CHAPTER

77

ENGINE INDICATING

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CHAPTER 77 - ENGINE INDICATING
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SPECIAL NOTE

WITHIN THIS MANUAL ALL REFERENCES TO LEFT AND RIGHT, CLOCKWISE AND COUNTERCLOCKWISE, FRONT AND REAR, ARE AS VIEWED FROM THE REAR OF THE AIRPLANE.

WITHIN THE ENGINE/PROPELLER MANUALS ALL SUCH REFERENCES ARE AS VIEWED FROM THE ACCESSORY GEARBOX/SPINNER BULKHEAD.

BECAUSE THE PIAGGIO P180 AVANTI IS CONFIGURED WITH "PUSHER" PROPELLERS, THE ENGINES ARE INSTALLED WITH THE ACCESSORY GEARBOX TOWARDS THE FRONT OF THE AIRPLANE; THEREFORE, IN THIS MANUAL ALL REFERENCES TO LEFT AND RIGHT, CLOCKWISE AND COUNTERCLOCKWISE, FRONT AND REAR (WHEN APPLIED TO ENGINE AND PROPELLER COMPONENTS) WILL BE THE OPPOSITE TO THE SAME REFERENCES IN THE ENGINE/PROPELLER MANUALS.

FOR EXAMPLE, ACCORDING TO THIS MANUAL, THE ENGINE ACCESSORY GEARBOX IS AT THE FRONT OF THE ENGINE; THE ENGINE MANUALS CONSIDER THE ACCESSORY GEARBOX TO BE THE REAR OF THE ENGINE.

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ENGINE INDICATING - DESCRIPTION AND OPERATION

1. General

A. The engine indicating chapter describes and provides maintenance instructions about those units, components and associated systems which indicate engine operation.

2. Description

(Refer to Figures 1 and 2)

A. The engine-indicating chapter comprises the following sections:

(1) Power, 77-10
(2) Temperature, 77-20
(3) Integrated Engine Instrument Systems, 77-40.

The figures 1 and 2 show the MFD displaying the engine related values and the wiring block diagram.

B. Power. This section comprises the indicators TORQ and NG.

C. Temperature. This section includes the indicator ITT.

NOTE: For the other indicators on the screen:

(1) AFX, autofeather function of the propeller blades, refer to Chap. 61.
(2) PROP, propeller rotation speed, refer to Chap. 61.
(3) FUEL FLOW, fuel flow towards burning chamber, refer to Chap. 73
(4) FUEL QTY, remaining fuel quantity, refer to Chap. 28.
(5) OIL PRESS, oil pressure, refer to Chap. 79
(6) OIL TEMP, oil temperature, refer to Chap. 79.

D. Integrated Engine Instruments Systems. The integrated engine instrument system includes MFD, PFD, DCU, EDC, Reversionary panel, IAPS.

