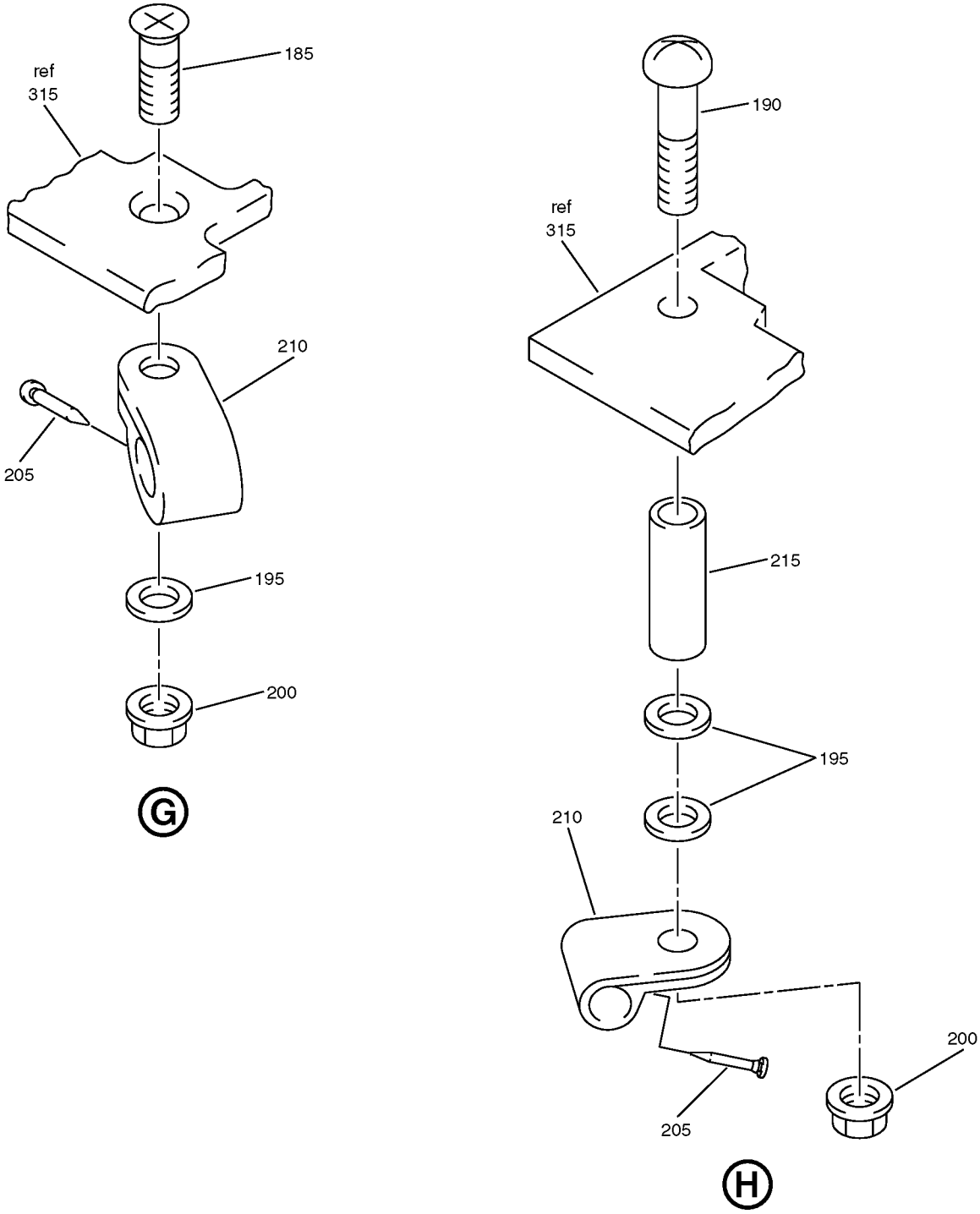
Autothrottle Switch Pack Assembly
IPL Figure 1 (Sheet 2 of 7)



