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MAINTENANCE MANUAL

TURBOPROP GAS TURBINE ENGINE

Model(s)

PT6A-66D

Manual Part No.3070902

Original Issue date26 August 2005

The contents of this manual have been examined and found acceptable to the Minister in meeting the requirements of an Engine Maintenance Manual for the Pratt & Whitney Canada PT6A-66D engine, as required by the Canadian Airworthiness Manual, Chapter 533.4 "Instructions for Continued Airworthiness".
[20211019v7.2]

Issue Date of Manual – August 23rd, 2005

Statement of Approval – P&WC

This manual complies with Transport Canada Requirements pursuant to the Canadian Airworthiness Manual CAM 533, section 533.4 Instructions for Continued Airworthiness.

Signed ..... Pratt & Whitney Canada

Print Name Jean Pelletier

Date Aug 23, 2005

TCA Design Approval Organization No. DAO 93-O-01

NOTE: The above certification does not apply to revisions or amendments issued

Export Control Classification			
			(X) if Applicable
Contains no Technical Data			( )
Not Subject to the EAR pursuant to 15 CFR 734.7(a)(1) or Not Subject to the ITAR pursuant to 22 CFR 120.11 (NSR)			( )
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If a Government agency or department intends to disclose any information, written notice should be given to: VP - Legal Services, Pratt & Whitney Canada Corp., 1000 Marie-Victorin (01BE5), Longueuil, Quebec J4G 1A1.

HIGHLIGHTS

Revision	CH/SE/SU	Pageblock Title	Description of Change
21.0	Front	SERVICE BULLETIN LIST	Service Bulletin list has been updated to revise SB14603R29 to SB14603R30.
21.0	Front	SERVICE BULLETIN LIST	Service Bulletin list has been updated to add SB14506R2.
21.0	Front	SERVICE BULLETIN LIST	Service Bulletin list has been updated to revise SB14002R26 to SB14002R27.
21.0	Front	SERVICE BULLETIN LIST	Service Bulletin list has been updated to add SB14546R1.
21.0	70.00.00 Standard Practices	70-00-00 STANDARD PRACTICES - MAINTENANCE PRACTICES	The procedure for safe handling of engine parts with suspected hexavalent chromium residue has been added.

RECORD OF REVISIONS

Rev. No.	Issue Date
1	Feb 10/2006
2	Aug 18/2006
3	Sep 28/2007
4	Apr 11/2008
5	Jun 27/2008
6	Nov 07/2008
7	Mar 13/2009
8	Jul 17/2009
9	Apr 30/2010
10	Oct 08/2010
11	Jan 27/2012
12	Dec 07/2012
13	Oct 07/2013
14	Jul 07/2014
15	Jan 12/2015
16	Jul 06/2015
17	Mar 07/2016
18	Apr 10/2017
19	Jan 18/2021
20	Apr 12/2021
21	Oct 11/2021

SERVICE BULLETIN LIST

This list identifies all Service Bulletins (SB's) for each listed engine model. Bulletins considered to have no effect on manual have the words "No Effect" added; effective bulletins give the date incorporated in the manual.

The incorporation of Service Bulletins on each engine is recorded in the engine log book and related documents.

For a current set of PT6A-66D Series engine Service Bulletins only, use ordering number 3034531.

NOTE: Service Bulletins are being continually revised to reflect P&WC recommendations for oil, fuels, engine planned maintenance, etc., and are concurrent with incorporation of engine modifications.