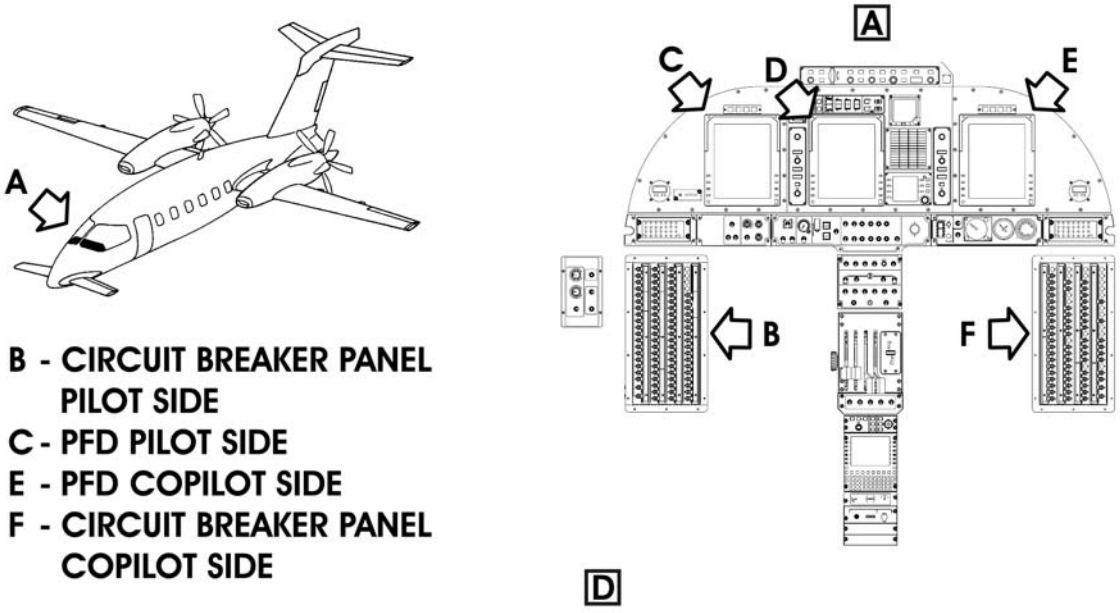

Fig. 1 - MFD displaying the Engine Related Values

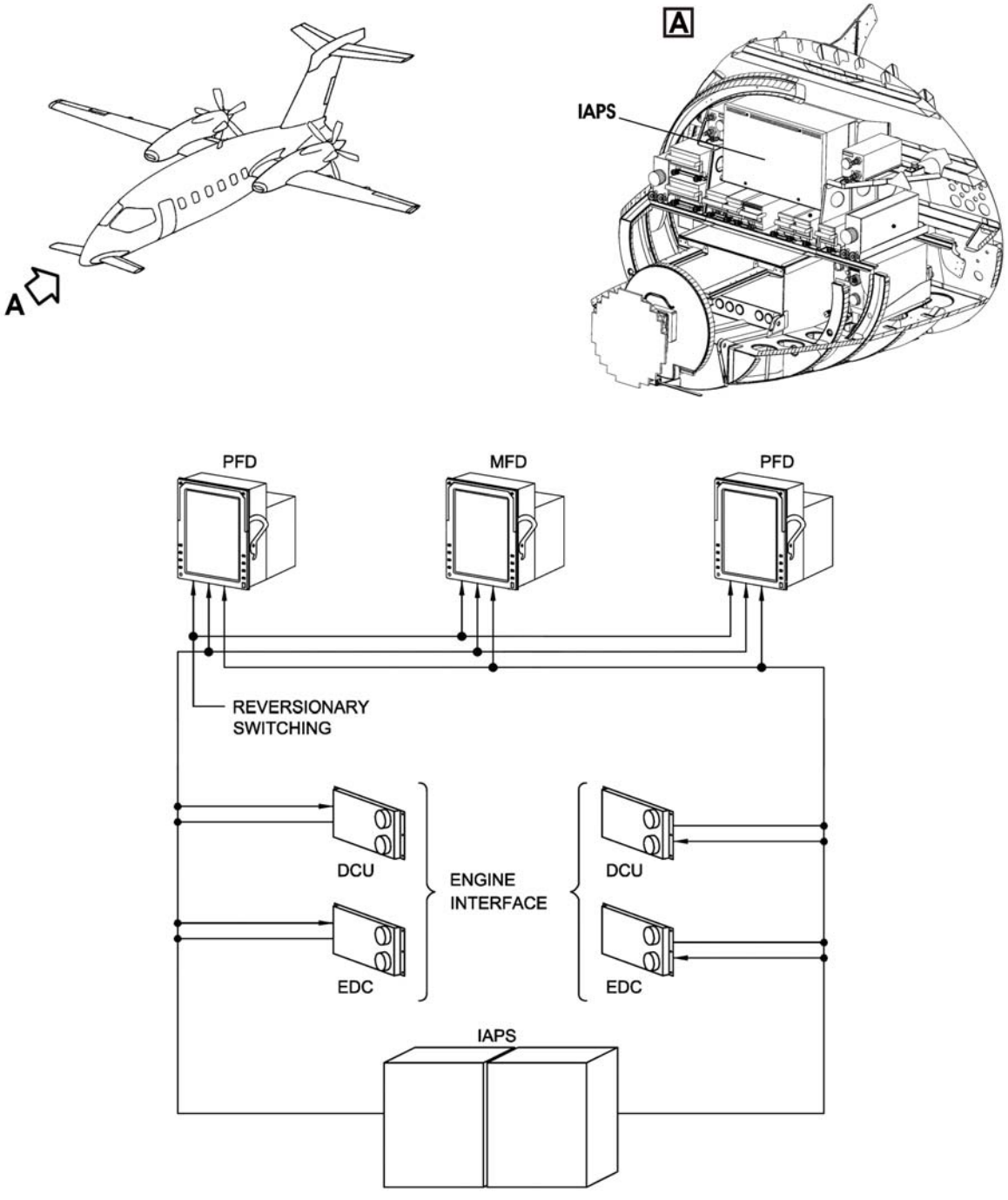

Fig. 2 - Wiring Block Diagram

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POWER - DESCRIPTION AND OPERATION

1. General

A. This section describes and provides maintenance instructions about the following indicators (Refer to 77-00-00 , Fig. 1):

(1) TORQ: Torque on the engine output shaft

(2) NG: Gas generation stage rotation speed.

2. Description

A. The engine display format consists of a full time EIS window (Refer to 77-00-00, Fig. 1). The indications assume different color for normal values, transient values and over limit values.

(1) Normal values: are those included between minimum and maximum value allowed for the parameter under measure. They are typically shown in green.

(2) Transient values: are those exceeding the normal values, but allowed for a limited period of time o under special conditions. They are typically shown in yellow. Yellow dashes are also displayed when all the sources of a parameter are out of service.

(3) Over limit values: are those not allowed. They are typically shown in red.

B. TORQ. The torque display consists of an analog and digital display for each engine; it is a measure of the engine shaft output torque (in percentage of an end-of-scale value). The torque scale, with radial tick marks, is shared with the ITT scale (Refer to 77-20-00) for the same engine. The torque digital readout display is a 4 digits format, with a decimal point between the third and fourth digit.

C. NG. The NG display consists of an analog and digital display for each engine; it is a display of engine gas generator speed RPM (in percentage of an end-of-scale value). NG is displayed on a semi-circle shaped analog scale. The NG digital display is a 4 digits format, with decimal point between third and fourth digits.

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POWER - MAINTENANCE PRACTICES

1. Torque Transmitter - Removal (Ref. Fig. 201)

A. Referenced Information

Maintenance Manual Chapter 54-10-00

B. Procedure

WARNING: DO NOT BEGIN TO REMOVE THE TORQUE TRANSMITTER UNTIL IT IS COOL. THE TEMPERATURE STAYS HIGH AFTER THE ENGINE STOPS. HIGH TEMPERATURE CAN CAUSE INJURY TO PERSONS.

WARNING: DO NOT GET THE OIL ON YOUR SKIN OR IN YOUR EYES. PUT ON SAFETY GOGGLES AND PROTECTIVE CLOTHING. IF THE OIL GETS ON YOUR SKIN OR IN YOUR EYES, GET MEDICAL HELP.

NOTE: This procedure is applicable to both left-hand and right-hand installation. Data for the right-hand procedure is given between parentheses.

(1) Set the battery switch to OFF.
(2) Set the Avionics Master Switch to OFF.
(3) Open, tag and safety these circuit breakers:
- L ENG START
- R ENG START
- L TRQ
- R TRQ

(4) Remove the nacelle panels 410AT and 410AB (420AT and 420AB) (Refer to 54-10-00).
(5) Disconnect the electrical connector (2).
(6) Remove the clamp (3) from the support (8).
(7) Disconnect the line end (4) from the transmitter (1).
(8) Unscrew the pressure port (5) with the transmitter (1) from the adapter (6).

2. Torque Transmitter - Installation (Ref. Fig. 201)

A. Fixtures, Test and Support Equipment

Lint-free cloth	Not Specified

B. Referenced Information

Maintenance Manual Chapter 54-10-00

C. Procedure

NOTE: This procedure is applicable to both left-hand and right-hand installation. Data for the right-hand procedure is given between parentheses.

