

Component Maintenance Manual

Brush Assemblies Electrothermal Propeller De-Icing Systems

ATA 30-60-01

Revised January 2, 2003

Modular Brush Assemblies

3E2042 series	3E2044 series
3E2046 series	3E2062 series
3E2071 series	3E2090 series
4E2360-2	

Constant Force Modular Brush Assemblies

3E2334 series	3E2342 series
3E2346 series	3E2414 series
3E2456 series	3E2457 series

Brush Block Assemblies

4E1213	4E1283
4E1294	4E1311 series
4E1327	4E1350 series
4E1387 series	4E1560-2
4E1639	4E1749-2,
4E1908-1	

Heavy Duty Brush Assemblies

4E3096-1	4E3097-1
4E3196-1	4E3197-1

(Supersedes 30-60-13 and 30-60-20)

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INTRODUCTION

A. General

There are four general types of brush assemblies used in Goodrich Electrothermal Propeller De-Icing Systems. They are Modular Brush Assemblies, Constant Force Modular Brush Assemblies, Heavy Duty Brush Assemblies and Brush Block Assemblies. Information specific to each type of brush assembly is provided in Sections I-IV of this manual. General information applicable to all brush assemblies is provided in the Introduction.

This component maintenance manual has been compiled using the requirements in specification ATA 100 as a guideline. It is intended to provide the data necessary to clean, repair and install replacement parts for Goodrich brush assemblies.

B. Manufacturing

The brush assemblies are manufactured and supported by:

Goodrich De-Icing and Specialty Systems Division
1555 Corporate Woods Pkwy.
Uniontown, OH 44685

C. Special Precautions

Warnings, Cautions and Notes are used throughout the text to highlight and emphasize important points, as they become necessary. Warnings give information that must be followed precisely to avoid personal injury and/or possible death. Cautions contain information that must be followed to avoid damage to equipment. Notes assist the reader and make the technician's job easier.

D. Layout of Manual

This manual is divided into four sections each covering a particular brush assembly type:

- I. Modular Brush Assemblies
- II. Constant Force Modular Brush Assemblies
- III. Brush Block Assemblies
- IV. Heavy Duty Brush Assemblies.

Each section contains a general description followed by data for check, cleaning and repair of the particular brush assembly type.

All weights and measures used in this manual are in U.S. (English) units, followed by the S.I. (International System of Units) equivalent in parentheses.

E. Applicability

The information contained in this manual is applicable only to brush assemblies and replacement parts manufactured by Goodrich.

F. Replacement Parts

Only replacement parts manufactured by Goodrich should be used in Goodrich brush assemblies.

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G. Complete Instructions and Information

Before proceeding it is recommended that the user read the instructions contained in this manual and other pertinent technical documentation completely. This manual is intended for use in conjunction with the following publications:

- 1) 30-60-02 Goodrich Installation and Maintenance Manual for Propeller De-Icing Systems
- 2) Applicable Aircraft Manual
- 3) Applicable De-icing System Manual

H. Sound Aircraft Maintenance Practices

Sound aircraft maintenance practices should always be followed when performing the procedures described in this manual. For the purposes of this manual, of particular importance are safety wiring and soldering methods.

I. MODULAR BRUSH ASSEMBLIES

A. Description

Each modular brush assembly contains two or three brush modules. Each brush module consists of a plastic housing with an integral brush and spring. Variations of the basic brush module (Part Number 3E2011) are shown in Figure 1. The brush modules are stacked with appropriate spacers to produce modular brush assemblies. Screws hold the brush modules and spacers together, forming the modular brush assembly.

The part number series for modular brush assemblies are 3E2042, 3E2044, 3E2046, 3E2062, 3E2071 and 3E2090. (For replacement parts lists and illustrations, see Figures 10-15.) Each series includes a different combination of brush modules and spacer(s). Different dash numbers within a part number series indicate different stacking arrangements.

B. Universal Replacement Brush Module Assembly 3E2011-10

Item	Description	P/N	Used on 3E2011(-X)
1	Silicone Tubing	BEN HAR 1258-2 #14 white	all
2	Insulating Bushing	2E1260	-2,-4,-8,-10
3	Ring Terminal	AMP 320619	all except -9
3A	Ring Terminal (alt)	Hollingsworth XR2442SN	all except -9
4	Lockwasher	MS35333-37	all except -9
5	Round Head Screw	MS35214-26	all except -8 & -9
5A	Round Head Screw	MS35214-27	-8
5B	Round Head Screw (alt 5A)	MS35214-28	-8
6A	Wire marker	"A"	-1,-4,-10
6B	Wire Marker	"B"	-2,-5,-8,-10
6C	Wire Marker	"C"	-3,-6,-10
-	Shrink Tubing	RNF100 3/16" White	-9
-	Replacement Brush*	3E1206-7	-9
-	Replacement Brush*	3E1443-7	all except -9

*Includes A,B,C markers, tubing, ring terminal

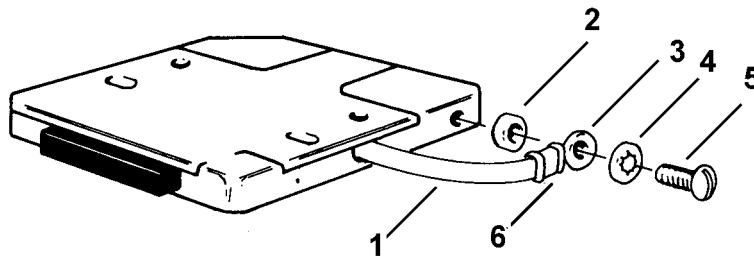


Figure 1
3E2011 series brush module

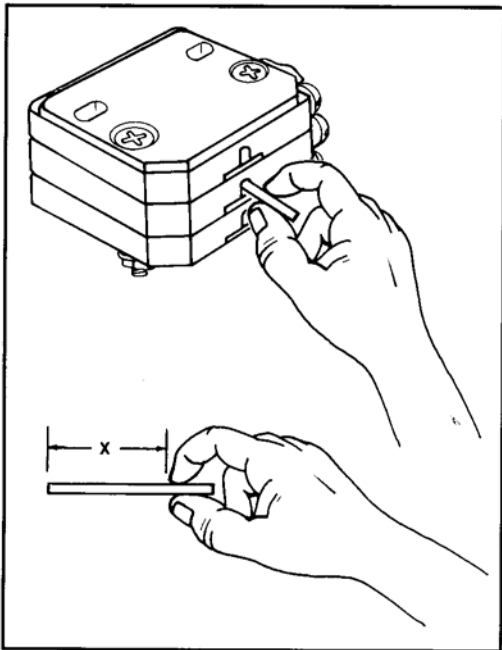
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NOTE: The 3E2011-10 universal replacement brush module cannot be used in place of P/N's 3E2011-6, -8 and -9.

P/N 3E2011-10 is a universal replacement brush module, which can be used in place of brush module assemblies 3E2011-1, -2, -3, -4, & -5. P/N 3E2011-10 comes with A, B, C, wire markers and nylon spacers, so that it can be configured as required for the specific application. Be sure to note the correct terminal identification and spacer position, so the universal replacement module can be correctly configured. Figure 1 and accompanying parts list illustrates the 3E2011 series brush modules, including the 3E2011-10 universal replacement module.

C. Measuring Brush Wear

Figure 2 illustrates how to measure brush wear and the measurement at which brush replacement is required. During measurement 1/16" of the brush should protrude from the brush module. This is the normal position of the brush when installed on the aircraft. When the X-dimension is reached, brush replacement is mandatory.



**Figure 2 - Measuring Brush Wear
Modular Brush Assemblies**

Modular Brush Assemblies	X-Dimension (Inches) MUST Replace
All modules having brushes with rods	23/64"
All modules having brushes without rods	1-25/64"
During measurement only 1/16" of brush should be allowed to protrude from brush block. This is normal position of the brush when installed on the aircraft.	

D. Brush Replacement

NOTE: The figures show brush replacement in an individual brush module for illustrative purposes. However it is not necessary to separate the brush modules in order to replace a brush. The 3E1443-7 replacement brush includes A,B,C wire markers, insulation tubing, and ring terminal.

Remove modular brush assembly from the aircraft. When the brush module is not worn or damaged, individual brushes can be replaced as follows.

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1. Removal of Worn Brushes

- a. Remove the #6-32 screw securing the ring terminal to the brush module. Note the brush wire marker A, B or C. Save spacer(s) (if installed).
- b. Remove the ring terminal from the brush lead and remove the brush through the brush slot in the module.
- c. Inspect the brush slot for signs of uneven wear, and replace the brush module unit as required.
- d. Inspect the inside of the brush module for foreign material and clean as required.
- e. Clean the outside of the brush slot to remove carbon deposits.

2. Installation of New Brush

NOTE: The brush module lid and base are bonded together. Do not try to pry them apart.

- a. Slide tubing over brush lead so end of tubing almost contacts the brush.
- b. Form the lead in an arc as shown in Figure 3.
- c. Insert the lead into the brush slot and slide the brush into the module until the lead protrudes through the exit hole, as shown in Figure 4.
- d. Compress the brush and pull the lead out of the exit hole until the maximum available lead length is external to the brush module.
- e. Secure the compressed brush with a rubber band as shown in Figure 5, and slide the tubing on the lead to within 3/16" of the end of the bare wire.
- f. Install the ring terminal so that the end of the tubing is positioned inside the jacket of the ring terminal and no bare wire is exposed.
- g. Crimp the ring terminal in place with crimping tool.
- h. Replace the screw and washer and spacer(s) (if required) as shown in Figure 6.
- i. Remove the rubber band and carefully pull the brush until all slack in the lead is encased in the module. Compress and release the brush to assure it does not bind or hang up inside the module.

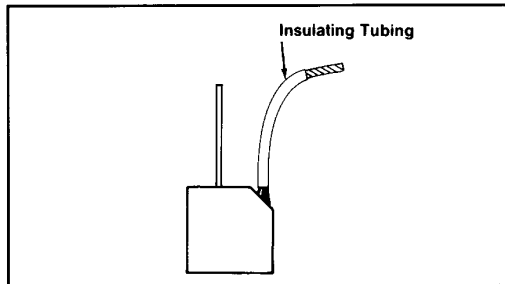


Figure 3 - Forming Replacement Brush Lead

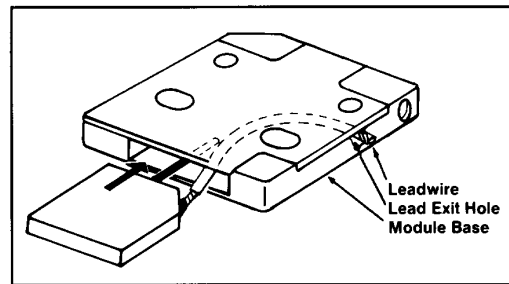


Figure 4 - Threading Lead thru Exit Hole

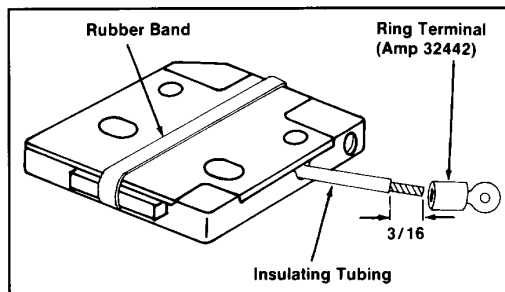


Figure 5 - Securing Brush with Rubber Band

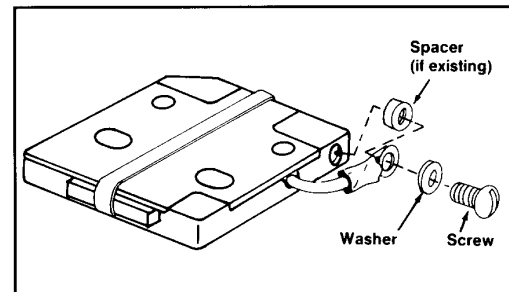


Figure 6 - Attaching Terminal to Lead

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E. Brush Module Replacement

1. Remove the modular brush assembly from the aircraft.
2. Remove the assembly screws and separate the modules and spacers.
3. Replace the worn module with the replacement module. The part number of each brush module is etched on the module lid: be sure to replace it with the same part number, or as listed in Paragraph B, the universal replacement module 3E2011-10, appropriately configured.
4. Stack the modules and spacers in correct order. When there is interference between the adjacent ring terminals, adjust the center module as shown in Figure 7.
5. Secure the modules and spacers. For 3E2046 series assemblies, use Loctite 242 or equivalent on the threads of the assembly screws. Make sure the assembly is squarely positioned and tighten the screws. For all other part numbers, install the flat washer between the module and the star washer, then tighten the screws.
6. Reconnect the aircraft wire harness, matching the A, B, C, terminals. Make sure that adjacent ring terminals do not touch.
7. Install the assembly on the aircraft.

