CHAPTER

77

ENGINE INDICATING

CHAPTER 77 - ENGINE INDICATING SYSTEM

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REVISION NO. 20, DATED JUL 15/99

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77-21-0, MAINTENANCE PRACTICES	Changed the existing NOTE after step B.(2) to a CAUTION, and relocated the CAUTION before step B.(2)	201
77-21-0, MAINTENANCE PRACTICES	Relocated the NOTE before step F, and revised the corrective action column of item F in para 3	202

CHAPTER 77 - ENGINE INDICATING SYSTEM

LIST OF EFFECTIVE PAGES

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ENGINE INDICATING SYSTEM - DESCRIPTION AND OPERATION

1. General.

A. The engine furnished indicating system consists of an 8 probe thermocouple harness for indicating exhaust gas temperature and the aft fan speed sensor. Optional engine equipment consists of an exhaust gas pressure sensing probe system.

B. The airframe furnished indicating system consists of one tachometer generator, located at aft end of oil tank, and a fuel flow indicator. Optional airframe equipment consists of oil pressure and anti-icing temperature indicating leads and indicators.

2. Description/Operation.

A. Thermocouples. The thermocouple harness consisting of 8 chromel-alumel aspirating probes and a lead assembly is mounted on the fan front frame just aft of the second-stage turbine wheel. When installed, the probes project into the exhaust gas stream and being connected in parallel, provide an arithmetical average temperature indication (EGT) when connected to the aircraft indicator.

B. Aft Fan Speed Sensor. The speed sensor is mounted to the fan rear frame in the bearing area housing. It senses fan speed (rpm) by magnetic pick-up from a gear type ring mounted to the fan rear rotor shaft. The resulting alternating current is transmitted through electrical leads and connectors to the cockpit indicator. Electrical leads from the sensor go from the bearing area through the bottom strut of the fan rear frame.

C. Pressure Probes. The pressure probes are part of the exhaust pressure ratio (EPR) sensing system. Exhaust gas pressure is sensed at the tail cone by the pressure probes and transmitted to an instrument which also senses inlet pressure. The instrument divides the exhaust pressure by the inlet pressure and indicates the resultant value on the cockpit instrument.

D. Tachometer Generator. The engine speed indicating equipment consists of one tachometer generator and electrical leads (airframe-furnished).

It is driven and mounted on the rear of the lubrication pump that extends through the oil tank. A frequency output by the tachometer generator is proportional to engine speed. This resulting electrical signal is transmitted through an electrical lead to the cockpit tachometer indicator.

E. Optional Aircraft Equipment. The following items are sensing elements, consisting of independent electrical devices and are energized by airframe components, which transmit electrical signals to cockpit instruments.

(1) The fuel flowmeter produces and transmits an electrical signal proportional to the mass flow rate of fuel passing through it. It is powered by an airframe-mounted AC generator.

(2) The oil pressure transducer produces and transmits an electrical signal proportional to the lube oil pressure at the lube pump outlet.

F. Engine Temperature Protector (ETP). The ETP consists of a resistor installed in series in the thermocouple harness circuit to more accurately indicate the actual average exhaust gas temperature.

ENGINE INDICATING SYSTEM - TROUBLE-SHOOTING

1. General.

If trouble occurs in the indicating system, it is important to be sure that all connections are secure and correctly made. Establish whether the malfunction is more likely an airframe or an engine fault before proceeding.

Trouble-Shooting information is furnished in Chapter 72-00.

EXHAUST PRESSURE PROBE - MAINTENANCE PRACTICES

1. General. The pressure probe is optional equipment. The maintenance is limited to the following.

NOTE: On CF700-2D-2 engines, pressure probes are calibrated to a specific engine. Make certain that the part number of the probe being used is the same as the one recorded in the engine log book.

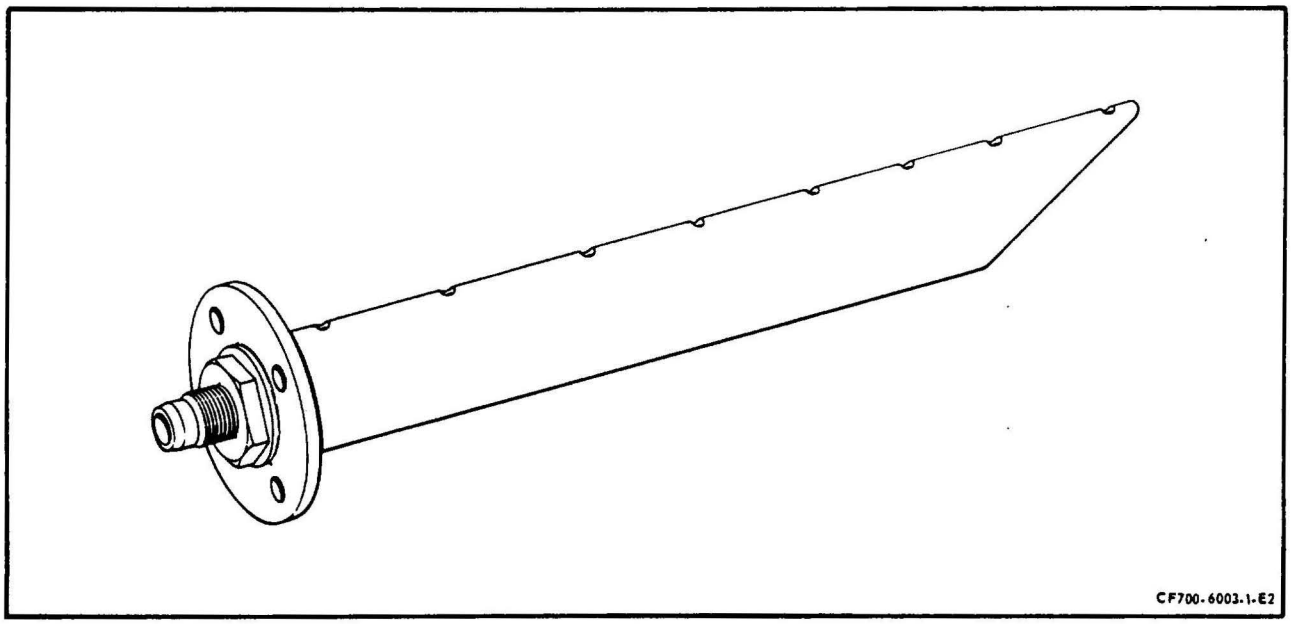
2. Removal/Installation.