(1) Make sure as necessary that:
- The applicable circuit breakers are open, tagged and safetied
- The system is safe
- Access is available (Refer to the Removal Procedure).

(2) Check the torque transmitter as described in this section, para. 3.
(3) Check the O-ring (7) for wear and replace if necessary.
(4) Screw the transmitter (1) to the adapter (6).
(5) Connect the line end (4) to the adapter (6).
(6) Secure the transmitter (1) to the support (8) with clamp (3).
(7) Connect the electrical connector (2).
(8) Install the nacelle panels 410AT and 410AB (420AT and 420AB) (Refer to 54-10-00).
(9) Remove the safety tags and close the previously opened circuit breakers:
- L ENG START
- R ENG START
- L TRQ
- R TRQ

(10) Set the Avionics Master Switch to AVIONICS.
(11) Set the battery switch to BAT.
(12) Clean the work area using a lint-free cloth.

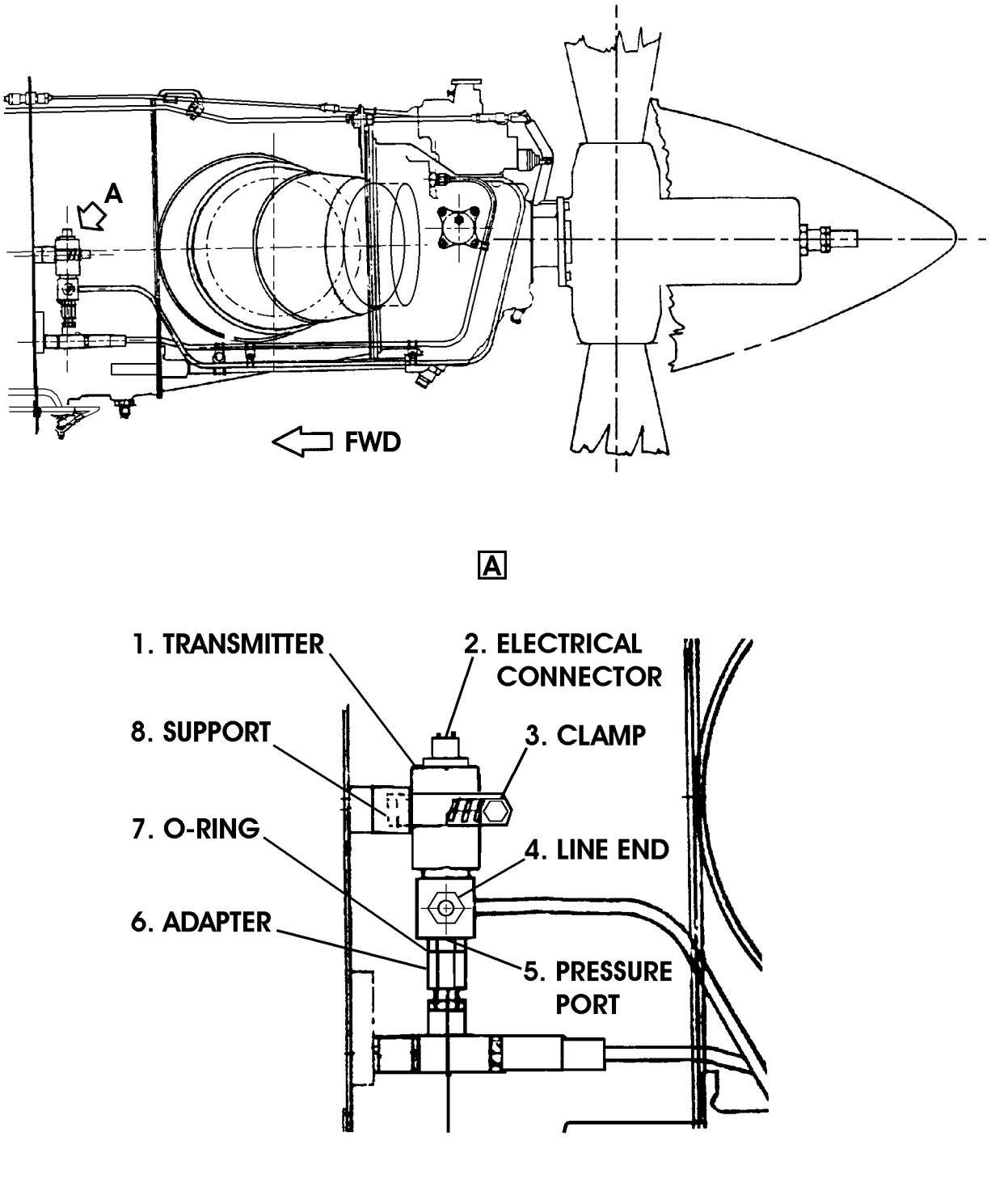
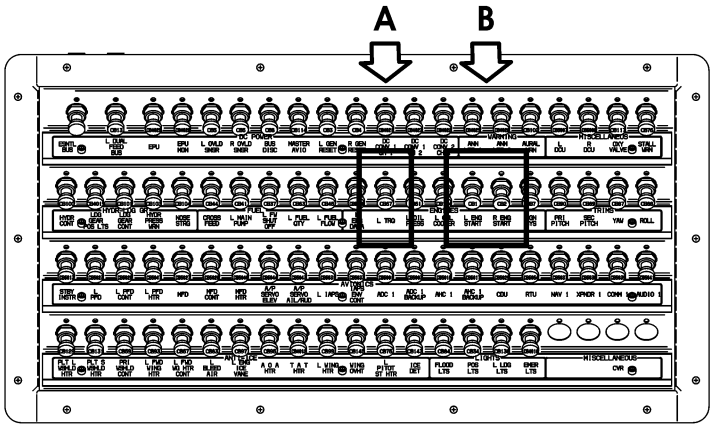
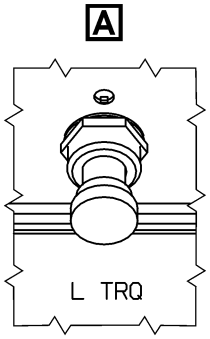
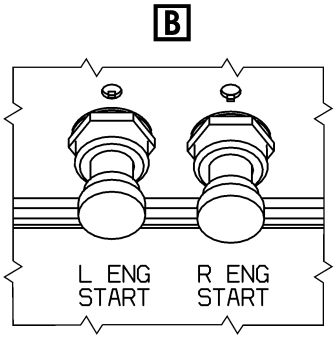