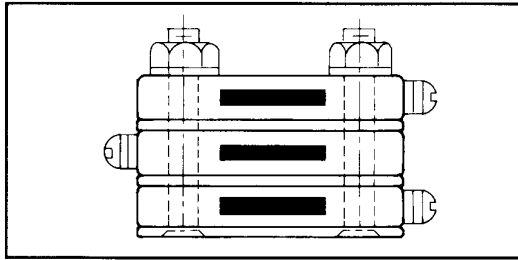


Figure 7 - Alternate Stacking Arrangement

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F. Alignment

1. Radial alignment of the modular brush assembly to the slip assembly is crucial to de-icing system operation. The brushes must contact the slip rings throughout 360 degrees of slip ring rotation. Angular fore and aft alignment prevents side loading and premature wear of the brushes and brush modules. Figures 8 & 9 illustrate correct and incorrect alignment.

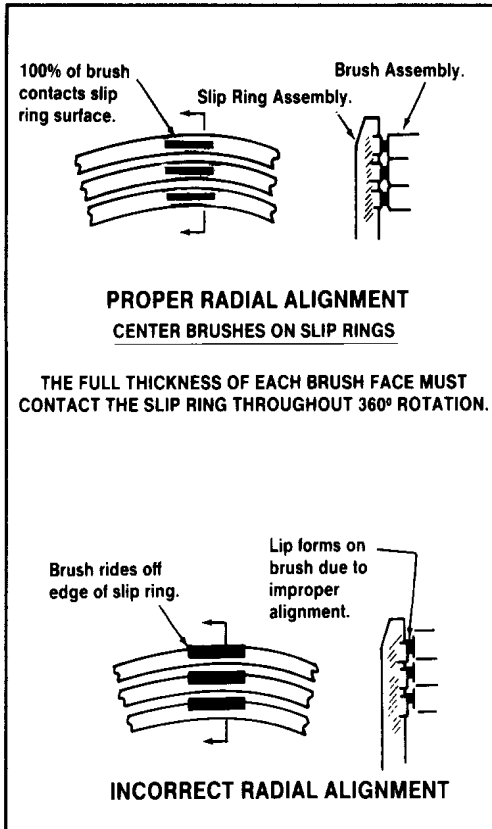


Figure 8 - Radial Brush Alignment

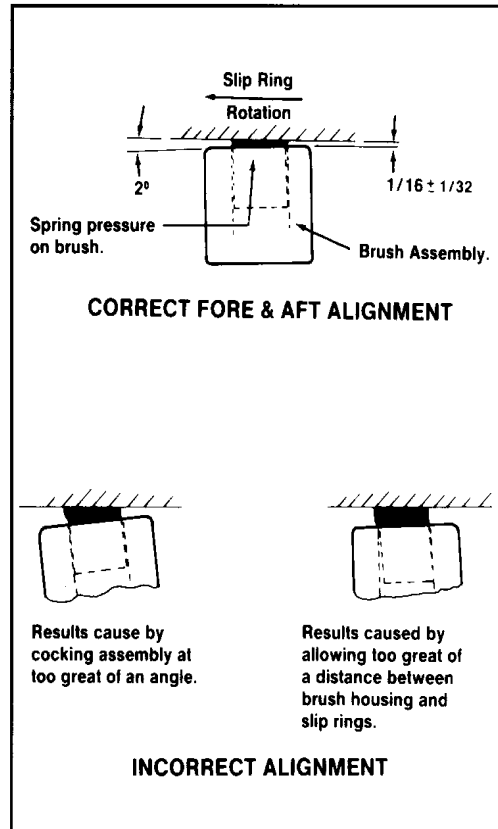
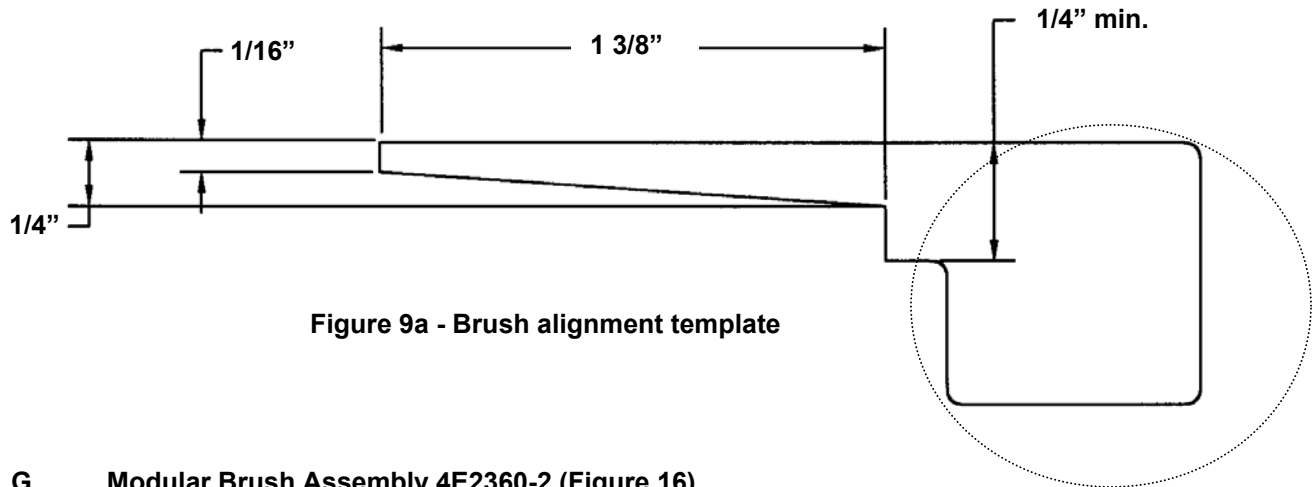


Figure 9 - Fore and Aft Brush Alignment

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2. A template can be devised to facilitate brush alignment per Figure 9a. Only critical dimensions shown. Portion of template within dotted circle serves as a handle to grasp the template. It can be fabricated to shape and dimensions desired.



G. Modular Brush Assembly 4E2360-2 (Figure 16)

1. Brush Replacement

- a. Remove the modular brush assembly from the aircraft by removing attachment hardware, and disconnecting the engine wire harness. When the brush module housings are not worn or damaged, individual brushes can be replaced as follows.
- b. Removal of Worn Brush
- i. Remove screws holding receptacle plug to the bracket and remove shrink tubing from appropriate receptacle pin.
 - ii. Desolder applicable lead from receptacle and remove worn brush through the brush slot.
 - iii. Inspect brush module for signs of uneven wear, and replace as required.
 - iv. Inspect the inside of the brush module for foreign material and clean as required.
 - v. Clean the outside of the brush slot to remove carbon deposits.
- c. Installation of New Brush
- i. Prepare and install brush as shown in Figures 3 & 4.
 - ii. Place new shrink tubing over the brush lead wire prior to soldering lead to receptacle. (The shrink tubing is taped to the top of the replacement module when it is shipped.)
 - iii. Solder lead to appropriate receptacle pin.
 - iv. Cover entire exposed solder cup with shrink tubing and overlap onto brush lead by 1/8". Heat tubing, shrinking it over solder connection.
 - v. Connect receptacle to bracket, install modular brush assembly on the aircraft, and reconnect engine wire harness to receptacle plug. Check brush alignment per Figures 8 & 9.

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2. Brush Module Replacement

- a. Disconnect modular brush assembly from engine wire harness and remove from the aircraft.
- b. Remove countersunk screws securing modular brush assembly to bracket and separate modules.
- c. Remove screws securing receptacle to bracket.
- d. Remove shrink tubing from appropriate receptacle pin and desolder brush lead from receptacle.
- e. Stack modules in correct sequence. The A brush module must be positioned against the bracket, followed by the B and C modules, respectively. This order is necessary for correct electrical wiring when installed on the aircraft.
- f. Secure receptacle and modular brush assembly to bracket. The correct order for washer and nut installation on the modular brush assembly is: flat washer against assembly, star washer, nut.
- g. Before tightening countersunk screws, check for free brush movement, and that brush modules are square to one another. The brush should extend approximately 1/2" from brush module.
- h. Install modular brush assembly on aircraft and connect engine wire harness to receptacle plug. Check brush alignment per Figures 8 & 9.

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Modular Brush Assemblies Parts List

- | | | |
|-----|---------------------------|-------------|
| 1. | Brush Module Assembly "A" | 3E2011-1* |
| 2. | Brush Module Assembly "B" | 3E2011-2* |
| 3. | Brush Module Assembly "C" | 3E2011-3* |
| 4. | Brush Module Assembly "A" | 3E2011-4* |
| 5. | Brush Module Assembly "B" | 3E2011-5* |
| 6. | Spacer | 4E2218-3 |
| 7. | Spacer | 4E2218-4 |
| 8. | Spacer | 4E2218-5 |
| 9. | Spacer | 4E2218-6 |
| 10. | Screw (#6-32 X 1 3/8") | MS24693-S35 |
| 11. | Screw | MS24693-S34 |
| 12. | Washer | AN960C6 |
| 13. | Lockwasher | MS35333-37 |
| 14. | Nut | MS35649-262 |
| 15. | Brush Module Assembly "C" | 3E2011-6 |
| 16. | Screw | MS24693-S32 |
| 17. | Brush | 3E1443-7 |
| 18. | Brush Module Assembly "B" | 3E2011-8 |

*3E2011-10 is a universal replacement part number.
 For 3E2011 parts call-out, see Figure 1.