A. Removal.

(1) Disconnect the pressure probe from the tube connector.

(2) Remove bolts attaching pressure probe to tailpipe.

(3) Remove the probe from the boss on the tailpipe section.



Pressure Probe
Figure 201

B. Installation.

(1) Lubricate the threads of the exhaust pressure probe and connector with antiseize compound, Milk of Magnesia, or equivalent.

(2) Install the probe in the tailpipe boss with the holes in the probe stem facing forward.

(3) Install the bolts to secure the probe to the tailpipe. Torque bolts to 40-50 lb-in. and lockwire.

(4) Connect the pressure probe to the tube nut. Torque to 40-50 lb-in.

3. Inspection/Check. (See figure 201.) Check probes for the following defects.

Inspection/Check	Maximum Serviceable Limits	Corrective Action
A. Obstructions in holes.	Not serviceable.	Remove all obstructions.
B. Bent or distorted.	Not serviceable.	Straighten and examine very closely for cracks.
C. Cracks.	Not serviceable.	Replace probe.

WARNING: COMPRESSED AIR

WHEN USING COMPRESSED AIR FOR ANY COOLING, CLEANING, OR DRYING OPERATION, DO NOT EXCEED 30 PSIG AT THE NOZZLE.

EYES CAN BE PERMANENTLY DAMAGED BY CONTACT WITH LIQUID OR LARGE PARTICLES PROPELLED BY COMPRESSED AIR. INHALATION OF AIR-BLOWN PARTICLES OR SOLVENT VAPOR CAN DAMAGE LUNGS.

WHEN USING AIR FOR CLEANING AT AN AIR-EXHAUSTED WORKBENCH, WEAR APPROVED GOGGLES OR FACE SHIELD.

WHEN USING AIR FOR CLEANING AT AN UNEXHAUSTED WORKBENCH, WEAR APPROVED RESPIRATOR AND GOGGLES.

4. Cleaning. If the probe is clogged it can be cleaned by passing a cleaning wire through the sensing holes (0.028-0.032 inch diameter) and then applying compressed air.

5. Repairs. Repairs other than those specified in paragraph 3 are not permitted.

NOTE: Do not apply compressed air to probe while connected to airframe system.

THERMOCOUPLE HARNESS AND ENGINE TEMPERATURE PROTECTOR - MAINTENANCE PRACTICES

1. General.

The thermocouple harness, the probes, and the engine temperature protector (ETP) are covered in this section. The remainder of the indicating system is covered in the Aircraft Manual.

2. Removal/Installation of Thermocouple Harness. (See figure 201.)

A. Removal.

(1) Disconnect the harness connector (2) from the bracket.

(2) Disconnect the harness (3) and clamps (4) from the standoff brackets.

(3) Remove the bolts (1) from the mounting pads on the fan front frame. Remove the harness.

B. Installation.

(1) Install the thermocouples in the mounting pads.

CAUTION: DO NOT LET THE UNFLAVORED MILK OF MAGNESIA GET ON THE THERMOCOUPLE ELEMENTS. DO NOT DAMAGE THE TIPS OF THE PROBES WHEN YOU INSERT THE PROBES IN THE PADS.

(2) Use unflavored milk of magnesia and lubricate the threads of the thermocouple mounting bolts. Install the bolts, and torque them to 24-27 lb in. Lockwire the bolts.

(3) Clamp the harness (3) to the brackets. Torque the clamp nuts to 20-25 lb in.

(4) Secure the harness connector (2) to the mounting bracket. Torque the screws to 8-10 lb in. Lockwire the screws.