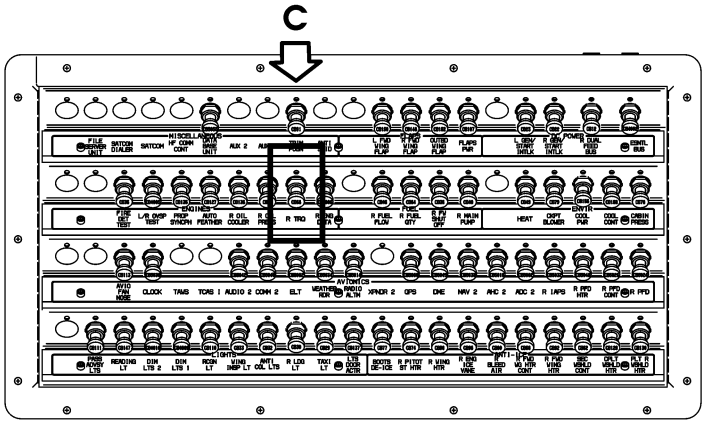
Fig. 201 - Torque Transmitter - Removal/Installation (Sheet 1 of 2)



CIRCUIT BREAKER PANEL
PILOT SIDE







CIRCUIT BREAKER PANEL
COPILOT SIDE

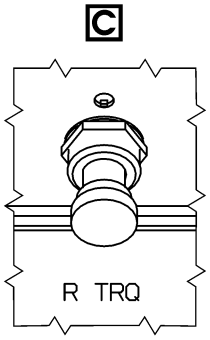


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Fig. 201 - Torque Transmitter - Removal/Installation (Sheet 2 of 2)

3. Torque Transmitter - Functional Test (Ref. Fig. 202)

A. Fixtures, Test and Support Equipment

Manometer	Not Specified
Lint-free cloth	Not Specified
Voltmeter	Not Specified

B. Materials

Approved Oil	Refer to P&WC S.B. 14001 latest revision and S.I.L. No. 20028

C. Procedure

NOTE: This procedure can be done either on the bench or on the airplane. If the procedure is done on bench, start from step (4) of the procedure.

WARNING: DO NOT BEGIN TO DISCONNECT THE PORTS OF THE TORQUE TRANSMITTER UNTIL IT IS COOL. THE TEMPERATURE STAYS HIGH AFTER THE ENGINE STOPS, HIGH TEMPERATURE CAN CAUSE INJURY TO PERSONS.

WARNING: DO NOT GET THE OIL ON YOUR SKIN OR IN YOUR EYES. PUT ON SAFETY GOGGLES AND PROTECTIVE CLOTHING. IF THE OIL GETS ON YOUR SKIN OR IN YOUR EYES, GET MEDICAL HELP.

(1) Set the battery switch to OFF.
(2) Set the Avionics Master Switch to OFF.
(3) Open, tag and safety these circuit breakers:
- L ENG START
- R ENG START
- L TRQ
- R TRQ

(4) Connect the voltmeter, manometer, torque transducer and the piping as shown in Fig. 202.
(5) Supply 28 Vdc to the transmitter.
(6) Supply oil pressure up to 20 PSID on the manometer.
(7) Read the correspondent value in volt on the voltmeter and check that the value is within the allowed range (Refer to the diagram shown in Fig. 202).
(8) Supply oil pressure up to 40 PSID on the manometer.
(9) Read the correspondent value in volt on the voltmeter and check that the value is within the allowed range (Refer to the diagram shown in Fig. 202).
(10) Supply oil pressure up to 62 PSID on the manometer.
(11) Read the correspondent value in volt on the voltmeter and check that the value is within the allowed range (Refer to the diagram shown in Fig. 202).
(12) Repeat steps 8, 9 and 6, 7 decreasing the oil pressure.
(13) If the values read on the voltmeter are not correct, the torque transmitter must be replaced.