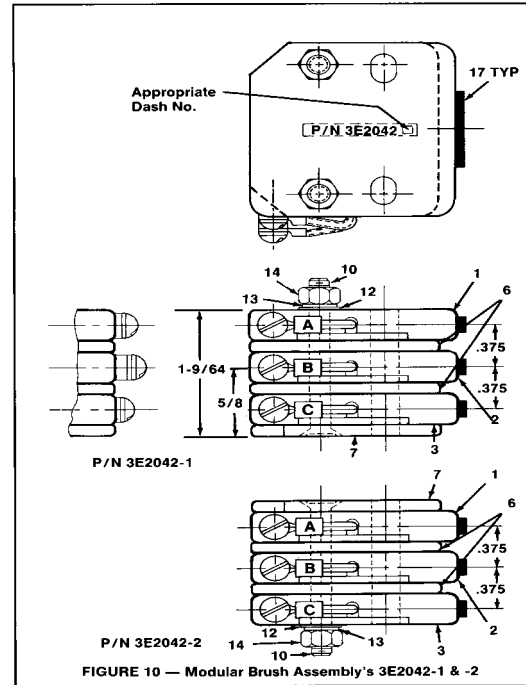


FIGURE 10 — Modular Brush Assembly's 3E2042-1 & -2

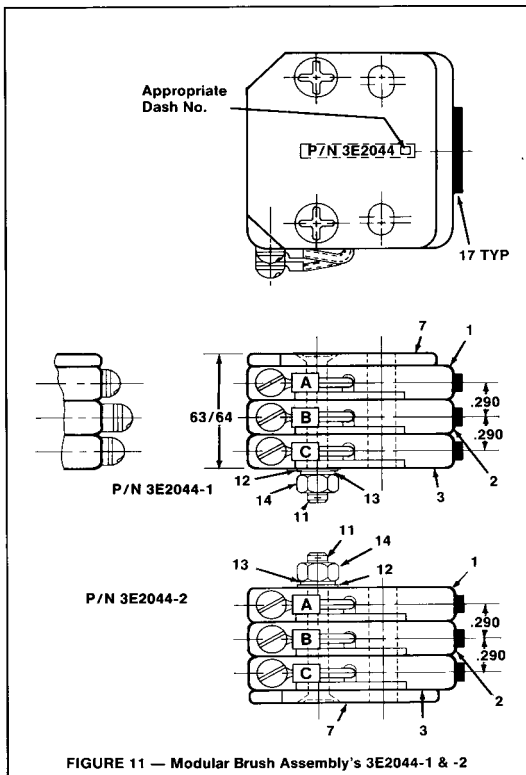


FIGURE 11 — Modular Brush Assembly's 3E2044-1 & -2

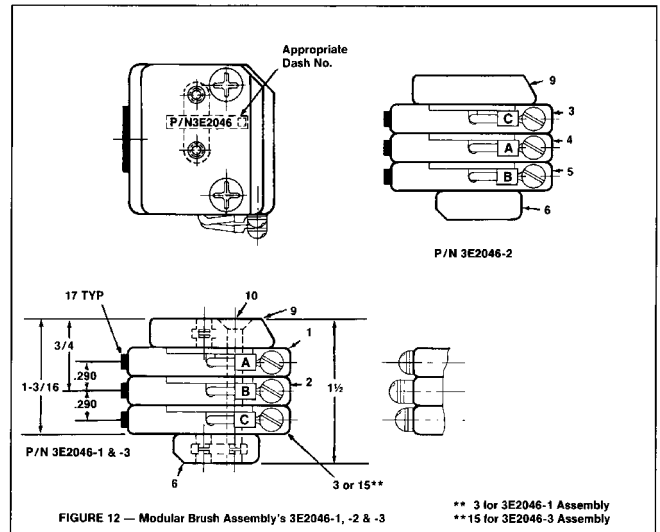
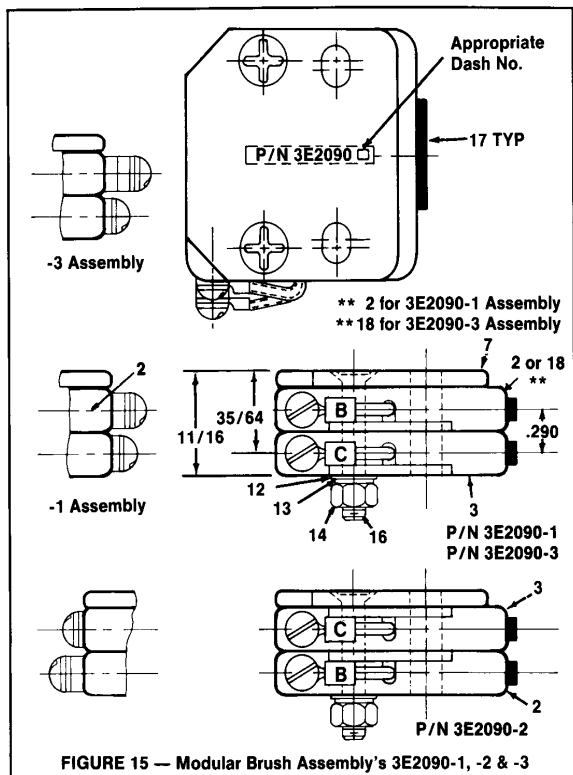
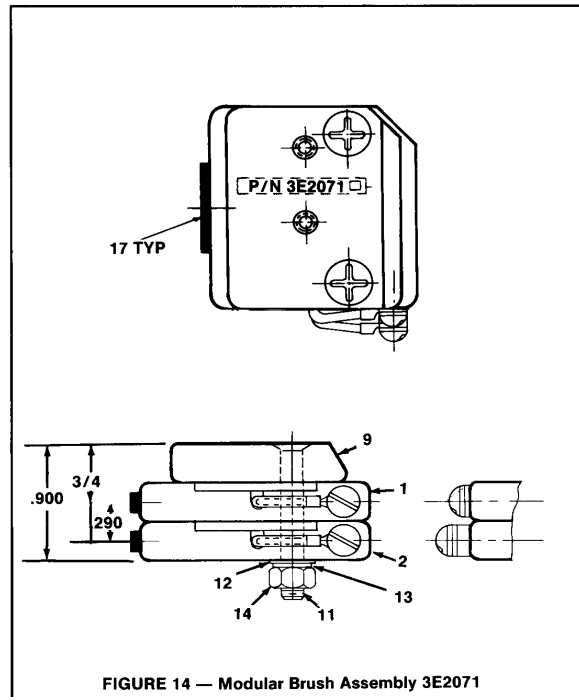
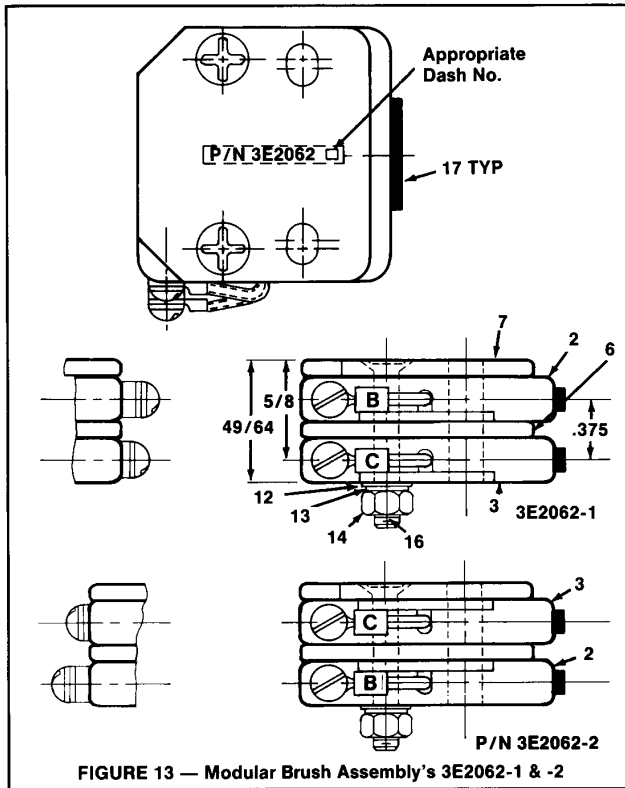


FIGURE 12 — Modular Brush Assembly's 3E2046-1, -2 & -3

** 3 for 3E2046-1 Assembly
 ** 15 for 3E2046-3 Assembly

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Modular Brush Assemblies Parts List

1.	Brush Module Assembly "A"	3E2011-1*
2.	Brush Module Assembly "B"	3E2011-2*
3.	Brush Module Assembly "C"	3E2011-3*
4.	Brush Module Assembly "A"	3E2011-4*
5.	Brush Module Assembly "B"	3E2011-5*
6.	Spacer	4E2218-3
7.	Spacer	4E2218-4
8.	Spacer	4E2218-5
9.	Spacer	4E2218-6
10.	Screw (#6-32 X 1 3/8")	MS24693-S35
11.	Screw	MS24693-S34
12.	Washer	AN960C6
13.	Lockwasher	MS35333-37
14.	Nut	MS35649-262
15.	Brush Module Assembly "C"	3E2011-6
16.	Screw	MS24693-S32
17.	Brush	3E1443-7
18.	Brush Module Assembly "B"	3E2011-8

*3E2011-10 is a universal replacement part number.
 For 3E2011 parts call-out, see Figure 1.

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1.	Brush Retainer Assembly	3E2114-1
2.	Brush Module Assembly	3E2011-9
3.	Brush	3E1206-7
4.	Bracket	3E2107
5.	Receptacle	MS3102A10SL-3P
6.	Screw	AN500AD4-7
7.	Washer	AN960C4
8.	Nut	MS24693-S34
9.	Screw	MS24693-S34
10.	Washer	AN960C6
11.	Lockwasher	MS35333-37
12.	Nut	MS35649-262

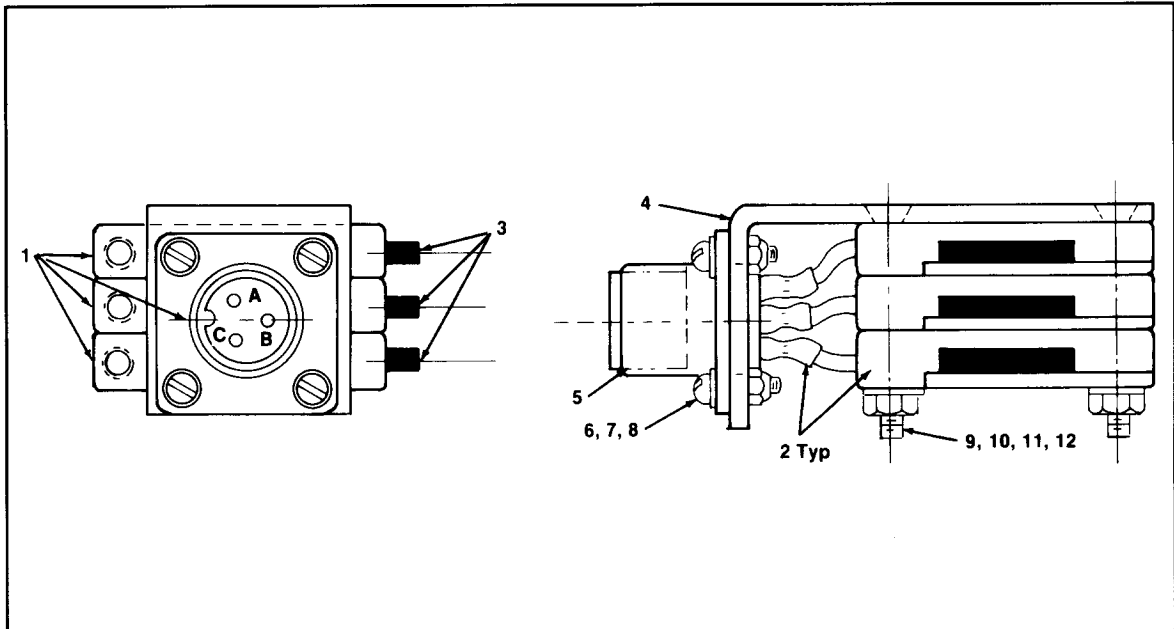


Figure 16 - 4E2360-2

II. CONSTANT FORCE MODULAR BRUSH ASSEMBLIES

A. Description

NOTE: Constant force modular brush assemblies are not directly interchangeable with standard modular brush assemblies, unless specified by the aircraft manufacturer.

To accommodate the increased propeller de-icing system usage by regional air carriers, Goodrich designed a constant force modular brush assembly. Each constant force modular brush assembly contains two or more brush modules. Each module consists of a plastic housing with an integral brush and two constant force springs. Variations of the basic module (P/N 3E2320) are shown in Figure 17. The brush modules are stacked with appropriate spacers to produce constant force modular brush assemblies. The P/N's for constant force modular brush assemblies are 3E2334-1, -2; 3E2342-1, -2, 3; 3E2346-1, -2, -3; 3E2414-1, -2, -3; 3E2456-1, -2, -3 and 3E2457-1, -2, -3. Figures 20-24 provide Illustrated Parts Lists for these assemblies. Each series includes a different combination of brush modules and spacer(s). Different dash numbers within a P/N series indicate different stacking arrangements. Screws hold the brush modules and spacers together, forming the constant force modular brush assembly.

B. Universal Constant Force Brush Module Assembly 3E2320-6

P/N 3E2320-6 is a universal replacement brush module for constant force modular brush assemblies. It can be used in place of module assemblies 3E2320-1,-2,-3,-4, -5 & -9. The -6 universal module comes with A, B C & D wire markers and nylon spacers, so it can be configured as required for the specific application. Be sure to note the correct terminal identification and spacer position, so that the -6 universal module can be correctly configured. See Figure 17 for Parts Lists of 3E2320 series brush modules, including the -6 universal module.

Item	Description	P/N	Used on 3E2320(-X)
1	Insulating Bushing	2E1260	-2,-4,-6,-8
2	Wire marker	"A"	-1,-6
3	Wire Marker	"B"	-2,-5,-6,-8,-9
4	Wire Marker	"C"	-3,-4,-6
4A	Wire Marker	"D"	-6,-9
5	Lockwasher	MS35333-37	-1,-2,-3,-4,-5,-6,-8,-9
6	Round Head Screw	MS35214-26	-1,-2,-3,-4,-5,-6,-9
6A	Round Head Screw	MS35214-28	-8
7	Spring	2E1750-1	-1,-2,-3,-4,-5,-6,-8,-9
8	Replacement Brush (brush + items 2,3,4,4A,7)	3E2326-2	-1 -2,-3,-4,-5,-6,-8
9	Screw	MS24693-S2	-1,-2,-3,-4,-5,-6,-8,-9
10	Lid	4E2734-2	-1,-2,-3,-4,-5,-6,-8,-9
-	Nut (secures item 9 screw)	MS35649-242	-1,-2,-3,-4,-5,-6,-8,-9
-	Base	4E2734-1	-1,-2,-3,-4,-5,-6,-8,-9

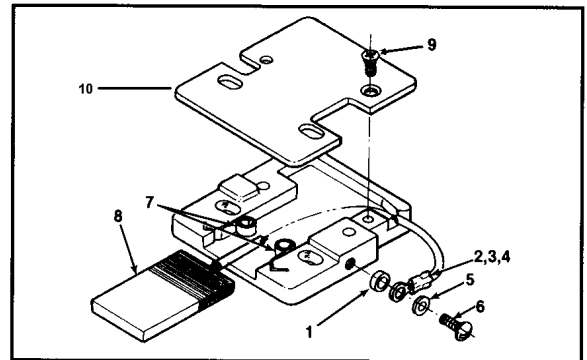


Figure 17 - 3E2320 Series Brush Modules

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C. Measuring Brush Wear

Each constant force brush has a white painted area, as shown in Figure 18, at the lead wire end used as an aid for tracking brush life. When the painted area of the brush protrudes from the brush slot of the installed constant force modular brush assembly, the assembly should be removed and brush free length measured. When the painted area becomes exposed, there is 1/4" of useable brush remaining. Brush replacement is mandatory when the free projected brush length is 1/8".

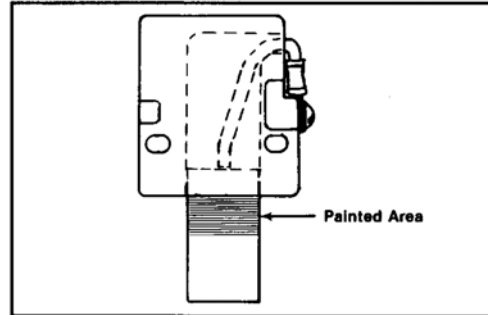


Figure 18 - Measuring Brush Wear

D. Brush and Spring Replacement (Figure 19)

Each constant force replacement brush includes two replacement springs. Brushes and springs may be replaced independently; however, it is recommended that springs be replaced each time a brush is replaced.