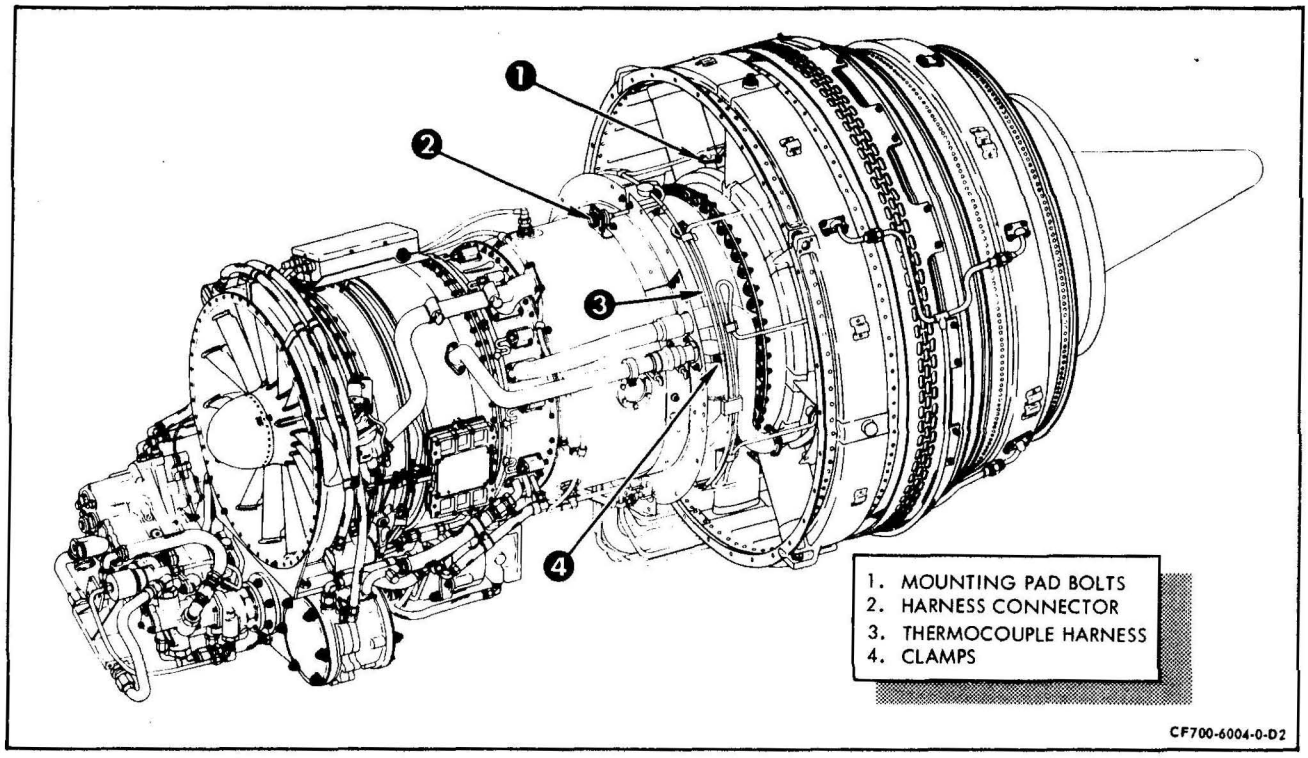
(5) Before you run the engine, check the aircraft/engine EGT indicating system for correct circuit resistance (refer to the applicable Aircraft Manual for the procedure).

3. Inspection Limits. (Installed on the engine.)

Inspection/Check	Maximum Serviceable Limits	Corrective Action
A. Rigid tubing for cracks.	Not serviceable.	Replace the harness.
B. Hot junctions for:		
(1) Erosion or burning.	1/2 of the original diameter.	Replace the harness.
(2) Carbon buildup.	Not serviceable.	Remove the carbon.
(3) Broken loops.	One broken loop per harness.	Replace the harness.
C. Harness for insulation resistance (lead-to-ground).	1200 ohms minimum.	Replace the harness.
D. No indication when local heat is applied to an individual probe (use a clean heat source).	One per harness (including broken loop).	Replace the harness.
E. Harness for continuity resistance.	0.350-0.450 ohm.	Replace the harness.

NOTE: Resistance of the ETP is checked by disconnecting both the connectors to the ETP, shorting across pins A and B on the input connector (from the thermocouple harness), and measuring the resistance across pins A and B on the output connector (to the aircraft T_5 meter) with a Wheatstone Bridge.

F. Engine temperature protector (ETP) resistance.	±0.1 ohm of the resistance value stamped on the ETP nameplate.	Replace the ETP with one that has the same resistance value as the ETP being replaced, as stamped on the metal ETP nameplate and recorded in the engine log book.



Thermocouple Harness
Figure 201

FAN SPEED SENSOR - MAINTENANCE PRACTICES

1. General. The fan speed sensor removal and installation procedures are covered in this sedtion. The electrical harness and cockpit indicator are covered in the Aircraft Manual.

CAUTION: BEFORE PROCEDING WITH THE REMOVAL/INSTALLATION INSTRUCTIONS, IDENTIFY THE SPEED SENSOR PART NUMBER. TO AVOID DAMAGING THE CABLE, IT IS IMPORTANT TO ADHERE TO THE PRESCRIBED PROCEDURE PERTAINING TO SPEED SENSOR INSTALLED.

2. Removal/Installation Fan Speed Sensor.

A. Removal. See figure 201.

(1) Remove parts (1) through (7).

NOTE: Do not lose washers (6) when removing brackets (4).

(2) Remove 2 bolts (8), washers (9), nuts (10) to free the speed sensor conduit (11).

NOTE: A crowfoot wrench (see figure 201, detail B), a modified box wrench or equivalent should be used to hold nut (10) while removing or installing bolt (8).

(3) Remove bolt (12) and pull out sensor pick-up head (13), shims (14) and O-rings (15) from bearing housing (16).