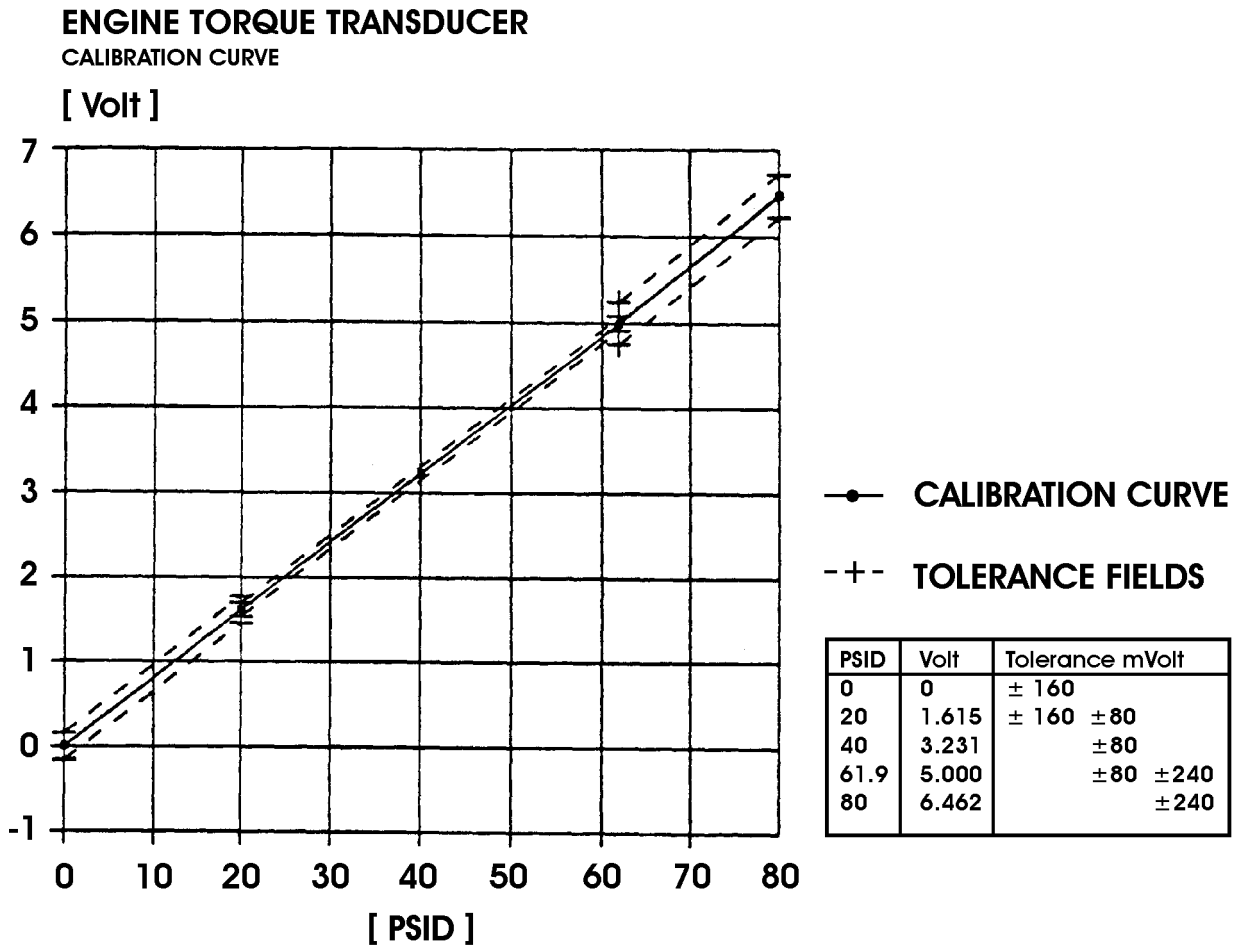

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Fig. 202 - Torque Transmitter - Functional Test (Sheet 1 of 2)

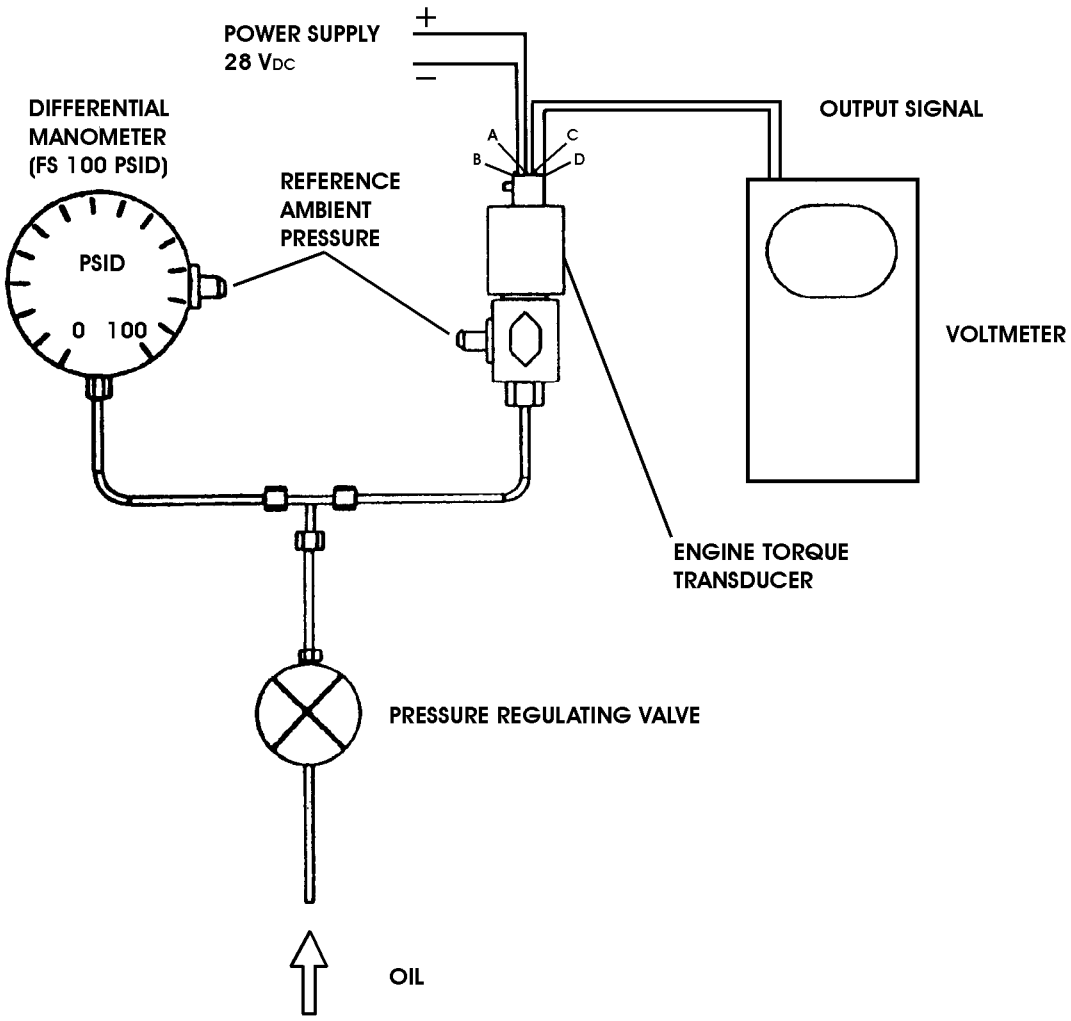

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Fig. 202 - Torque Transmitter - Functional Test (Sheet 2 of 2)

4. Torque Indicating - Calibration Test (Ref. Fig. 203)

A. Fixtures, Test and Support Equipment

Manometer	Not Specified
Lint-free cloth	Not Specified
Voltmeter	Not Specified

B. Materials

Approved Oil	Refer to P&WC S.B. 14001 latest revision and S.I.L. No. 20026

C. Procedure

NOTE: This procedure can be done either on the bench or on the airplane. If the procedure is done on bench, start from step (4) of the procedure.