Remove the constant force modular brush assembly from the aircraft. When the brush module housings are not worn or damaged, the brush only can be replaced as follows.

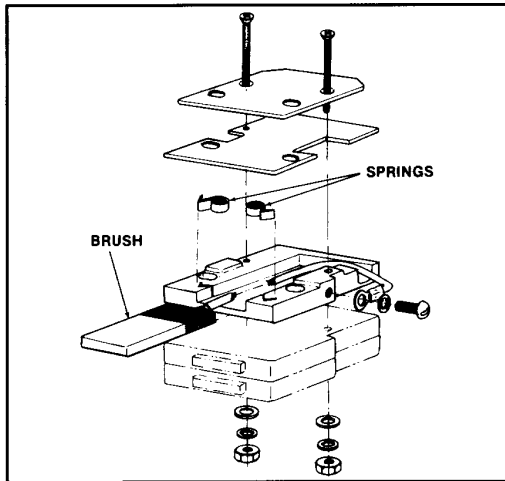


Figure 19 - Brush & Spring Replacement

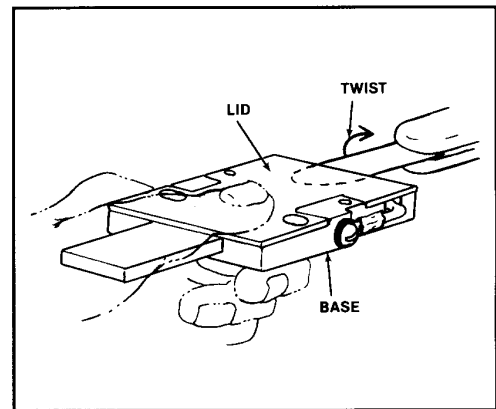


Figure 19a - Removing Glued Lid

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E. Removal of Worn Constant Force Brush and Springs

1. Remove brush module lid by removing the screw and nut. (The lids of earlier constant force modular assemblies were bonded to the base. To replace the springs and brushes in these, carefully pry the lid from the base using a flat knife and/or MEK to weaken the bond, as shown in Figure 19a.) Remove the brush and springs.
2. Clean the assembly to remove any carbon and oil build-up, commonly found in the brush area.

F. Installation of New Constant Force Brush and Springs

NOTE: Approximately 1 1/16" of the brush should protrude from the brush slot in its free state.

1. Install **BOTH** new springs. Install the new brush (or old brush if changing springs only.)
2. Place the lid on the base, without pinching the brush lead. Hold the lid securely to the base, and compress the brush several times to assure there is free movement.
3. Attach lid and assemble with stacking screws.

G. Constant Force Brush Module Replacement

1. Remove the constant force modular brush assembly from the aircraft.
2. Remove assembly screws and separate modules and spacer(s).
3. Replace worn module with replacement module. The P/N of each brush module is etched on the lid; be sure to replace with the same P/N, or the universal constant force replacement module 3E2320-6, appropriately configured.
4. Stack modules and spacers in correct order.
5. Connect aircraft wire harness, matching the A, B, C, D terminals, and install on the aircraft.

H. Alignment

NOTE: Unlike modular brush assemblies angular fore and aft alignment is not required; the constant force brush module must be parallel with the ring surface.

Radial alignment of the constant force modular brush assembly to the slip ring assembly is crucial to de-icing system operation. Figure 8 shows correct radial alignment.

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Parts List for Constant Force Modular Brush Assemblies		
1.	Brush Module Assembly "A"	3E2320-1*
2.	Brush Module Assembly "B"	3E2320-2*
3.	Brush Module Assembly "C"	3E2320-3*
4.	Brush Module Assembly "B"	3E2320-5*
5.	Brush Module Assembly "B"	3E2320-8
6.	Spacer	4E2218-3
7.	Spacer	4E2218-4
8.	Screw	MS24693-S32
9.	Screw	MS24693-S34
10.	Screw	MS24693-S36
11.	Washer	AN960C6
12.	Screw 100° Flat Head (Carbon Steel, Cadmium Plated)	#6-32-2A X 1-3/8"
13.	Lockwasher	MS35333-37
14.	Nut	MS35649-262
15.	Brush	3E2326-2

* 3E2320-6 is the replacement part number. (Figure 17)

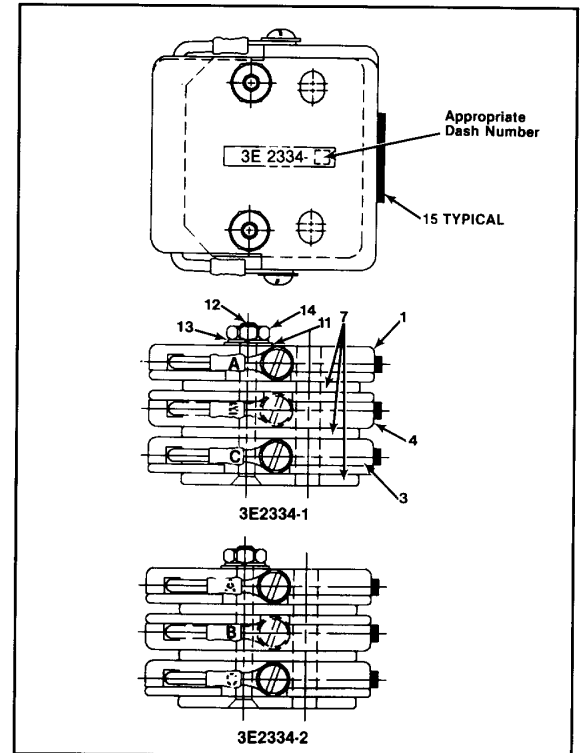


Figure 20 - 3E2334 Series

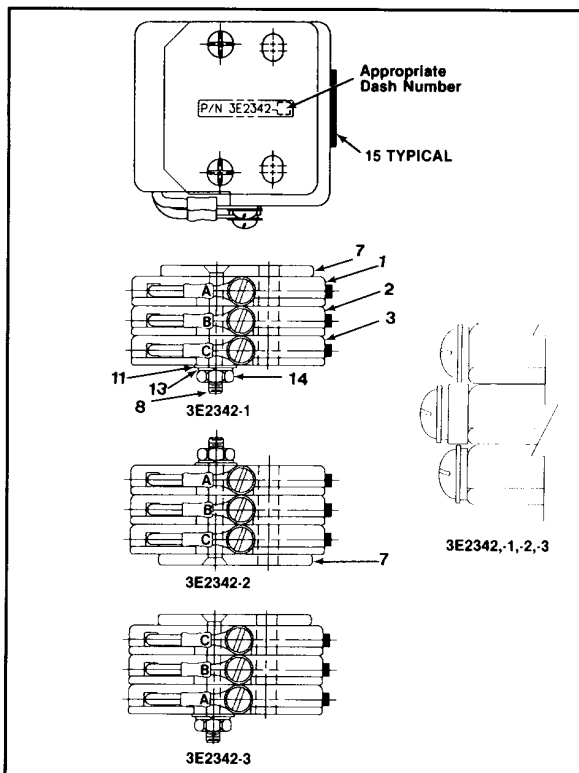


Figure 21 - 3E2342 Series

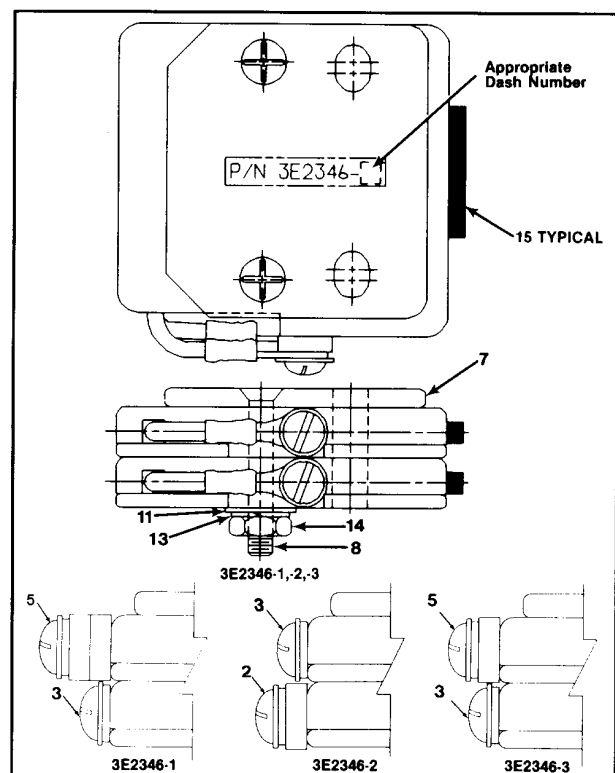


Figure 22 - 3E2346 Series

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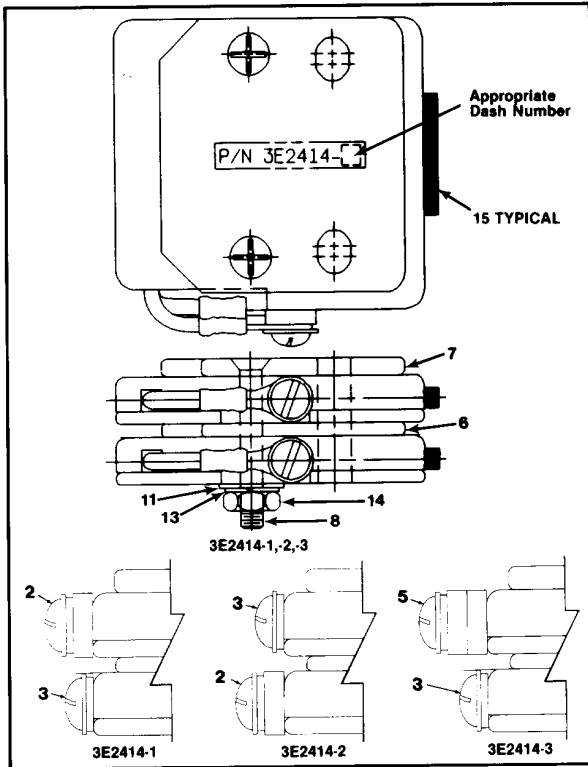


Figure 23 - 3E2414 Series

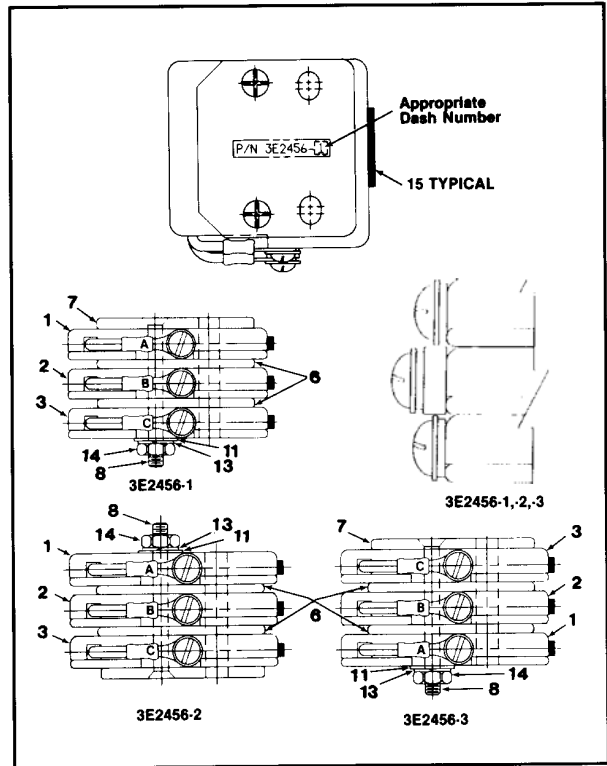


Figure 24 - 3E2456 Series

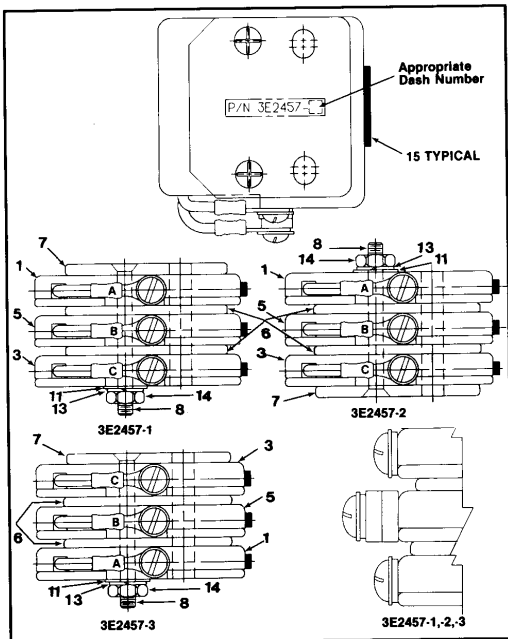


Figure 25 - 3E2457 Series

Parts List for	
Constant Force Modular Brush Assemblies	
1.	Brush Module Assembly "A" 3E2320-1*
2.	Brush Module Assembly "B" 3E2320-2*
3.	Brush Module Assembly "C" 3E2320-3*
4.	Brush Module Assembly "B" 3E2320-5*
5.	Brush Module Assembly "B" 3E2320-8
6.	Spacer 4E2218-3
7.	Spacer 4E2218-4
8.	Screw MS24693-S32
9.	Screw MS24693-S34
10.	Screw MS24693-S36
11.	Washer AN960C6
12.	Screw 100° Flat Head (Carbon Steel, Cadmium Plated) #6-32-2A X 1-3/8"
13.	Lockwasher MS35333-37
14.	Nut MS35649-262
15.	Brush 3E2326-2
* 3E2320-6 is the replacement part number. For 3E2320 parts list, see Figure 17.	