P&WC SB No.	ATA SB No.	Rev. No.	Engine Model Applicability	Effect/Date Incorporated
14001	72-14001	20	PT6A-66D	No Effect (See Note)
14002	72-14002	27	PT6A-66D	No Effect (See Note)
14004	72-14004	21	PT6A-66D	No Effect (See Note)
14028	72-14028	1	PT6A-66D	No Effect
14049	72-14049	1	PT6A-66D	No Effect
14350	72-14350	1	PT6A-66D	No Effect
14357	72-14357	4	PT6A-66D	No Effect
14386	72-14386	3	PT6A-66D	No Effect
14389	72-14389	4	PT6A-66D	No Effect
14390	72-14390	Original	PT6A-66D	No Effect
14391	72-14391	1	PT6A-66D	No Effect
14392	72-14392	1	PT6A-66D	No Effect

14393	72-14393	2	PT6A-66D	No Effect
14394	72-14394	3	PT6A-66D	No Effect
14396	72-14396	1	PT6A-66D	No Effect
14397	72-14397	1	PT6A-66D	No Effect
14398	72-14398	5	PT6A-66D	No Effect
14399	72-14399	2	PT6A-66D	No Effect
14405	72-14405	2	PT6A-66D	No Effect
14406	72-14406	Original	PT6A-66D	No Effect
14407	72-14407	3	PT6A-66D	No Effect
14408	72-14408	2	PT6A-66D	No Effect
14410	72-14410	2	PT6A-66D	No Effect
14413	72-14413	Original	PT6A-66D	No Effect
14416	72-14416	2	PT6A-66D	No Effect
14428	72-14428	1	PT6A-66D	No Effect
14431	72-14431	1	PT6A-66D	No Effect
14438	72-14438	3	PT6A-66D	No Effect
14441	72-14441	2	PT6A-66D	No Effect
14447	72-14447	1	PT6A-66D	No Effect

14450	72-14450	Original	PT6A-66D	No Effect
14451	72-14451	1	PT6A-66D	No Effect
14469	72-14469	1	PT6A-66D	No Effect
14472	72-14472	Original	PT6A-66D	Jan 12/2015
14473	72-14473	3	PT6A-66D	No Effect
14474	72-14474	2	PT6A-66D	No Effect
14476	72-14476	4	PT6A-64	No Effect
14479	72-14479	Original	PT6A-66D	No Effect
14483	72-14483	1	PT6A-66D	No Effect
14488	72-14488	Original	PT6A-66D	No Effect
14492	72-14492	6	PT6A-66D	No Effect (See Note)
14495	72-14495	4	PT6A-66D	No Effect
14498	72-14498	Original	PT6A-66D	No Effect
14500	72-14500	1	PT6A-66D	No Effect
14506	72-14506	2	PT6A-66D	No Effect
14509	72-14509	3	PT6A-66D	No Effect
14511	72-14511	1	PT6A-66D	No Effect
14512	72-14512	7	PT6A-66D	No Effect

14513	72-14513	1	PT6A-66D	No Effect
14516	72-14516	Original	PT6A-66D	No Effect
14535	72-14535	3	PT6A-66D	No Effect
14546	72-14546	1	PT6A-66D	No Effect
14547	72-14547	1	PT6A-66D	No Effect
14548	72-14548	Original	PT6A-66D	No Effect
14549	72-14549	Original	PT6A-66D	No Effect
14550	72-14550	1	PT6A-66D	No Effect
14553	72-14553	Original	PT6A-66D	No Effect
14603	72-14603	30	PT6A-66D	No Effect (See Note)

INTRODUCTION

1. General

A. This maintenance manual contains the recommended procedures for maintaining engines manufactured by Pratt & Whitney Canada. Personnel involved with engine maintenance should acquaint themselves with the contents of the following introductory paragraphs for full comprehension of the information contained in this manual.

B. Any discrepancies, problems or suggestions regarding this publication should be forwarded in writing, using the Pratt & Whitney Canada Customer Feedback Sheet (RSVP), to:

Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada
J4G 1A1

Attention: Manager Publications 05MS1

Email: customer.service@pwc.ca

Website: www.pwc.ca

C. Customer Feedback Sheets are enclosed with new manuals and each subsequent revision. Additional forms may be obtained by contacting: The Supervisor, Publications Customer Services, at the above address.