CAUTION: DO NOT OVERSTRESS SPEED SENSOR (17) WHEN SEPARATING ELBOW FROM MOUNTING PAD. LIMIT SEPARATION TO THE AMOUNT OF SLACK IN THE CABLE LEADS.

(4) Remove bolts (18), separate elbow (19) from mounting pad and remove associated parts per applicable step (a) or step (b) as follows:

(a) For P/N 4049T17: Remove screws (20), slide spacer plate (21) away from elbow and remove retaining plate halves (22).

(b) For P/N 4034T97: Remove retaining plate halves (22).

(5) Remove bolts (23) and separate receptacle (24) from elbow (19).

2.A. (Cont)

(6) Disassemble receptacle as follows (see figure 202):

(a) Position elbow away from receptacle.

(b) Remove retaining ring (1) from shell (4).

(c) Pull pin assembly (2 or 8) out of shell.

(d) Remove front insulator from shell. (3)

(7) Disassemble pin assembly per applicable step (a) or step (b).

(a) For P/N 4049T17 or P/N 4034T97 (pin assembly (2): Remove E rings (5) from pins (6) and remove rear insulator (7).

(b) For P/N 4011T92 (pin assembly (8): Press ceramic retaining rings (9) against silicone bushings (10) until rings can be lifted off pins (11) then remove bushings and rear insulator (7).

(8) Remove elbow (19, figure 201) from sensor cable and (for P/N 4049T17 only) remove spacer plate (21).

(9) Remove sensor (17) and conduit (11) from strut and remove conduit from sensor.

B. Installation. See figure 201.

(1) Slide conduit (11) (end with sharper bend first) over sensor lead down to the pick-up head (13).

NOTE: The sensor cable may have a splice covered by a curved metal sleeve, 1-1/8 inch long, crimped at both ends. If metal sleeve will not pass through conduit, the sleeve curvature may be slightly increased or decreased to allow passage. To avoid loosening the sleeve, do not squeeze sleeve at sides of crimped areas.

(2) Thread sensor contact pins and cable through 6 o'clock strut.

2.B. (Cont)

(3) Slip spacer plate (21) (for P/N 4049T17 only) over cable with countersinks facing the mounting flange.

(4) Slip elbow (19) over sensor cable.

(5) Assemble pin assembly (2 or 8, figure 202) per applicable step (a) or step (b) as follows:

(a) For P/N 4049T17 or P/N 4034T97: Install rear insulator (7), smaller diameter hole first, over contact pins (6) then install E rings (5).

(b) For P/N 4011T92: Install rear insulator (7), smaller hole diameter first, over contact pins (11) then install silicone bushings (10). Install ceramic retaining rings (9) by pushing rings against bushings until ring can be slipped over pin diameter B and onto diameter A. Silicone bushing will expand and hold ring on diameter A.

(6) Install front insulator (3) over contact pins. Make sure that keyways of the front and rear insulators are in line.

(7) Insert the assembled items into shell (4) with keyways aligned, then insert retaining ring (1) into groove in shell.

(8) Push receptacle (24, figure 201) into elbow, taking up slack in sensor cable from opposite end of elbow and fasten them together with bolts (23).

(9) Install elbow (19) on the casing mounting pad per applicable step (a), or step (b) or step (c) as follows:

(a) For P/N 4049T17: Assemble both halves of the retaining plate (22) between elbow and spacer so that they match the shape of the elbow, so that they fit into the retaining groove of the cable ferrule (25), and so that their edges meet. Install two flathead screws (20) through spacer and tighten. Fasten elbow to casing with 4 bolts (18).

NOTE: Bolts used in step (a) must be 7/16 inch long as supplied in repair kit 1900T71G01. Discard old bolts (5/16 long) if P/N 4049T17 is being installed for the first time.

2.B.(9) (Cont)

(b) For P/N 4034T97: Assemble both halves of retaining plate (22) on the elbow so that they natch the shape of the elbow, so that they fit into the retaining groove of the cable ferrule, so that their edges meet. Fasten elbow to casing with 4 bolts (18).

(c) For P/N 4011T92: Fasten elbow to casing with 4 bolts (18).

(10) Insert pick-up head of speed sensor into rear bearing housing (16).

NOTE: To accurately establish the clearance between probe and sensor ring (26), The scavenge pump (27) must be removed prior to installing pick-up head (13).

(11) Check the clearance between tip of probe and speed sensor ring (26) on the rotor aft shaft. Maintain a clearance of 0.005 - 0.008 inch by placing shims (14) under probe head.

(12) Insert probe into rear bearing housing, install bolt (12) torque to 18-22 lb-in. and lockwire.

(13) Recheck the clearance between the probe end and the speed sensor ring and record the dimension.

(14) Make a continuity check of the speed sensor at the receptacle. The resistance limit is 123 to 183 ohms.

(15) Connect the leads from a Millivolt meter to the contact pins of the speed sensor cable. Do not allow leads to touch.

(16) Hand rotate (spin) the fan.

(17) An indication (needle deflection from zero) should appear on meter scale.

(18) If an indication appears on meter scale, installation is probably good. If no indication appears, recheck for proper probe clearance of 0.005-0.008 inch. Recheck solder joints or recheck for broken wiring, pins, or insulation.

2.B. (Cont)

(19) Install scavenge pump (27) as follows:

(a) Install the O-ring retainer (28) into the recess on pump housing with the flat side of retainer against pump housing.