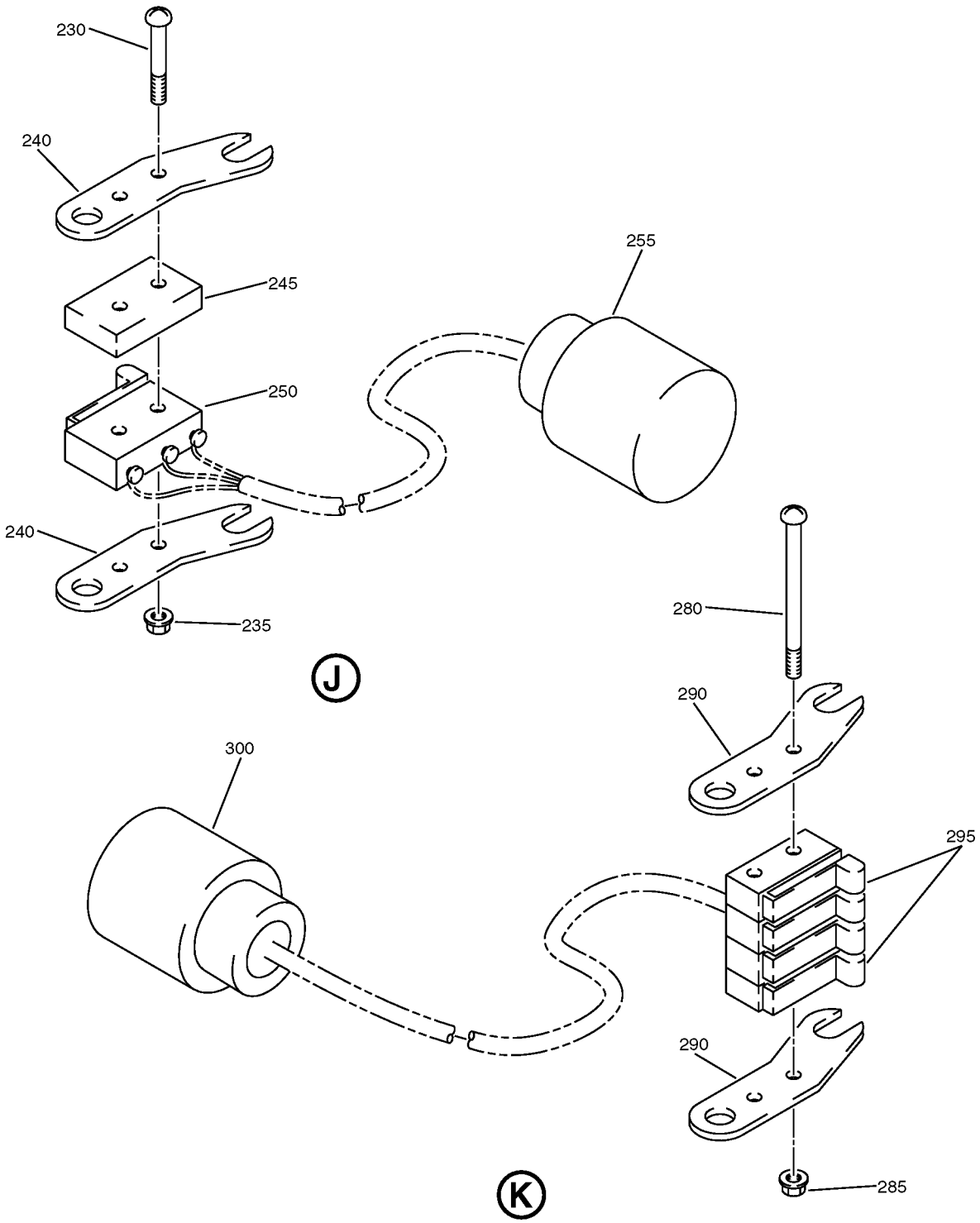
Autothrottle Switch Pack Assembly
IPL Figure 1 (Sheet 3 of 7)