III. BRUSH BLOCK ASSEMBLIES

A. Description

Most brush block assemblies contain a brush retainer assembly that includes two or three brushes and springs. Table 2 lists each brush block assembly, the applicable brush retainer assembly, brush and spring part numbers. Brushes, springs and their component parts, including "B" barrels, braid and tubing can be purchased separately from Goodrich. It is recommended that brushes and matching springs be purchased and installed in sets.

B. Superseding parts

1. Modular brush assemblies supersede brush block assembly Part Number series' 4E1311, 4E1350 and 4E1387. The brush block assembly part number, superseding modular brush assembly part number and conversion kit part number are shown in Table 1. Modular brush assemblies in general are designed for use with ring terminal connectors. Most brush block assemblies, and the engine wire harnesses used with them, use MS style connectors and receptacles. Each conversion kit contains the applicable modular brush assembly, A, B, C, wire markers and ring terminals for 14/16 gauge wire and No.6 studs. Conversion instructions are contained in Paragraph B 2 below. After conversion is accomplished, brush modules and brushes can be replaced individually. (Reference Section I, Modular Brush Assemblies.)

TABLE 1 - SUPERSEDING MODULAR BRUSH ASSEMBLIES^(A)		
Superseded Brush Block Assembly	Superseding Modular Brush Assembly	Conversion Kit
4E1311-1, -2	3E2044-1	65-402
4E1311-3 ^(B)	3E2044-1	65-402
4E1311-3 ^(C)	3E2044-2	65-405
4E1350-1	3E2046-2	65-404
4E1350-2, -3	3E2046-1	65-403
4E1350-4	3E2046-2	65-404
4E1350-5	3E2046-3	65-406
4E1350-5 ^(D)	3E2046-1	65-403
4E1350-6	3E2046-1	65-403
4E1387-1, -2, -3, -4, -5	3E2042-1	65-401
4E1387-5 ^(E)	3E2042-2	65-407
4E1387-6	3E2042-1	65-401
(A)	When converting brush block assemblies to modular brush assemblies on Beech turboprop aircraft (King Air Series), contact Beech for replacement instructions.	
(B)	Used on Pratt & Whitney Engines only.	
(C)	Used on AiResearch Engines only.	
(D)	Used on Beech Barons with Continental engine TS10-520-L only.	
(E)	Beech Barons 95-55, 95-A55 and 95-B55 only as part of 4E1496-2 & -3 brush block and mounting bracket assembly.	

2. Conversion from Brush Block Assembly to Modular Brush Assembly

These instructions apply only to the Brush Block Assemblies shown in Table 1 for which conversion kits have been obtained.

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- a. **Removal of Brush Block Assemblies 4E1311-1, -2, 4E1350-1, -2, -4 & -5, and 4E1387-1, -3 & -5**
- i. Remove brush block assembly from mounting bracket and disconnect the MS connector and mating receptacle.
 - ii. The pins of the receptacle are identified as A, B or C on surface of the rubber insert (looking at face of connector). Determine identification of each leadwire going into receptacle and identify with appropriate wire marker.
 - iii. Remove cable clamp from wire harness at receptacle and disassemble connector. Cut or desolder the wires. When sufficient wire length is not available after desoldering, splice a suitable length of the same gauge aircraft wire (105°C minimum insulation rating) to the harness with insulated butt splice connectors.
 - iv. Strip 3/32" insulation from the wire and crimp on ring terminals provided. When larger than 14/16-gauge wire is used, install an insulated ring terminal for that size wire and a No.6 stud.
- b. **Removal of Brush Block Assemblies 4E1311-3, 4E1350-3/-6 and 4E1387-2, -4/-6**
- i. Remove brush block assembly from mounting bracket, maintaining connection between wire harness and brush block assembly.
 - ii. The terminals on surface of receptacle are identified as A, B or C. Determine identification of each leadwire going to receptacle and identify with appropriate A, B or C wire marker.
 - iii. Disconnect wire harness ring terminals from receptacle.
- c. **Installation of Modular Brush Assembly**
- i. Attach modular brush assembly to mounting bracket and align per Fig 8 & 9.
 - ii. Connect ring terminals on wire harness to appropriate screw terminals (A, B, C) on brush modules. Make sure uninsulated portions of ring terminals on adjacent brush modules do not touch. When there is interference between adjacent terminals, disassemble modular brush assembly and reassemble as shown in Figure 7.
 - iii. Make sure butt splice connectors (when used) and wires of harness going to brush modules do not interfere with aircraft components.

C. Replacement of Brush Retainer Assembly or Brush Assembly

The following general instructions apply to all brush block assemblies unless otherwise noted. It is recommended that the general replacement instructions and the specific part number instructions be read completely before proceeding. Figures 27-33 illustrate the configuration of the various groups of brush block assemblies. Refer to these as required.

1. Brush Retainer Assembly Replacement

- a. Remove the brush block assembly from the aircraft.
- b. Separate the brush retainer assembly from the guide block. Note the orientation of terminals in the assembly, then discard it.
- c. Assemble the new brush retainer assembly: determine correct brush-to-receptacle orientation and carefully insert brushes into brush guide block slots or slide guide block over brushes, as applicable. Avoid side loading of brushes. Make sure springs are inserted in the alignment slots or holes in the retainer and guide blocks.

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- d. Secure brush retainer assembly to guide block. Make sure the receptacle is oriented according to the correct pin identification.
- e. Install brush block assembly on the aircraft.
- f. Align per **Figures 8 & 9**.

2. Brush Replacement

- a. Remove brush block assembly from the aircraft.
- b. Mark receptacle flange and brush retainer so they can be reinstalled in same position.
- c. Separate brush retainer assembly from guide block.
- d. Unfasten receptacle from brush block and/or guide block.
- e. Disconnect or desolder brush leads from studs or receptacle pins as applicable, and discard worn brushes and springs.
- f. Install insulating tube over brush leads.
- g. Connect or solder brush leads to studs or receptacle pins, as applicable.
- h. Assemble brushes and springs to guide block.
- i. Align receptacle flange and brush retainer correctly and refasten receptacle to brush retainer assembly and/or guide block.
- j. Check that each brush moves freely. With your finger at center of brush, press brush into guide block and allow spring to force brush back out slowly. **Do not allow brush to snap back.**
- k. Check resistance from each brush face to respective stud or receptacle pin with a low range ohmmeter. Resistance must not exceed 0.013 ohms. The probe contacting the brush should have an area of 1/16 square inch to provide accurate measurement.
- l. Check insulation resistance between brushes and from brushes to receptacle housing (if applicable), with a 500VDC, 1000 megohm range "Megger" type insulation tester. Resistance should not be less than 10 megohms for 1 minute.
- m. Install brush block assembly on aircraft and check alignment per **Figures 8 & 9**.

D. Brush Block Assemblies 4E1213, 4E1283 and 4E1327 (Figure 27)

1. Measuring Brush Wear

Brushes should be replaced when "B" barrel is 1/8" from the spring retainer plate. Brushes must be replaced when "B" barrel is against the spring retainer plate. Brushes should protrude from block 1/116" when measuring.

2. Brush Retainer Assembly Replacement

Follow the instructions in Paragraph C 1, with these additions:

- a. When removing brush block assembly from aircraft, disconnect brush leads from terminal studs.
- b. When assembling brush block assembly, connect brush leads to terminal studs with correct pin orientation.

3. Brush Replacement

Follow the instructions in Paragraph C 2, with these additions:

- a. Ignore references to a separate receptacle.
- b. After disconnecting brush leads, compress springs so that rods protrude through rear of brush retainer assembly.
- c. Desolder "B" barrels and brush leads from brush rods. Save them unless new ones are to be installed.

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- d. Clean and tin 1/4" of the end of brush rods and clean inside "B" barrels and ends of brush leads.
- e. Place springs over brush rods, insert rods in retainer plate so ends extend through, and hold brushes in position with rubber bands.
- f. Install "B" barrels on brush rods so ends of barrels are flush and concentric with ends of rods.
- g. Install tubing over brush leads, and insert brush leads between rods and barrels so that flat side of lead is parallel to longer retainer plate surface. The longest lead must be installed on the center brush rod. Soft solder in place.

E. Brush Block Assemblies 4E1350-1, -2, -3 (Figure 28)

1. Measuring Brush Wear

Brushes should be replaced when "B" barrel is 3/32" or less from the maximum wear position. Brushes must be replaced when maximum wear position is reached. Brushes should protrude from block 1/16" when measuring.

2. Brush Retainer Assembly Retainer Replacement

Follow the instructions in **Paragraph C 1**.

3. Brush Replacement

Follow the instructions in **Paragraph C 2**.

F. Brush Block Assembly 4E1294 (Figure 29)

1. Measuring Brush Wear

Brushes should be replaced when end of the "B" barrel is flush with guide block. Brushes must be replaced when end of barrel is 3/32" inside block counter bore. Brushes should protrude from block 1/16" when measuring.

2. Brush Retainer Assembly Replacement

The replacement brush retainer for this assembly is the brush block assembly ordered less mounting bracket. Replace as follows:

- a. Remove guide block/side-plate/brush assembly from mounting bracket.
- b. Attach new assembly to mounting bracket with same hardware and install on aircraft.
- c. Check alignment per Figures 8 & 9.

3. Brush Replacement

- a. Remove guide block/side-plate/brush assembly from mounting bracket.
- b. Compress springs so that rods protrude through rear of guide block.
- c. Desolder and clean "B" barrels of worn brushes.
- d. Separate side-plate from guide block.
- e. Cut terminal lugs from leads of worn brushes and discard brushes, springs and lugs.
- f. Clean and tin the end 1/4" of brush rods.
- g. Place springs over brush rods, insert rods in guide block so that ends extend through, and hold brushes in position with rubber bands.
- h. Install "B" barrels on brush rods so ends of barrels are 3/32" over ends of rods and soft solder in place.

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- i. Install tubing over brush leads and insert leads through proper slots in side-plate.
- j. Install crimp on terminal lugs on brush leads and reassemble side-plate.
- k. Remove rubber band, finish assembling and install on aircraft.
- l. Check alignment per Figures 8 & 9.

G. Brush Block Assemblies 4E1311-1, 4E1387-1, -2 and 4E1560-2 (Figure 30)

1. Measuring Brush Wear

Measure brush wear per Figure 26. Brushes must be replaced at X-dimension as shown.

2. Brush Retainer Assembly Replacement

Follow the instructions contained in Paragraph C 1, with the following additions:

- a. When separating or reassembling brush retainer block, guide block and brush retainer assembly, move guide block laterally to disengage or engage dowel pins (where used).
- b. When reassembling brush retainer assembly, align receptacle per figure referenced in the instructions for the specific brush block assembly.

3. Brush Replacement

Follow the instructions in Paragraph C 2.

H. Brush Block Assemblies 4E1311-2, -3, 4E1387-3, -4, -5, -6, 4E1639, 4E1908-1 and 4E1749-2 (Figures 31 & 32)

1. Measuring Brush Wear

Measure per **Figure 26**. Brushes must be replaced at X-dimension shown.

2. Brush Retainer Assembly Replacement

Follow the instructions in **Paragraph C 1**.

3. Brush Replacement

Follow the instructions in **Paragraph C 2**.

I. Brush Block Assemblies 4E1350-4, -5 & -6 (Figure 33)

1. Measuring Brush Wear

Measure per Figure 26. Brushes must be replaced at the X-dimension show.

2. Brush Retainer Assembly Replacement

Follow the instructions in Paragraph C 1, with the following additions:

- a. After separating brush retainer assembly from guide block, turn brushes sideways. Slip them through hole in brush retainer block to complete removal of brush retainer assembly.
- b. To assemble, turn brushes sideways. Slip them through hole in brush retainer block and continue assembly.

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3. Brush Replacement

Follow instructions in Paragraph C 2.