WARNING: DO NOT BEGIN TO DISCONNECT THE PORTS OF THE TORQUE TRANSMITTER UNTIL IT IS COOL. THE TEMPERATURE STAYS HIGH AFTER THE ENGINE STOPS, HIGH TEMPERATURE CAN CAUSE INJURY TO PERSONS.

WARNING: DO NOT GET THE OIL ON YOUR SKIN OR IN YOUR EYES. PUT ON SAFETY GOGGLES AND PROTECTIVE CLOTHING. IF THE OIL GETS ON YOUR SKIN OR IN YOUR EYES, GET MEDICAL HELP.

(1) Set the battery switch to OFF.
(2) Set the Avionics Master Switch to OFF.
(3) Open, tag and safety these circuit breakers:
  – L ENG START
  – R ENG START
(4) Connect the voltmeter, manometer, torque transducer and the piping as shown in Fig. 203.
(5) Supply 28 Vdc to the transmitter.
(6) Do not supply oil pressure and check that the manometer is set to 0.
(7) Read the correspondent value in volt on the voltmeter and the analogue/digital values read on the indicator. Make a note of the values reading.
(8) Check that the values previously read correspond with the values shown in Table 1.
(9) Supply oil pressure up to 0 PSID.
(10) Repeat steps 7 and 8.
(11) Supply oil pressure up to 20 PSID.
(12) Repeat steps 7 and 8.
(13) Supply oil pressure up to 40 PSID.
(14) Repeat steps 7 and 8.

(15) Supply oil pressure up to 60 PSID.
(16) Repeat steps 7 and 8.
(17) Supply oil pressure up to 60,24 PSID.
(18) Repeat steps 7 and 8.
(19) Supply oil pressure up to 61,9 PSID.
(20) Repeat steps 7 and 8.
(21) Supply oil pressure up to 75 PSID.
(22) Repeat steps 7 and 8.
(23) Supply oil pressure up to 90 PSID.
(24) Repeat steps 7 and 8.
(25) If the Torque Transducer Output Voltage values are not in the limit indicated in Table 1, the Torque Transducer must be replaced.
(26) If Pressure Transducer Output Voltage is correct and there is not correspondance with Indicating Torque - Analog/Digital limits indicating in Table 1, the Torque Indicator must be replaced.

Table 1: Torque Indication

Acceptance limits table

Test Point		Press. Ref psid	Torque Transducer Volt Volt		Indicator Digital lb*ft lb*ft		Indicator Analogue lb*ft lb*ft	
			Transducer Tolerance	Transducer Limits	Indicator Tolerance	Indication Limits	Indicator Tolerance	Indication Limits
1	min	**0**	-0,133	-0,133	-7	-68	-56	-117
	ref			**0,000**	**0**	**0**	**0**	**0**
	max		0,133	0,133	7	68	56	117
2	min	**20**	-0,08	1,536	-7	697	-56	648
	ref			**1,616**	**0**	**741**	**0**	**741**
	max		0,08	1,696	7	785	56	834
3	min	**40**	-0,08	3,231	-7	1475	-56	1426
	ref			**3,231**	**0**	**1482**	**0**	**1482**
	max		0,08	3,311	7	1525	56	1574
4	min	**60**	-0,08	4,767	-7	2179	-56	2130
	ref			**4,847**	**0**	**2222**	**0**	**2222**
	max		0,08	4,927	7	2266	56	2315
Ref	min	**60,24**	-0,08	4,786	-7	2188	-56	2139
	ref			**4,866**	**0**	**2231**	**0**	**2231**
	max		0,08	4,946	7	2275	56	2324
Ref	min	**61,9**	-0,08	4,920	-7	2249	-56	2200
	ref			**5,000**	**0**	**2293**	**0**	**2293**
	max		0,08	5,08	7	2336	56	2385
5	min	**75**	-0,08	5,978	-7	2734	-56	2685
	ref			**6,058**	**0**	**2778**	**0**	**2778**
	max		0,08	6,138	7	2822	56	2871
Option **6**	min	**90**	-0,2	7,07	-7	3235	-56	3186
	ref			**7,27**	**0**	**3334**	**0**	**3334**
	maX		0,2	7,47	7	3432	56	3481