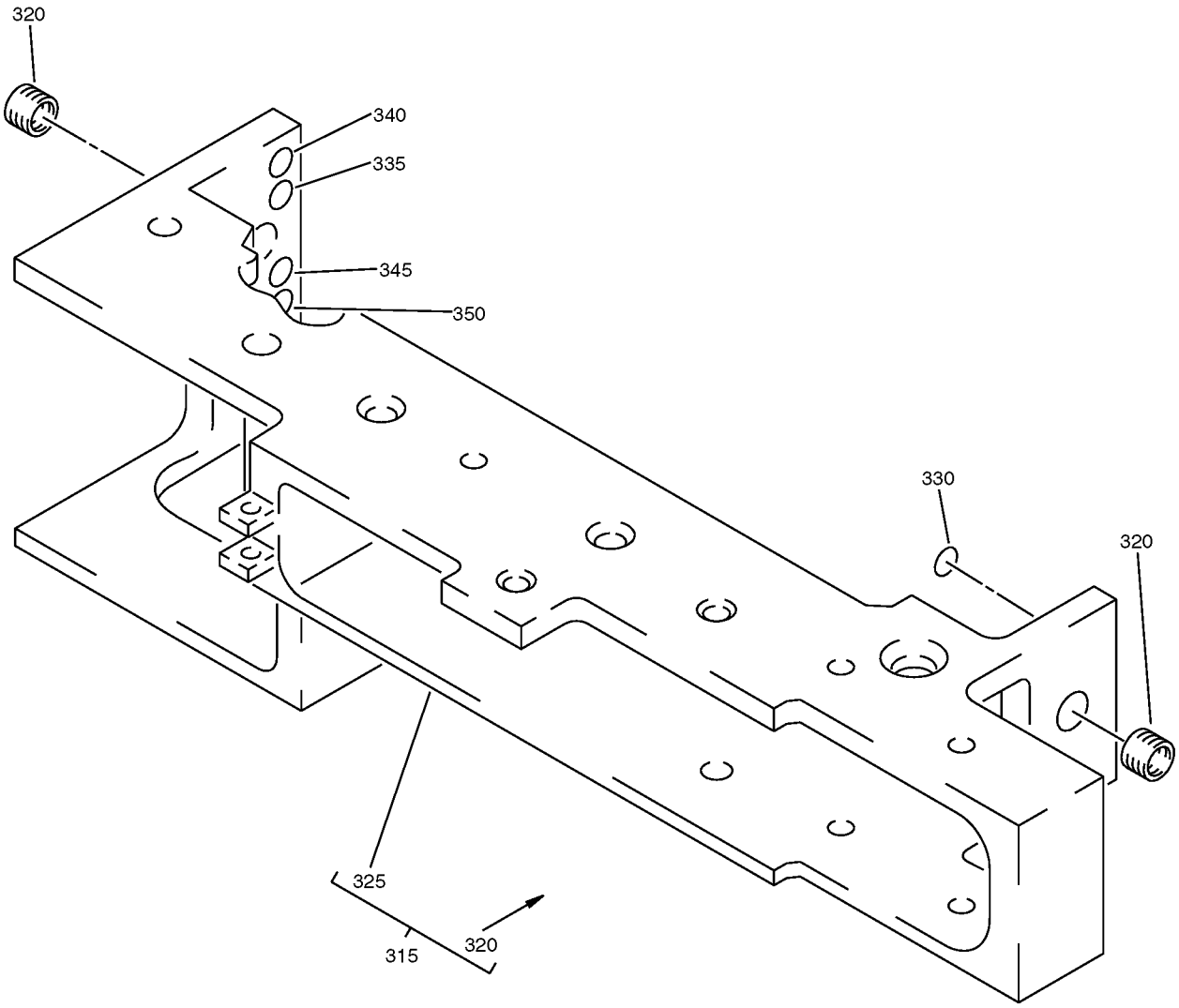
Autothrottle Switch Pack Assembly
IPL Figure 1 (Sheet 4 of 7)



Autothrottle Switch Pack Assembly
IPL Figure 1 (Sheet 5 of 7)



Autothrottle Switch Pack Assembly
IPL Figure 1 (Sheet 6 of 7)



Autothrottle Switch Pack Assembly
IPL Figure 1 (Sheet 7 of 7)