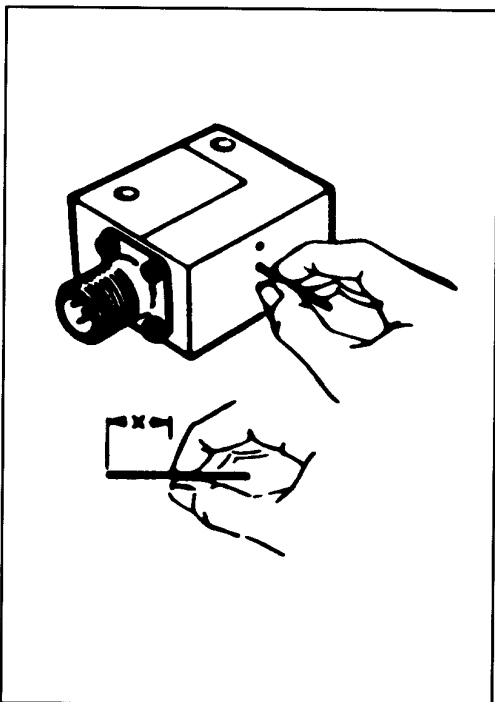


Figure 26 - Measuring Brush Wear

Brush Block Assembly	X-Dimension (inches) MUST Replace
4E1311-1, 4E1387-1, -2	17/32"
4E1311-2, -3, 4E1387-3, -4, -5, -6, 4E1749-2	1 - 9/16"
4E1350-4, -5, -6	1 - 1/4"
4E1560-2	15/32"
4E1639, 4E1908-1	1 - 3/8"

TABLE 2 - BRUSH BLOCK ASSEMBLY REPAIR PARTS			
Brush Block Assembly	Brush Retainer Assembly	Brush(es)	Spring
4E1213	3E1176	2E1081	2E1076
4E1283	3E1176	2E1081	2E1076
4E1294	None	3E1206-3	1E1136
4E1311-1*	3E1345	2 ea. 3E1206-1 & 1 ea. 3E1206-2	2E1108
4E1311-2*	3E1483	2 ea. 3E1443-1 & 1 ea. 3E1443-2	1E1136
4E1311-3*	3E1562	2 ea. 3E1443-1 & 1 ea. 3E1443-2	1E1136
4E1327	3E1176	2E1081	2E1076
4E1350-1*	3E1294	3E1206-1	2E1207
4E1350-2*	3E1398	3E1206-1	2E1207
4E1350-3*	3E1450	3E1206-2	2E1207
4E1350-4*, -5*	3E1536	3E1443-2	2E1207
4E1350-6*	3E1538	1 ea. 3E1443-1 & 2 ea. 3E1443-2	2E1207
4E1387-1*	3E1345	2 ea. 3E1206-1 & 1 ea. 3E1206-2	2E1108
4E1387-2*	3E1416	2 ea. 3E1206-1 & 1 ea. 3E1206-2	2E1108
4E1387-3*, -5*	3E1483	2 ea. 3E1443-1 & 1 ea. 3E1443-2	1E1136
4E1387-4*, -6*	3E1562	2 ea. 3E1443-1 & 1 ea. 3E1443-2	1E1136
4E1560-2	3E1420	3E1206-3	2E1108
4E1639	3E1500	2 ea. 3E1443-1 & 1 ea. 3E1443-2	1E1136
4E1749-2	3E1573	3E1206-1	1E1136
4E1908-1	3E1789	3E1443-1	1E1136

* Brush guide blocks and brush retainer blocks for these assemblies are no longer available. When these items require replacement, the brush block assembly must be converted to a modular brush assembly with a conversion kit as shown in Table 1.

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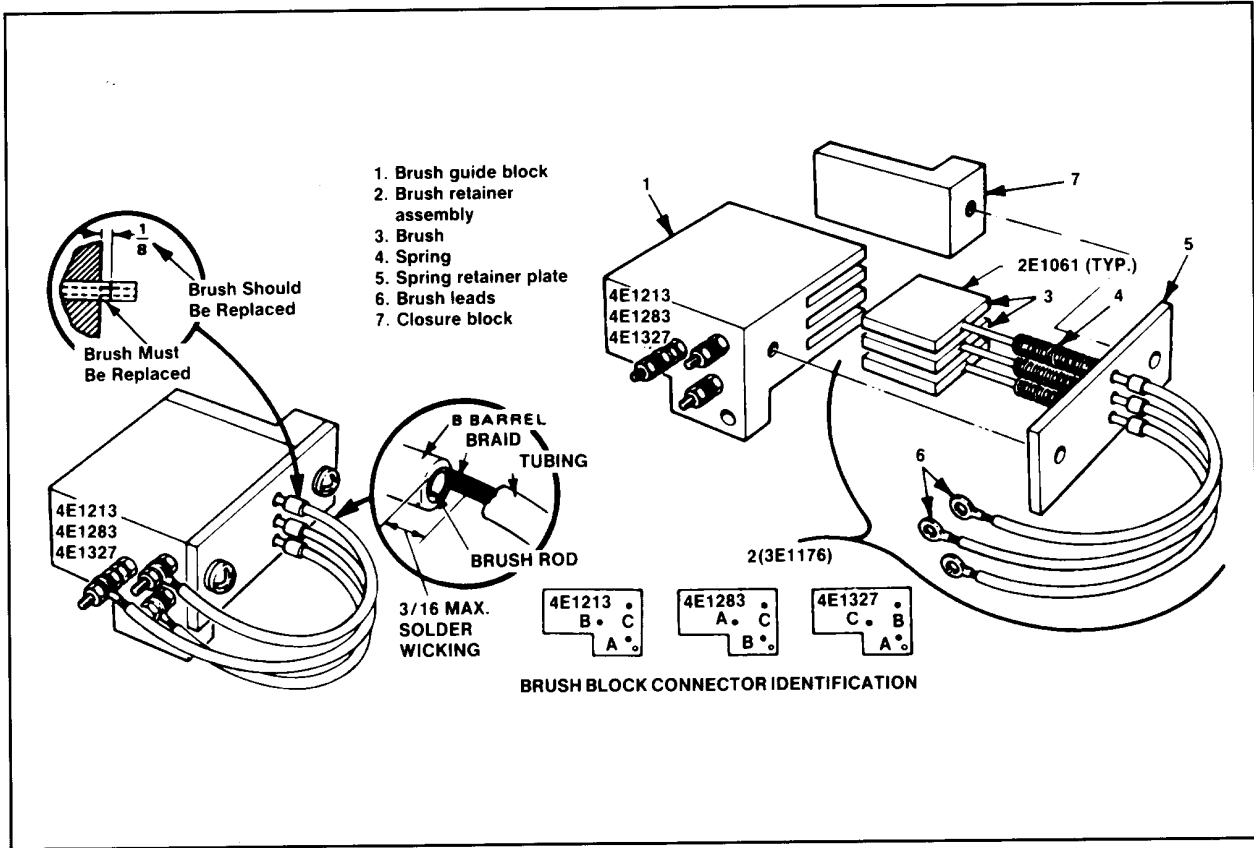
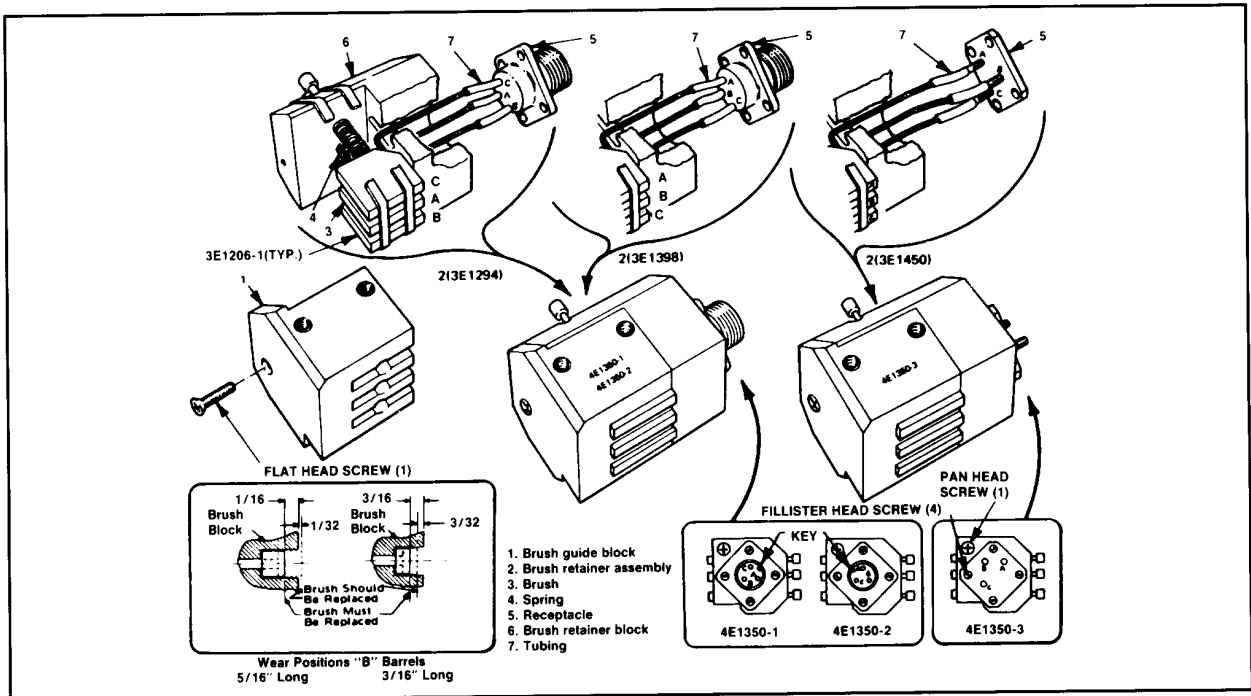


Figure 27 - 4E1213, 4E1283, 4E1327 Brush Block Assemblies

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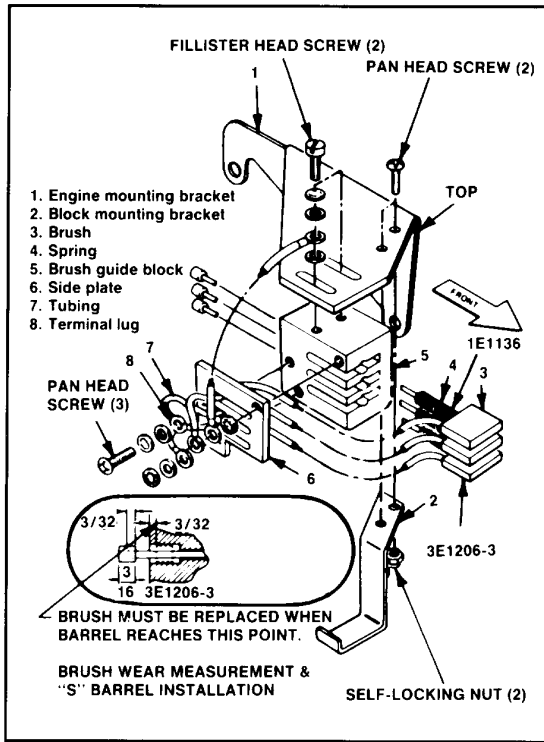