(b) Install O-ring (29) against retainer.

(c) Install the two O-rings (30) into the oil-IN and oil-OUT ports.

(d) Install pump to the bearing housing and secure with bolts (8), washers (9) and nuts (10) except do not install bolts at the 3 and 5 o'clock positions. Cross-tighten until the pump is seated.

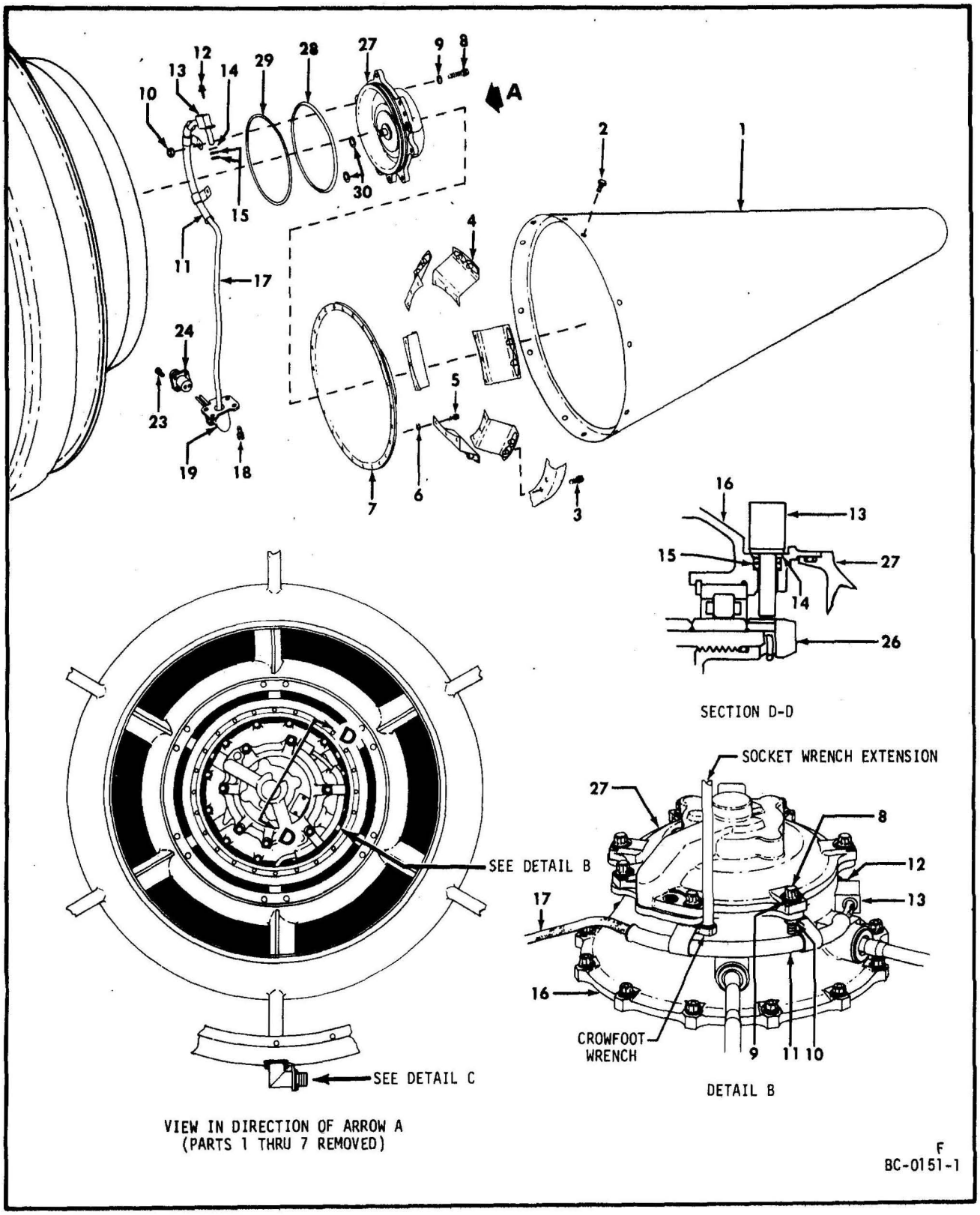
NOTE: If the O-ring retainer shears, remove the sheared section and re-install the pump assembly.

CAUTION: TO AVOID OVERSTRESSING THE SPEED SENSOR CABLE, THE CONDUIT CLAMPS MUST BE FASTENED AGAINST THE REAR BEARING HOUSING AS SHOWN IN FIGURE 201, DETAIL B.