FIG/ ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
1–					
–1A	65C36725-1		PACK ASSY-AUTOTHROTTLE SWITCH		RF
5	MS24665-5		. PIN-COTTER		2
10	69B81754-6		. BOLT		2
15	NAS1149DN832K		. WASHER		8
20	PLH508CD		. NUT (V62554) (SPEC BACN10YR08CD) (OPT H52732-08CD (V15653))		2
25	69B81938-1		. NUT		2
30	MS24585C95		. SPRING		2
35	69B81753-5		. TRUNNION		1
40	69-78679-1		. TRUNNION		1
45	MS24586C47		. SPRING		1
50	MS24586C70		. SPRING		1
55	BACB30LU06-3		. BOLT		2
60	69-78677-1		. SHAFT ASSY		2
65	MS21209C0625		. . INSERT		1
70	69-78677-2		. . SHAFT		1
75	65C36727-2		. ARM ASSY		1
80	253T2137-4		. . RIVET-BRG		2
85	BCREF11098		. . BEARING (V83086) (SSR1-618EEHA7P25LDP) (OPT ITEM 85A)		2
–85A	S618CE		. . BEARING (V83086) (OPT ITEM 85)		2
90	BACR15BB3D		. . RIVET (SIZE DETERMINED ON INST)		2
95	69-78676-1		. . RETAINER		1
100	BACS12BG02P3		. . SCREW		2
105	69B82746-4		. . PAD		2
110	NAS1352-02-8P		. . SCREW		2
115	MS35649-222		. . NUT		2

–Item not Illustrated

FIG/ ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
1–					
120	10-60516-361		. . BUSHING		2
125	65C36727-4		. . ARM		1
130	65C36727-1		. ARM ASSY		1
135	253T2137-4		. . RIVET-BRG		1
140	BCREF11098		. . BEARING (V83086) (SSR1-618EEHA7P25LDP) (OPT ITEM 140A)		1
–140A	S618CE		. . BEARING (V83086) (OPT ITEM 140)		1
145	BACR15BB3D		. . RIVET (SIZE DETERMINED ON INST)		2
150	69B81750-3		. . SUPPORT		1
155	BACS12BG02P3		. . SCREW		4
160	69B82746-4		. . PAD		4
165	NAS1352-02-8P		. . SCREW		4
170	MS35649-222		. . NUT		4
175	10-60516-361		. . BUSHING		2
180	65C36727-3		. . ARM		1
185	BACB30LH3-4		. BOLT		1
190	NAS623-3-10		. SCREW		1
195	NAS1149D0332K		. WASHER		3
200	PLH53CD		. NUT (V62554) (SPEC BACN10YR3CD) (OPT H52732-3CD (V15653))		2
205	N2088		. PLUG (V75345) (SPEC BACP20BA1) (OPT SZ7105 (V95272)) (OPT 4841 (V84914))		2
210	BACC10DK4		. CLAMP		2
215	NAS42DD6B28FC		. SPACER		1
220	69-78678-1		. BOLT		1
–225	65C36725-3		. WIRE BUNDLE ASSY		1

–Item not Illustrated

FIG/ ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
1–					
230	MS35214-9		. . SCREW		2
235	92-1660-256		. . NUT (V15653) (SPEC BACN10DN26) (OPT 92-1660-26 (V72962))		2
240	69B81752-2		. . ARM		2
245	69B82747-1		. . SPACER		1
250	141SM2T2		. . SWITCH (V91929)		1
255	BACC45FT12A12P		. . CONNECTOR		1
260	MS24665-132		. PIN-COTTER		1
265	MS20392-2C63		. PIN-DRILLED SHANK		1
270	NAS1149D0332K		. WASHER		1
–275	65C36725-2		. WIRE BUNDLE ASSY		1
280	BACS12BE02-21		. . SCREW		2
285	92-1660-256		. . NUT (V15653) (SPEC BACN10DN26) (OPT 92-1660-26 (V72962))		2
290	69B81752-2		. . ARM-MTG		2
295	141SM2T2		. . SWITCH (V91929)		4
300	BACC45FT14A15P		. . CONNECTOR		1
305	BACR15BA4AD		. RIVET (SIZE DETERMINED ON INST) (OPT ITEM 305A)		1
–305A	BACR15BB4AD		. RIVET (SIZE DETERMINED ON INST) (OPT ITEM 305)		1
310	NAS42DD4-20FC		. SPACER		1
315	65C36726-1		. HOUSING ASSY		1
320	MS21209C0810		. . INSERT		2
325	65C36726-2		. . HOUSING		1
330	BAC27TCT0016		. MARKER-S5		1
335	BAC27TCT0015		. MARKER-S4		1

–Item not Illustrated

FIG/ ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
1–					
340	BAC27TCT0014		. MARKER-S3		1
345	BAC27TCT0013		. MARKER-S2		1
350	BAC27TCT0012		. MARKER-S1		1

–Item not Illustrated