Figure 29 - 4E1294 Brush Block Assembly

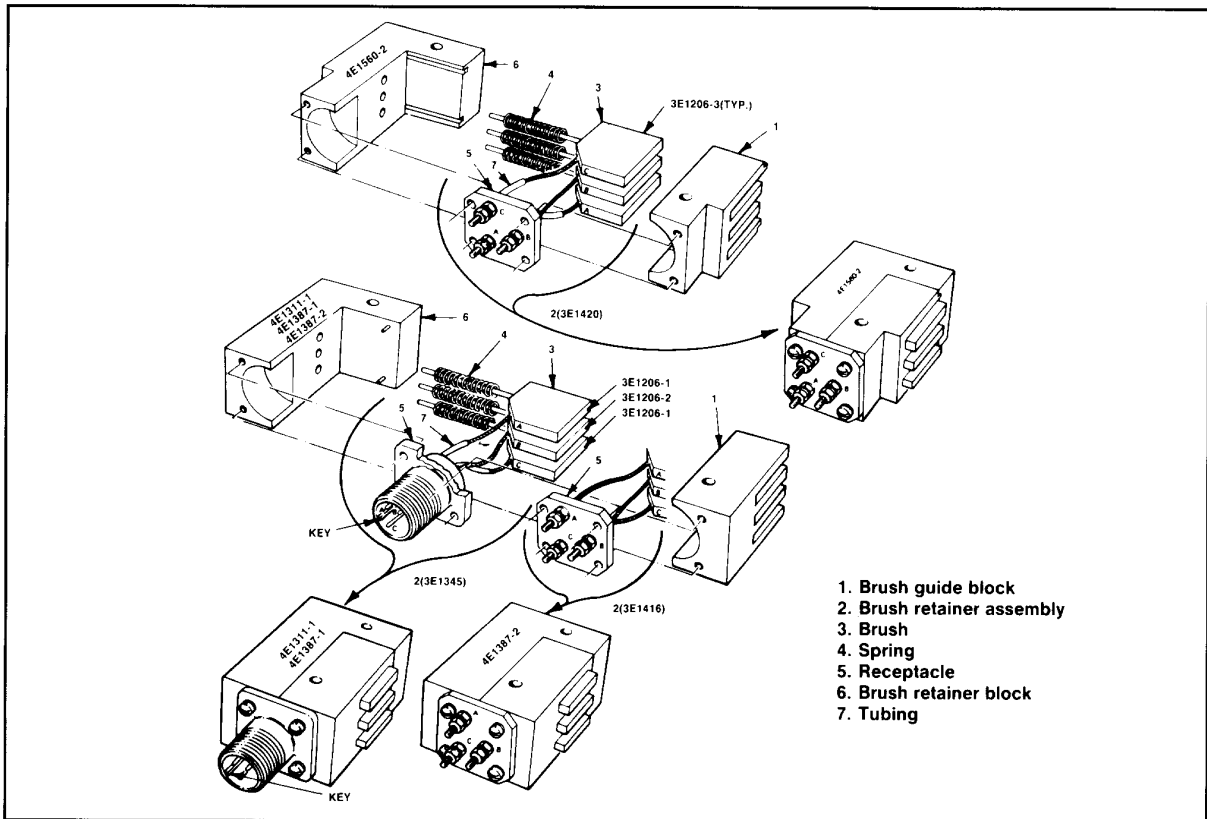


Figure 30 - 4E1311-1, 4E1387-1,-2, 4E1560-2 Brush Block Assemblies

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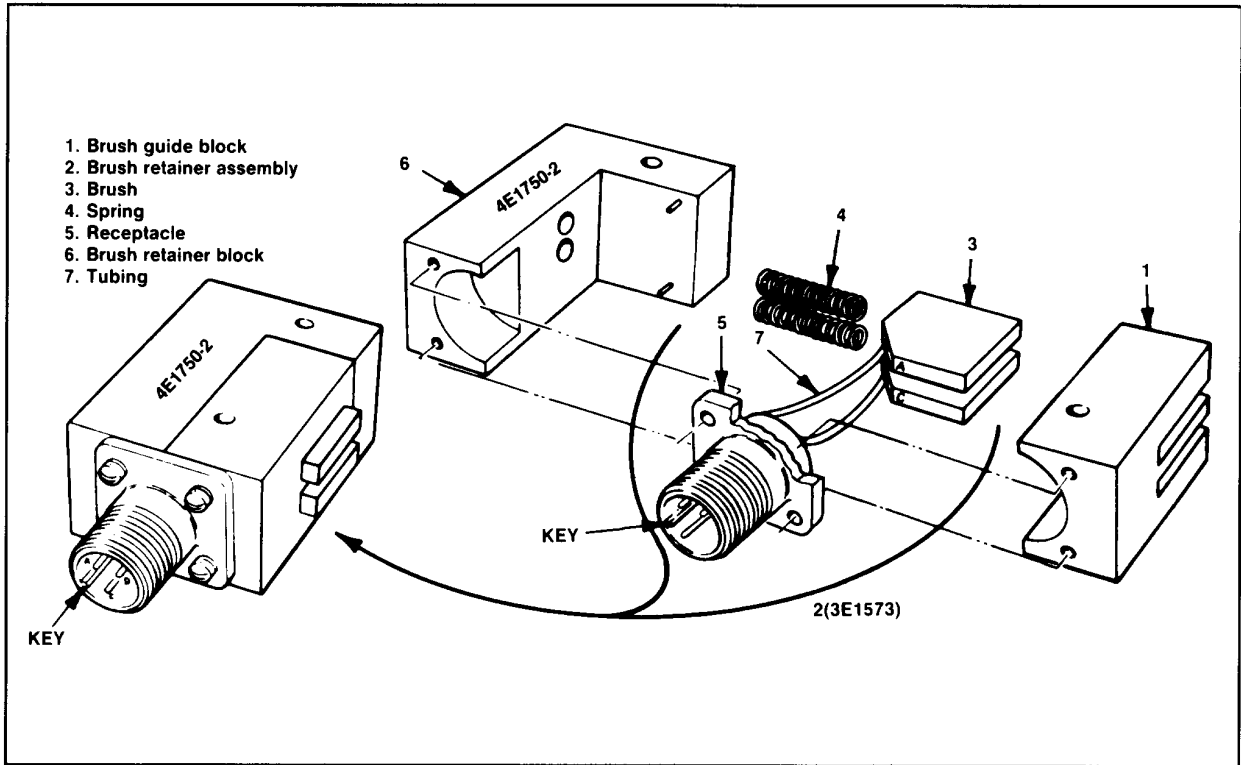


Figure 32 - 4E1749-2 Brush Block Assembly

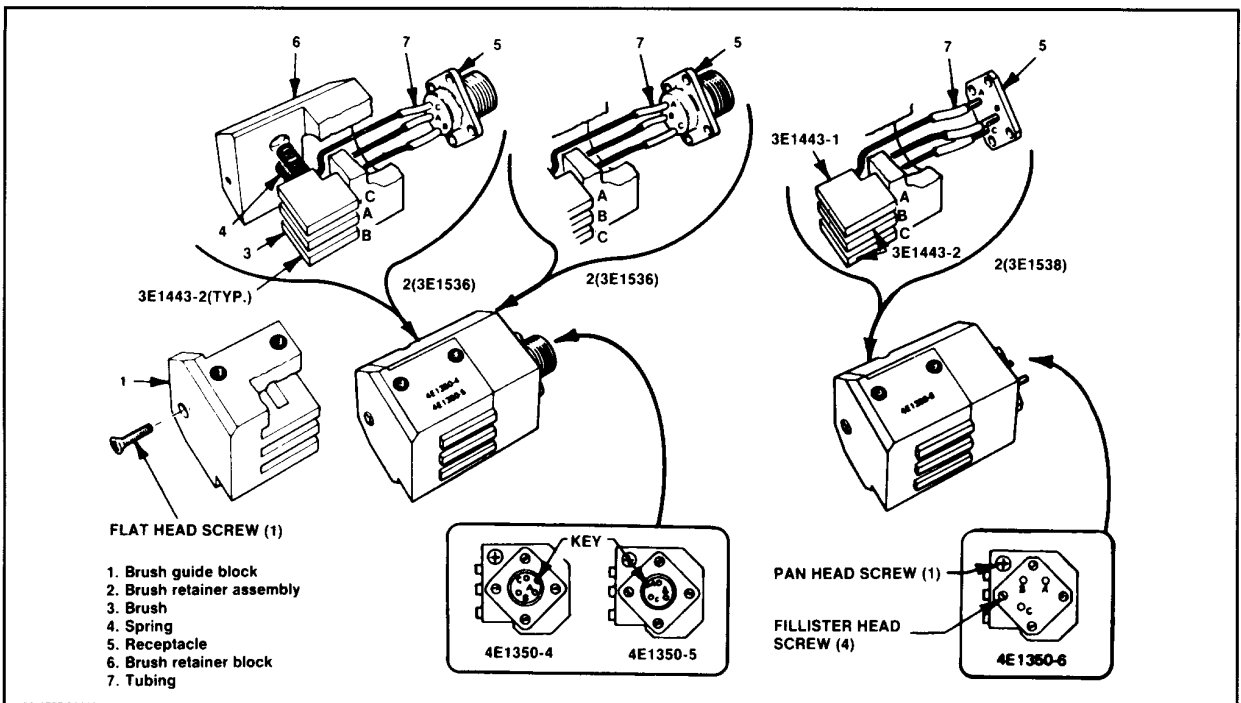


Figure 33 - 4E1350-4,-5,-6 Brush Block Assemblies

IV. HEAVY DUTY BRUSH ASSEMBLIES

A. Description (Figure 34)

1. General

There are four heavy-duty brush assembly (HDBA) part numbers: 4E3096-1, 4E3097-1, 4E3196-1 and 4E3197-1. P/N 4E3196-1 supersedes P/N 4E3096-1 and P/N 4E3197-1 supersedes P/N 4E3196-1. Brushes, springs and certain other replacement components are still available for superseded P/N's. See Illustrated Parts List for details.

There are four brushes in each (HDBA). Each brush has a shunt wire and ring terminal for connection to one of two studs in the lid. "B" and "C" wire markers identify individual brushes.

Four springs push brushes against the rotating slip ring assembly. A Metal Oxide Varister (MOV) provides lightning strike protection.

There are two threaded inserts in the side of the base to mount the HDBA to a mounting bracket on aircraft. There are four holes (indicated in Figure 34) on top of the base with threaded inserts to attach the lid to the base. The MOV is installed in a pocket in the center of the base. The individual brushes and springs are installed in four slots with two brass wear inserts in each slot. There are four check holes in the lid to measure brush wear.

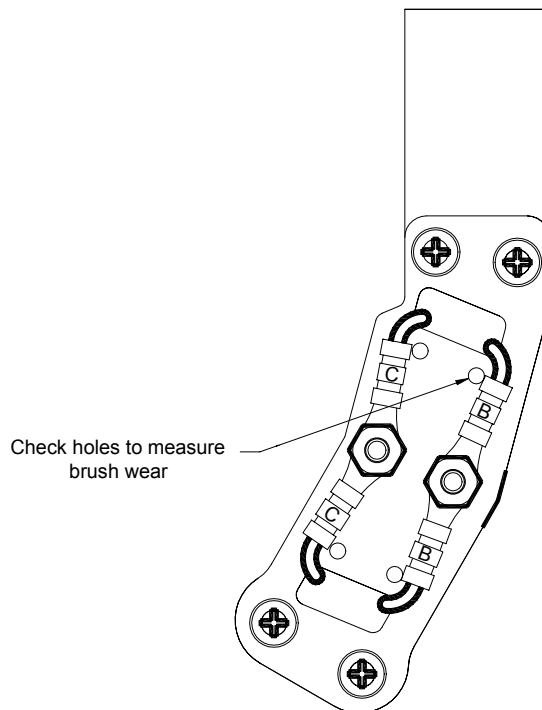


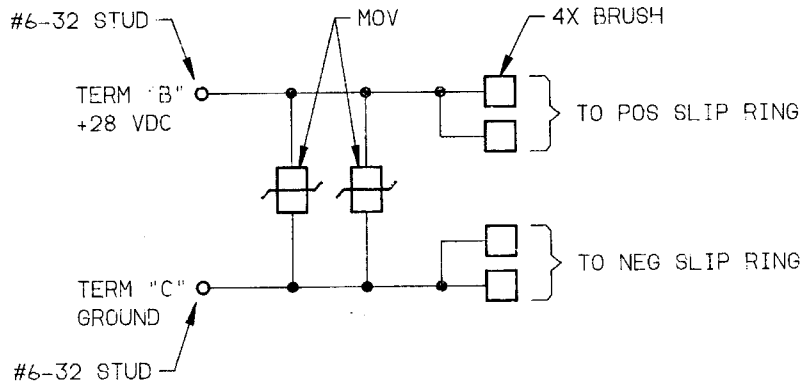
Figure 34
Heavy Duty Brush Assembly
Top View

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2. Operation (Figure 35)

During operation the HDBA transfers DC current from the aircraft generator to the propeller de-icing circuits.

When power from the generator is applied to terminal "B," the HDBA transfers current to the de-icer circuits through the brush/slip ring interface. The current return path is also through the brush/slip ring interface.



**Figure 35
Heavy Duty Brush Assembly
Schematic**

3. Configuration

In P/N's 4E3096-1 and 4E3097-1, the MOV and studs are an integral part of the lid/MOV assembly and there are no wear inserts in the brush slots. The base is machined.

Superseding P/N's 4E3196-1 and 4E3197-1 contain product improvements. The MOV and studs are separate replacement components, eight wear inserts (two in each brush slot) help prevent premature brush slot wear, an MOV vibration pad is added and the base is molded.

4. Dimensional Data

Part Number	Envelope Dimensions	Mounting
4E3096-1	4.26"W X 1.91"L X 2.14"H	#8-32 UNC through holes
4E3196-1	(108.20mm X 48.51mm X 54.36mm)	
4E3097-1	4.19"W X 2.03"L X 2.14"H	#8-32 UNC through holes
4E3197-1	(106.43mm X 51.56mm X 54.36mm)	

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B. Troubleshooting

PROBLEM	PROBABLE CAUSE	CORRECTION
No power transfer from HDBA leads to slip ring	a) Brushes sticking b) Insufficient pressure on brush(es) to make contact with slip ring(s) c) Failed crimp terminal or shunt wire d) Broken stud	a) Clean HDBA b) Replace spring(s) and/or brushes as required c) Replace brush(es) d) Replace stud
Sluggish brushes	a) Worn or dirty brushes.	a) Clean HDBA and/or replace brush(es) as required
Lightning strike		Replace MOV.