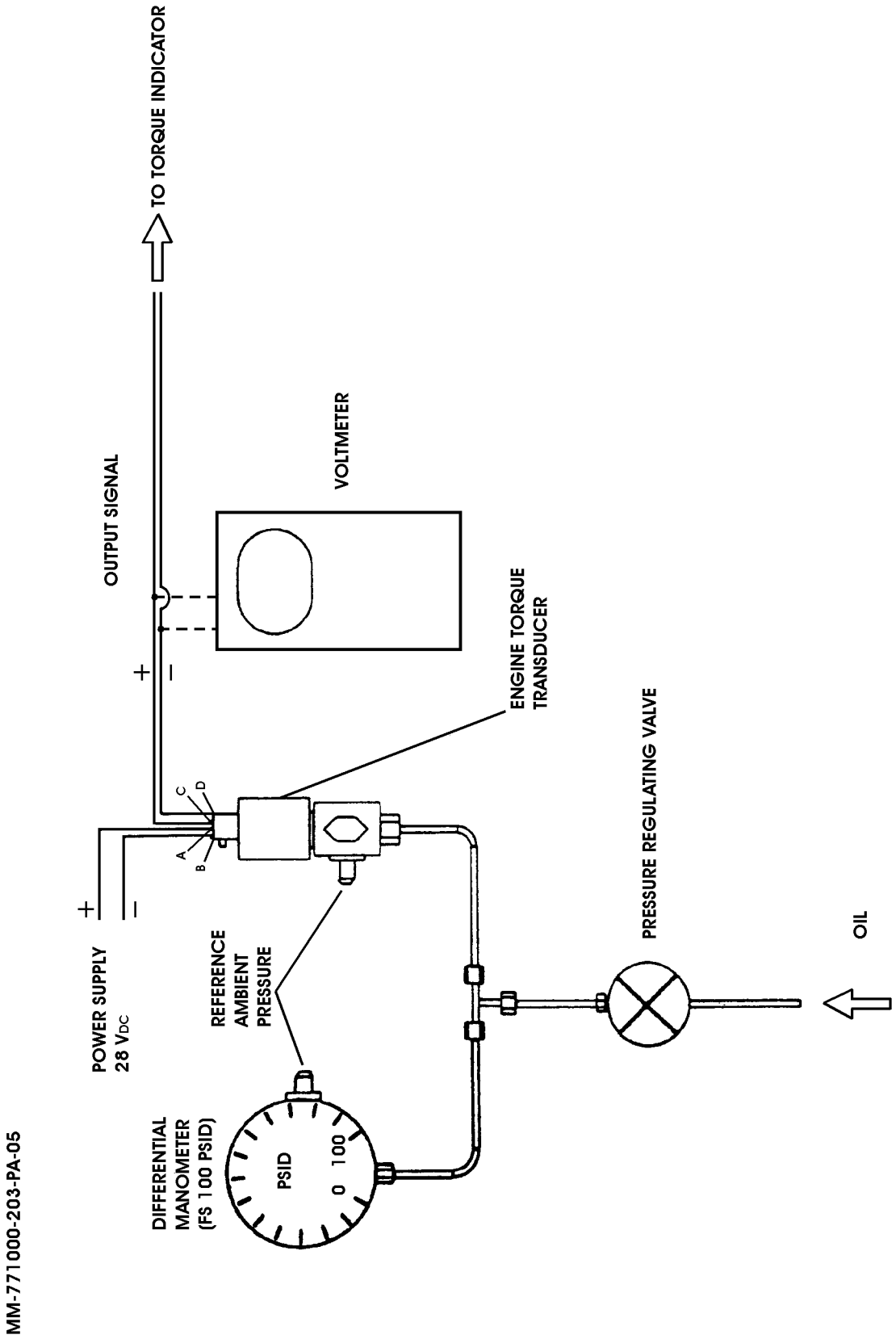

Fig. 203 - Torque Indicating - Calibration Test

5. Rotation Speed Transmitter - Removal-Installation and Test

Refer to the Pratt & Witney Engine Maintenance Manual.

6. Tachometer Generator - Removal (Ref. Fig. 204)

A. Fixtures, Test and Support Equipment

Cover, engine pad	P&WC PK255
Access Platform	3 ft.(1 m)

B. Referenced Information

Maintenance Manual Chapter 54-00-00

C. Procedure

NOTE: This procedure is applicable to both the left hand and right hand installations. Data for the right hand procedure is given between parentheses.

(1) Open, tag and safety this circuit breaker:

Pilot CB Panel
L ENG START
(R ENG START)

(2) Remove nacelle panels 410AT and 410AB (420AT and 420AB) (Refer to 54-00-00).
(3) Remove the lockwire and disconnect the electrical connector from the tachometer generator.
(4) Remove the four nuts and washers securing the tachometer generator to its mounting pad.
(5) Remove the tachometer generator from the engine taking care to avoid damaging the drive shaft splines.
(6) Remove and discard the gasket.
(7) Install a cover on the mounting pad.