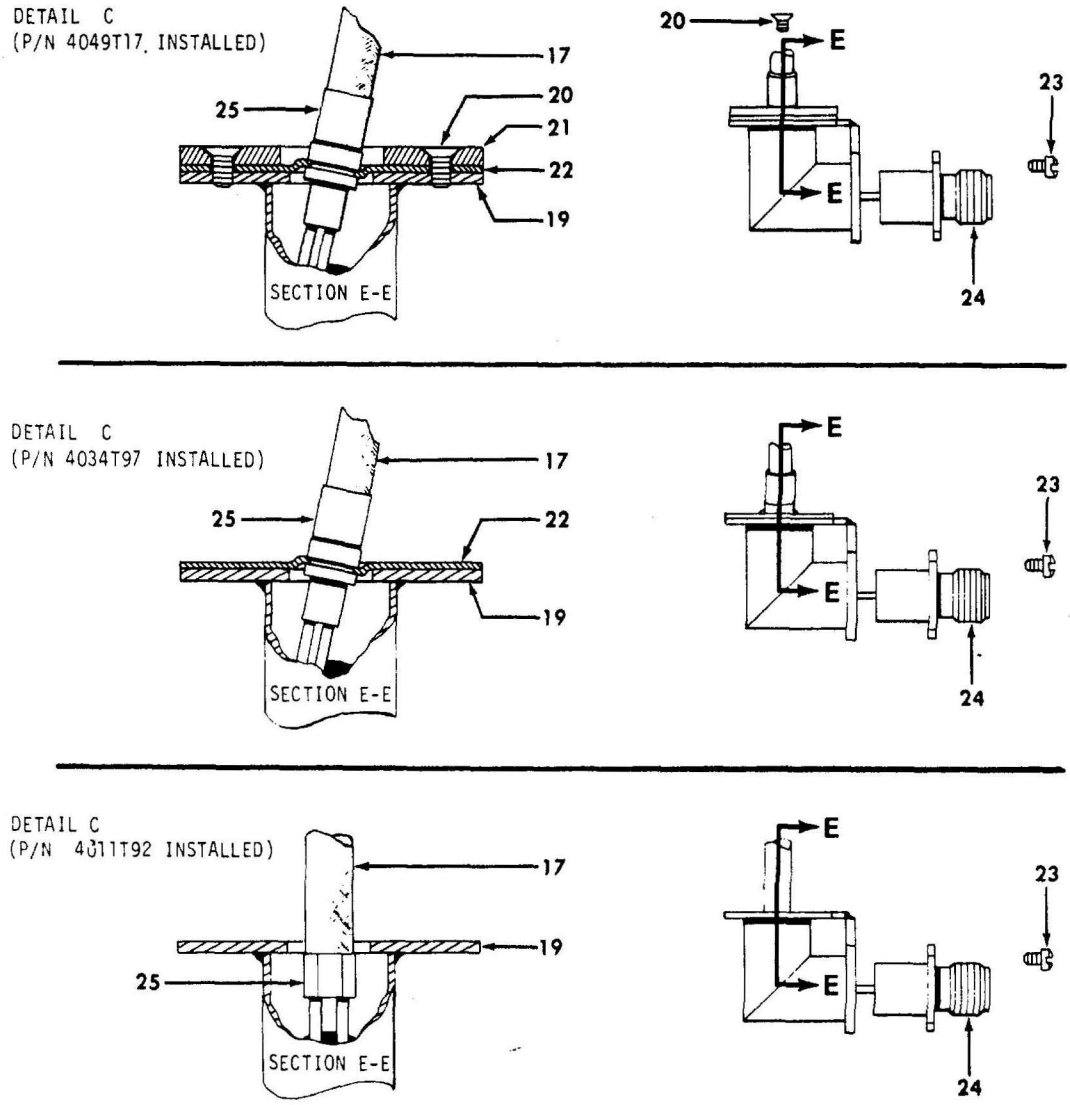
(e) Fasten the conduit (11) against the rear bearing housing at the 3 and 5 o'clock boltholes. Torque all the pump bolts to 30-35 lb-in.

(20) Install the rear shield (7) and secure in position with two bolts (5).

(21) Install 6 brackets (4) equally spaced around OD of casing, using bolts (5) and placing washers (6) between the rear shiels and the brackets, Install remainder of bolts (5) in rear shield and torque all bolts (5) to 18-22 lb-in. Fasten brackets to the aft end of the inner casing with bolts (3). Torque bolts (3) to 30-35 lb-in.



Fan Speed Sensor - Removal/Installation (Sheet 1 of 2)
Figure 201



1. Extension Cone
2. Bolt
3. Bolt
4. Bracket
5. Bolt
6. Washer
7. Rear Shield
8. Bolt
9. Washer
10. Nut
11. Conduit
12. Bolt (Pick-up Head)
13. Pick-up Head (Sensor)
14. Shim (Pick-up Head)
15. O-ring (Pick-up Head)
16. Rear Bearing Housing
17. Speed Sensor
18. Bolt
19. Elbow
20. Screw
21. Spacer Plate
22. Retaining Plate (Halves)
23. Bolt
24. Receptacle
25. Ferrule
26. Speed Sensor Ring
27. Scavenge Pump
28. O-ring Retainer
29. O-ring
30. O-ring