C. Measuring Brush Wear

1. Brush Length in Assembled HDBA Off Aircraft

- a. Depress brushes completely and hold.
- b. Insert a .06" (1.52 mm) diameter rod into each check hole shown in **Figure 34**.
- c. Mark and measure amount of rod inserted into each check hole.
- d. Replace brush(es) if inserted rod length is 1.093" (27.2 mm) or more:

2. Brush Length in Disassembled HDBA

- a. Clean brushes using methyl ethyl ketone (MEK) and a soft brush.
- b. Measure brush length with a dial caliper.
- c. Replace brush(es) if measured rod length is .406" (10.3 mm) or less.

3. Brush Length in Assembled HDBA On Aircraft

NOTE: During measurement, brushes should protrude .06" (1.52 mm) from the HDBA.

- a. Insert a .06" (1.52 mm) diameter rod into each check hole shown in Figure 34.
- b. Mark and measure amount of rod inserted into each check hole.
- c. Replace brush(es) if inserted rod length 1.156" (29.4 mm) or more

D. Disassembly

1. To Replace Single Brush Without Removing Lid

- a. Removal of worn brush.
 - i. Depress worn brush and cut shunt wire between ring terminal and brush. (Reference Figure 36)
 - ii. Remove worn brush with cut shunt wire from base.
 - iii. With a nut driver remove upper two hex nuts and lockwashers from applicable stud.

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NOTE: If necessary, remove other ring terminal to access ring terminal on cut shunt wire. Replace other ring terminal on stud after removing ring terminal with cut shunt wire.

- iv. Remove ring terminal with cut shunt wire from stud.
- b. Installation of replacement brush
 - i. Solvent soak new insulation tubing in alcohol and assemble onto replacement brush shunt wire.
NOTE: Make sure insulation tubing is fully on shunt wire.
 - ii. Straighten shunt wire/insulation tubing, taking care not to pull insulation tubing off shunt wire. Allow insulation tubing to fully dry.
 - iii. Insert partially assembled replacement brush into brush slot in bottom of the base, shunt wire first. Be sure that shunt wire feeds easily up through the slot in lid.
 - iv. Crimp ring terminal on end of shunt wire.
 - v. Affix appropriate wire marker B or C to ring terminal base.
 - vi. Place ring terminal on stud in lid.
 - vii. Place one lockwasher and hex nut on stud and hand tighten.
 - viii. Align ring terminals so brush wear check holes shown in Figure 34 are not covered.
 - ix. Torque installed hex nut 12-15 inch pounds (1.36 – 1.70 N m).
 - x. Place second lockwasher and hex nut on stud and hand tighten.

2. To Replace Parts or Clean HDBA

- a. With a nut driver remove upper two hex nuts and lockwashers from each stud.
- b. Depress brushes and remove ring terminals from studs, allowing brushes to extend out of bottom of base.

CAUTION: Securely hold the base and lid together to prevent springs from popping out until Step (4).

- c. While holding base and lid together, remove four screws and lockwashers from lid.
- d. Slowly lift lid (with attached MOV and studs), allowing brush leads with ring terminals attached to pass through lid as it is removed. Springs will pop up as lid is removed; take care to keep them in brush slots.
- e. Remove springs from brush slots in base.
- f. Remove brushes/leadwires/ring terminals by pulling them through top of base.
- g. For P/N's 4E3196-1 and 4E3197-1, remove eight wear inserts from brush slots.
- h. For P/N's 4E3196-1 and 4E3197-1, remove MOV vibration pad from center pocket of base.

NOTE: The lid, MOV and studs are an inseparable subassembly in P/N's 4E3096-1 and 4E3097-1 and are not disassembled. The lid, MOV and studs are separate items in P/N's 4E3196-1 and 4E3197-1.

- i. For P/N's 4E3196-1 and 4E3197-1, remove hex nut and lockwasher from each stud to separate lid, MOV and stud.

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E. Maintenance

1. Inspection

- a. Before disassembly, depress and release brushes while examining visually and by feel for dirt, brush wear, brush slot wear, ease of brush movement, and brush length (Reference Paragraph C). Disassemble, clean and replace component parts as required.
- b. Disassemble HDBA per Paragraph D.
- c. Examine base, lid and studs for cracks, chips, wear, distortion, breakage, crossed, galled or stripped threads, worn or damaged wear inserts (if installed). Replace component parts as required.

2. Cleaning

CAUTION: Do not soak HDBA components in MEK or other solvent.

- a. Disassemble HDBA per Paragraph 4A.
- b. Using a soft brush, scrub brushes, wear inserts and brush slots with MEK.
- c. Wash springs, lid, MOV, studs and base with MEK.
- d. Using lint-free cloth, dry all components.

F. Assembly

1. For P/N's 4E3196-1 and 4E3197-1, install wear inserts in brush slots.
2. For P/N's 4E3196-1 and 4E3197-1, install vibration pad in bottom of center pocket in base.
3. For P/N's 4E3196-1 and 4E3197-1 install MOV on studs, push studs through stud holes in lid and secure with lockwasher and hex nut on each stud. Torque to 12-15 inch pounds (1.36-1.70 N m).
For P/N's 4E3096 and 4E3097-1, push MOV/studs through stud holes in lid and secure with hex nut and lockwasher on each stud. Torque to 12-15 inch pounds (1.36-1.70 N m).
4. Place lid/MOV/studs into base to assure fit, adjust as required, then remove.
5. Insert assembled brushes through brush slots in top of base, allowing brushes to extend through brush slots in bottom of base. Ring terminals will rest on top of brush slots to prevent assembled brushes from dropping through the base.

CAUTION: Make sure springs are depressed into base straight and are not tangled or bent.

6. Insert spring into each brush slot in top of base over brushes. Brushes will stick out of top of base.
7. Align spring alignment bosses on underside of lid into center of each spring and gentle push lid onto base. Feed brush ring terminals through holes in lid while pushing lid onto base. Securely hold base and lid together to prevent springs from popping out until Step H is completed.
8. Secure lid to base with four lockwashers and screws.
9. Place both "B" labeled ring terminals on adjacent stud.
10. Place one lockwasher and hex nut on stud over "B" labeled ring terminals and hand tighten.

CAUTION: "B" and "C" brush shunt wires must not be crossed.

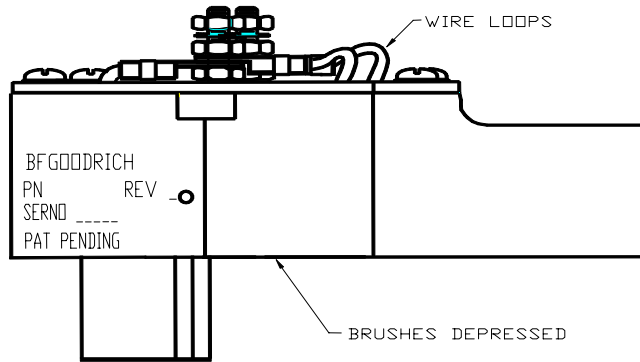
11. Place both "C" labeled ring terminals on adjacent stud.
12. Place one lockwasher and hex nut on stud over "C" labeled ring terminals and hand tighten.

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13. Depress each brush one at a time, while pulling shunt wire up through lid to form a loop as shown in Figure 36. Brush must move in and out freely and the brush lead should freely form a loop when the brush is depressed.
14. Align brush ring terminals so that four check holes (Reference Figure 34) are not covered. Torque one hex nut on each stud to 12-15 inch pounds (1.36-1.70 N m).

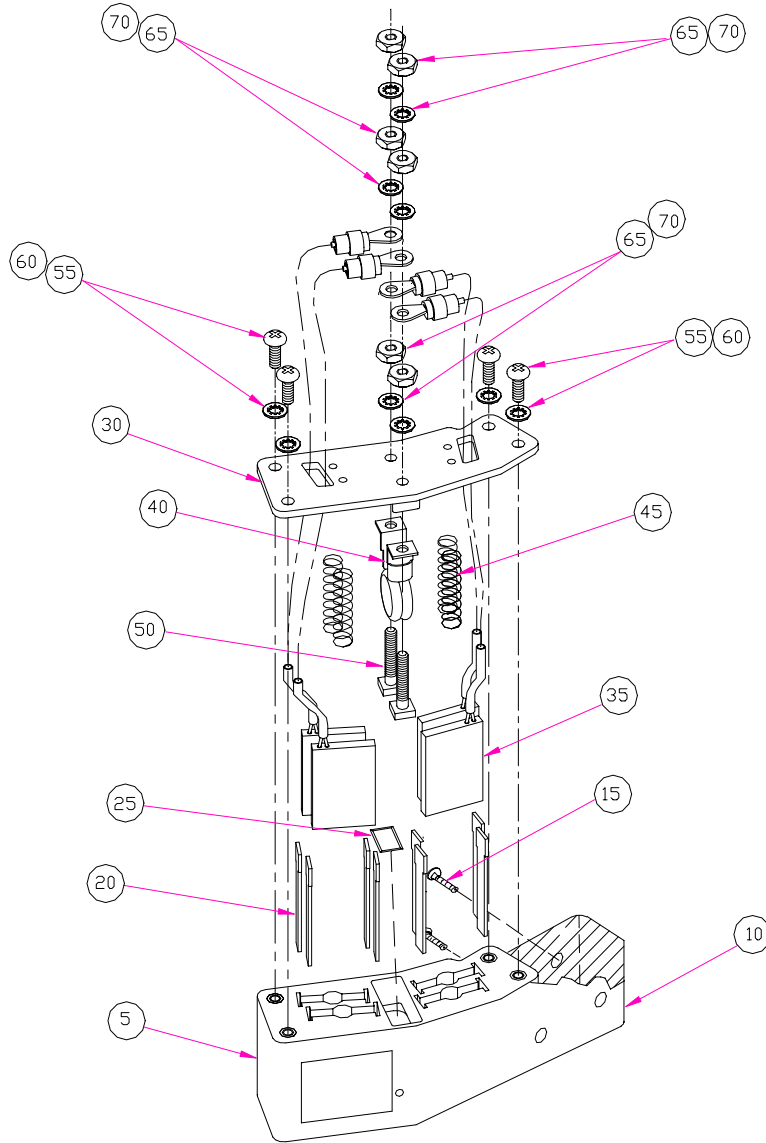
CAUTION: Do not torque the top nut, hand tighten only.

15. Place second lockwasher and hex nut on each stud and hand tighten.



**Figure 36
Heavy Duty Brush Assembly
Side View**

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IPL - Figure 37
Heavy Duty Brush Assembly
4E3196-1/4E3197-1
(Depicts 4E3096-1/4E3097-1 also except as noted in IPL)

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Illustrated Parts List

Figure 37 Item No.	Part Number	Description	Effectivity Code	Quantity per Assembly
-Ref	4E3196-1	Heavy Duty Brush Assembly	A	-
-Ref	4E3096-1*	Heavy Duty Brush Assembly	B	-
-Ref	4E3197-1	Heavy Duty Brush Assembly	C	-
-Ref	4E3097-1*	Heavy Duty Brush Assembly	D	-
5	4E3187-1	.Base	A	1
5A	4E3191-1	.Base	C	1
5B	Not available*	.Base	B	1
5C	Not available*	.Base	D	1
20	2E1940-1	..Insert, Wear	A,C	8
25	2E1907-1	..Pad, Vibration, MOV	A,C	1
30	4E3189-1	.Lid	A	1
30A	4E3192-1	.Lid	C	1
30B	Not available*	.Lid Assembly (includes MOV assy., studs, 2 each items 65 & 70))	B	1
30C	Not available*	.Lid Assembly (includes MOV assy., studs, 2 each items 65 & 70))	D	1
35	3E2522-1	.Brush Assembly, Replacement**		(4)
-37	.066"X.010"	..Tubing, Insulation, Translucent Silicone, 50 Durometer (V0BZG4)		4
-38	"B"	..Wire Marker		2
-38A	"C"	..Wire Marker		2
-39	XR1901SN	..Terminal Ring (V14726)		4
40	2E1942-1	.Metal Oxide Varister (MOV)	A,C	1
45	2E1902-1	.Spring	A,B	4
45A	2E1905-1	.Spring	C,D	4
50	2E1941-1	.Stud	A,C	2
55	MS35333-71	.Lockwasher		4
60	MS51957-26	.Screw, Panhead Machine #6-32x1/4"	A,C	4
60A	MS51957-28	.Screw, UNC-2A	B,D	4
65	MS35333-105	.Lockwasher	A,C B,D	6 4
70	MS35649-265T	.Nut, Hex	A,C B,D	6 4

* If component parts of P/N's 4E3096-1 or 4E3097-1 that are noted as "Not available" require replacement, the HDBA must be replaced with the superseding P/N's 4E3196-1 or 4E3197-1, respectively.

** Replacement brush assembly P/N 3E2522-1 includes: 1 each brush, 1 each item 37, 1 each item 38, 1 each item 38A and 1 each item 39 loose in a bag.