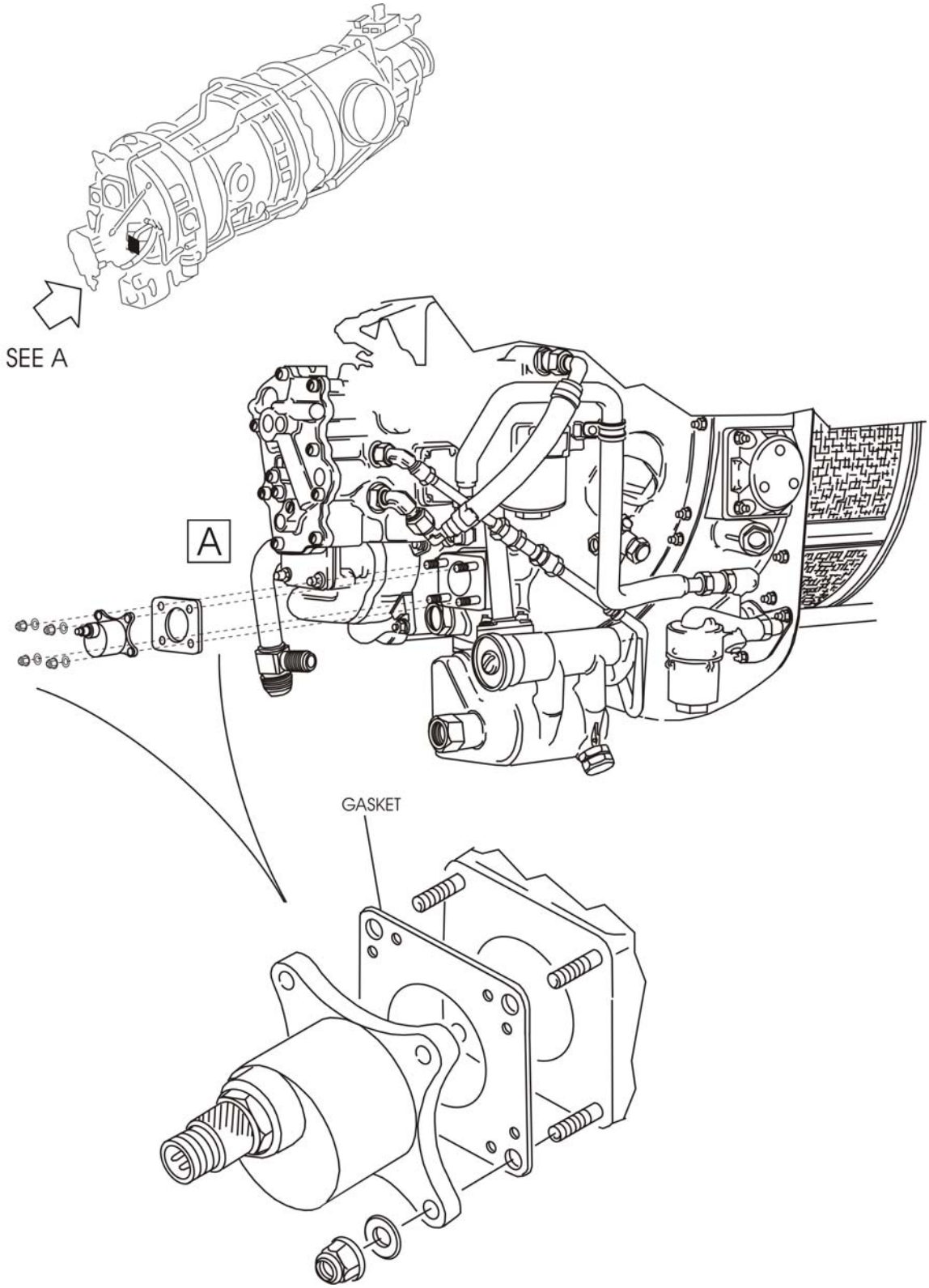

Fig. 204 - Engine Tachometer Generator - Removal and Installation

7. Tachometer Generator - Installation (Ref. Fig. 204)

A. Tools

Torque Wrench 75-85 lb.in. (8.5-9.6 Nm)	Not specified

B. Expendable Parts

Gasket	MS9134-01

C. Materials

Lockwire	04-008

D. Referenced Information

Maintenance Manual Chapter 54-00-00
Maintenance Manual Chapter 71-00-00

E. Procedure

NOTE: This procedure is applicable to both the left hand and right hand installations. Data for the right hand installation is given between parentheses.

(1) Make sure that:
- the L ENG START (R ENG START) circuit breaker is open, tagged and safetied
- access is available.

(2) Make sure that the tachometer generator base, its drive shaft and electrical receptacle are clean and free from damage.

(3) Remove the cover from the mounting pad and make sure that the pad and its internal drive are clean and free from damage.

(4) Install a new gasket on the pad.

(5) Install the tachometer generator on the pad taking care to avoid damaging the splines of the drive shaft.

(6) Secure the tachometer generator to the pad with the four nuts and washers. Torque tighten the nuts, progressively and diametrically, to between 75 and 85 lb.in. (8.5 and 9.6 Nm) plus the run-down torque applicable to each nut.

(7) Connect the electrical connector to the receptacle and safety the connector with lockwire.

(8) Remove the safety tags and close this circuit breaker:

Pilot CB Panel

L ENG START
(R ENG START)

(9) Ground run the engine (Refer to 71-00-00) and check the operation of the propeller speed indication system.

(10) After the ground run inspect the tachometer generator installation for oil leaks and rectify as necessary.

(11) Install nacelle panels 410AT and 410AB (420AT and 420AB) (Refer to 54-00-00).

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TEMPERATURE - DESCRIPTION AND OPERATION

1. General

A. This section relates to description and maintenance instructions of the following indicator (Refer to 77-00-00, Fig. 1):

(1) ITT: Inter-stage Turbine Temperature.

2. Description

A. The engine display format consists of a full time EIS window (Refer to 77-00-00, Fig. 1). The indications assume different color for normal values, transient values and over limit values.

(1) Normal values: are those included between minimum and maximum value allowed for the parameter under measure. They are typically shown in green.

(2) Transient values: are those exceeding the normal values, but allowed for a limited period of time o under special conditions. They are typically shown in yellow. Yellow dashes are also displayed when all the sources of a parameter are out of service.

(3) Over limit values: are those not allowed. They are typically shown in red.

B. ITT. The ITT display consists of an analog and digital display for each engine; it is a measure of temperature between specific stages of the engine (in Celsius degrees). The temperature scale, with radial tick marks, is shared with the TORQ scale (Refer to 77-00-00) for the same engine. The torque digital display is a 4 digits format.

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TEMPERATURE - MAINTENANCE PRACTICES

1. Temperature Transmitter - Removal-Installation and Test

   Refer to the Pratt & Witney Engine Maintenance Manual.

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INTEGRATED ENGINE INSTRUMENT SYSTEMS - DESCRIPTION AND OPERATION

1. General

A. This section relates to description and maintenance instructions about the following systems (Refer to 77-00-00, Fig. 2):

(1) MFD (primary AFD)
(2) PFD (secondary AFD)
(3) DCU (first interface)
(4) EDC (second interface)
(5) Reversionary panel
(6) IAPS.

2. Description

A. The engine display format consists of a full time EIS window that displays ITT and Torque on a shared analog gauge and NG on individual smaller analog gauge.

Two sources for the primary engine parameters (ITT, Torque, NG) exist for each engine: one is the Data Concentrator Unit (DCU) and the other is the Engine Data Concentrator (EDC). The DCU is normally the source of all displayed engine data and the EDC is a secondary source of all displayed engine data.

Discrete pins to the AFD control the display of engine information on a specific AFD. The interconnect wiring normally allows the engine information to appear only on the MFD. If display reversion switching causes the MFD to become a PFD, the engine information remains displayed on that AFD (now a PFD) and engine information is also displayed on the right PFD. In the event of an MFD failure, reversionary switching will cause the left and right PFDs to display engine data.

The IAPS contains the logic that controls the whole system.

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INTEGRATED ENGINE INSTRUMENT SYSTEMS - MAINTENANCE PRACTICES

1. Removal-Installation and Test

   A. MFD, PDF, DCU, EDC, Reversionary panel, IAPS. Refer to 31-00-00.

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