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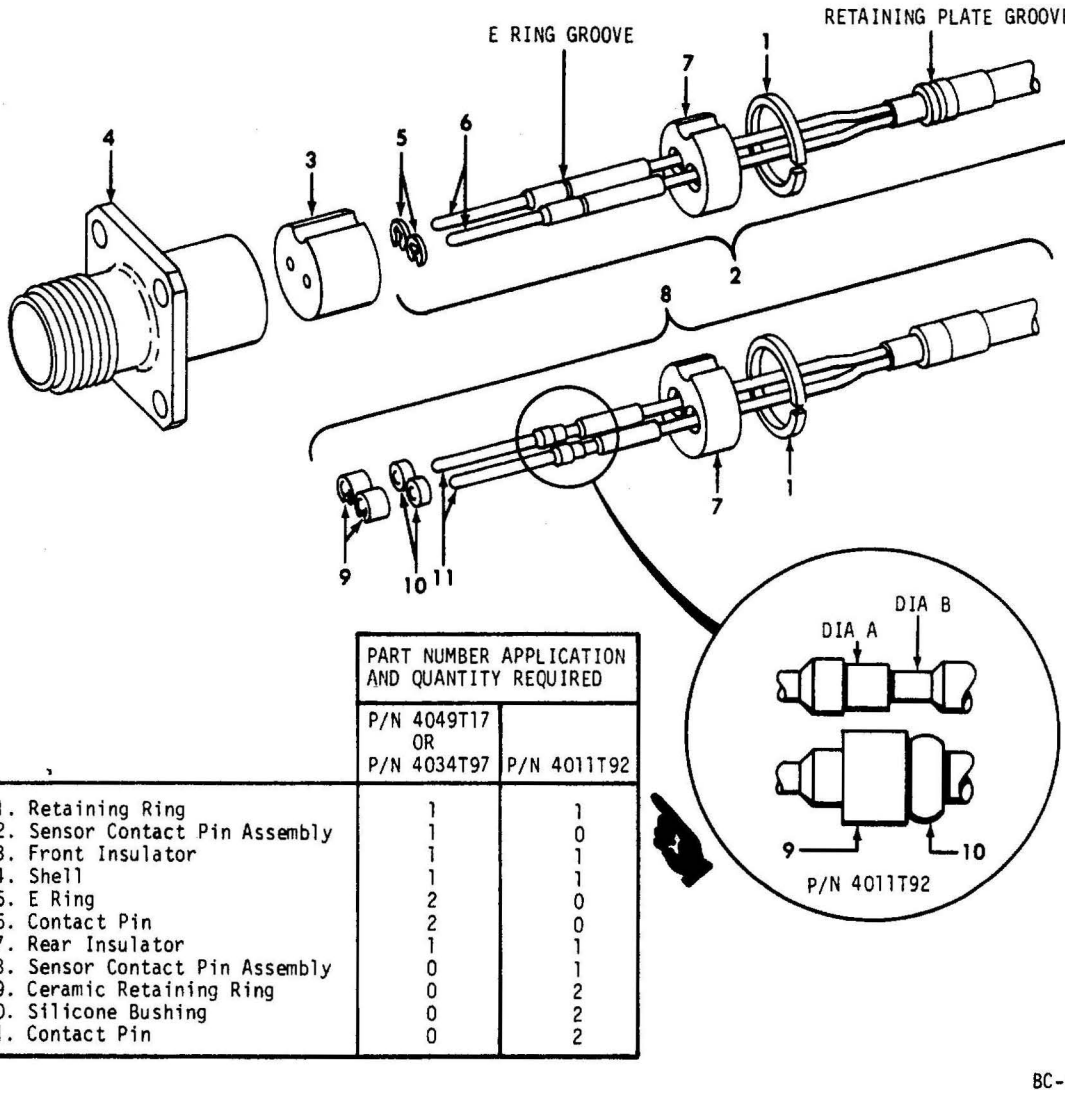
Fan Speed Sensor - Removal/Installation (Sheet 2 of 2)
Figure 201



	PART NUMBER APPLICATION AND QUANTITY REQUIRED	
	P/N 4049T17 OR P/N 4034T97	P/N 4011T92
1. Retaining Ring	1	1
2. Sensor Contact Pin Assembly	1	0
3. Front Insulator	1	1
4. Shell	1	1
5. E Ring	2	0
6. Contact Pin	2	0
7. Rear Insulator	1	1
8. Sensor Contact Pin Assembly	0	1
9. Ceramic Retaining Ring	0	2
10. Silicone Bushing	0	2
11. Contact Pin	0	2

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Speed Sensor Receptacle Assembly
Figure 202

3. Inspection/Check. Visually inspect speed sensor and associated parts as follows:

Inspection/Check	Maximum Serviceable Limits	Remarks
A. Wire braid for fraying.	Not serviceable.	Repair per paragraph 4.
B. Broken insulation on wire at pin end.	Not serviceable.	Repair per paragraph 4.
C. Pins for damage.	Not serviceable.	Repair per paragraph 4.
D. Receptacle assembly for damage and cracks.	Not serviceable.	Replace receptacle assembly.
E. Electrical elbow for cracks.	Not serviceable.	Replace elbow.

4. Repair

A. Repair damaged pins or lead if at least 5-1/2 inches from probe, as follows:

(1) Obtain speed sensor repair kit P/N 4034T99P01.

(2) Cut off defective lead of speed sensor assembly, 5-1/2 inches from probe base. Discard the defective section of lead.

(3) Slide a 3/16 inch long straight sleeve over lead and tape it in position, 5/16 to 3/8 inch from end of lead.

(4) With a sharp, pointed instrument, comb out metal braid and lay the strands back over sleeve. Clip off glass braid that covers both wires, but do not damage individual wire insulation. See figure 203, view B.

(5) Clip off the metal braid strands flush with sleeve. Remove tape applied in step (3).

(6) Skin the two underlying wires back 3/16 inch. Do not disturb layer of individual strands or wire will not fit connector.

(7) Make a continuity check of the speed sensor at the receptacle. The resistance limit is 123 to 183 ohms.

(8) Slide 1-1/8 inch long curved sleeve over braid of speed sensor lead far enough so that sleeve is even with braid. Rotate sleeve until it points in same direction as speed sensor probe. See figure 203, view C.

(9) Push connectors of the repair kit lead assembly over skinned leads of speed sensor. Crimp both connectors with crimping pliers, P/N T-5444 (manufactured by Co-operative Industries, Chester, New Jersey 07930), using outermost notch. Crimp is not complete until jaws of pliers close tight. See figure 203, view D and E.

(10) Wrap two layers of glass tape around each connector. Make sure the entire area is covered, from the straight sleeve on the repair kit lead to the straight sleeve on speed sensor lead.

(11) Wrap both connectors together with enough glass tape to build up nearly the same diameter as the ID of the curved sleeve. Finish with two half-hitches to keep tape from unwinding.

(12) Slide 1-1/8 inch long curved sleeve over splice and onto straight sleeve on repair kit lead. Curved sleeve should just cover the straight sleeve on each lead.

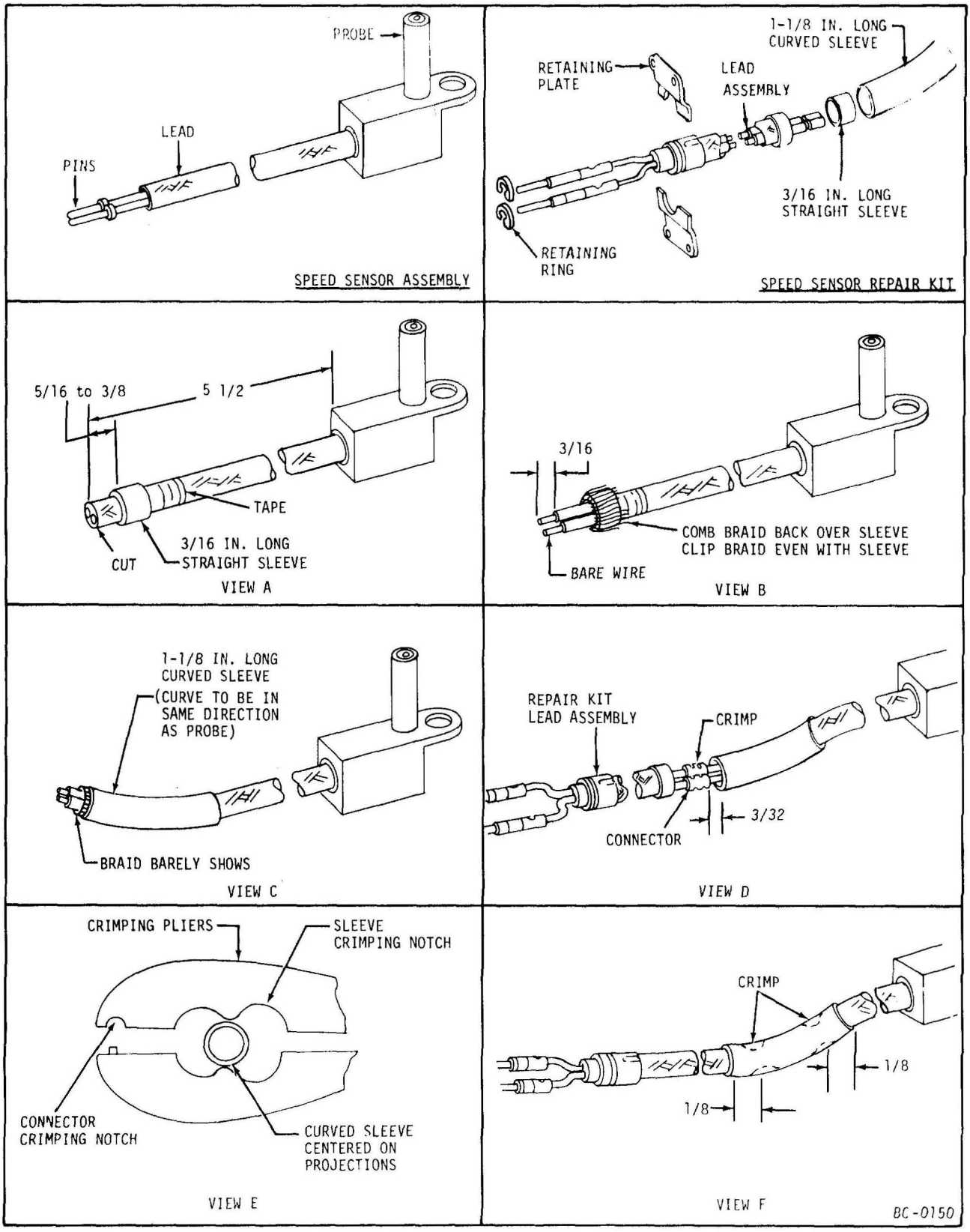
(13) Recheck 1-1/8 inch long curved sleeve and probe to make sure they are in the same plane and direction.

(14) Using the large double slot in the crimping pliers, crimp both ends of curved sleeve in same plane as curve of sleeve. Crimp is not complete until jaws of pliers close tight. See figure 203, view E and F.

(15) Reidentify sensor assembly by lining out old number and by adding reword drawing number 4034T97G01.

(16) Repeat tests specified in step (7).

(17) Attach the two retaining plates and retaining rings from speed sensor repair kit to the repaired speed sensor assembly for use at engine assembly.



Speed Sensor Lead Repair
Figure 203