D. The on-line Customer Feedback Sheet (RSVP form) is also available on the Pratt & Whitney Canada website (www.pwc.ca).

E. Procedures in this manual may be accomplished with the engine installed or removed from the airframe. This manual will be revised as necessary to incorporate any changes as they arise and also incorporate latest approved procedures and data. This manual is not customized to any particular airframe installation. Configurational variations that may arise as a result of installation or peculiar requirement will be dealt with in the text as they occur.

2. Customer Service

Customer Service representatives maintain contact with operators and service activities and are available for investigation of any specific difficulty or problem. Request for assistance should be directed to:

Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada
J4G 1A1

Attention: Customer Service

Request for AOG support should also be directed to:

Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada
J4G 1A1

Attention: Customer First Centre (CFirst) (01TS4)

REF: CFirst (24-hour service)

Toll Free - USA and Canada: 1-800-268-8000

Toll Free - International: (International Access Code) -8000-268-8000

Other: 1-450-647-8000

FAX: 1-450-647-2888

E-mail: CFirst@pwc.ca

Telephone or write to the manager of the Spare Parts Sales Department to get details about how to order parts. You can also get information from the Customer First Centre (CFirst).

Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada
J4G 1A1

Attention: Spare Parts Sales Department

3. Accessories Support

Accessories may be sent for repair or complete overhaul to:

P&WC Accessories Services
333 rue d'Auvergne (Area 2K)
Longueuil, Quebec
Canada
J4H 3Y3

4. How to Use this Manual

A. Chapter/Section/Subject Numbering

Subject matter in this manual is separated into specific Chapters, Sections and Subjects in accordance with ATA Specification No. 100. Each chapter is divided into sections and each section is divided into units. These three elements are shown in large bold numbers at the lower right hand corner of each page, where applicable. Chapters are separated by tab dividers.

Chapters contained in this manual are as follows:

AIRWORTHINESS LIMITATIONS	Life Limited Parts
61	Propeller Control
70	Standard Practices
71	Power Plant
72	Engine
73	Fuel and Control Systems
74	Ignition System
75	Air System
77	Engine Indicating System
79	Oil System

73	Fuel and Control Systems
74	Ignition System
75	Air System
77	Engine Indicating System
79	Oil System

B. Chapter 72

The engine chapter is further broken down into sections:

72-01	Power Section
72-10	Reduction Gearbox
72-20	Air Inlet Section
72-30	Compressor Section
72-40	Combustion Section
72-50	Turbine Section
72-60	Accessory Gearbox

C. Other Chapters

Chapter/Section breakdown for the other Chapters is extensive and is shown in the Table of Contents for each Chapter.

5. Engine and Module Concept

A. An engine comprises two modules: power section module (PSM) and gas generator module (GGM), each maintained at its own Time Between Overhaul (TBO) schedule (Ref. 72-00-00, DESCRIPTION AND OPERATION, Transport Canada Approved Service Bulletins); an approved engine modular program will define the procedures. Scheduled overhaul of a module is due when the TBO expires, and it may be shipped separately, or as a component of the complete engine (Ref. 72-00-00, SERVICING, Storage and Shipping).

B. Before shipping a power section module (PSM) for replacement at overhaul:

(1) Remove the classified power turbine stator assembly from the PSM and retain with the GGM as a matched unit.

(2) If the T5 immersion thermocouples configuration of the replacement PSM is not identical to the original PSM configuration , remove and transfer the original PSM T5 immersion thermocouples to the replacement PSM.

(3) Record power turbine stator assembly removal and transfer of T5 immersion thermocouple probes (if required) in PSM documents.

C. Before shipping a gas generator module (GGM) for replacement at overhaul:

(1) Install power turbine stator assembly retained with replacement GGM on original PSM.

(2) Verify and confirm the configuration of the combustion chamber liner of the replacement GGM .

(3) Make sure T5 immersion thermocouples are of the correct configuration in relation to the combustion chamber liner configuration.

(4) Record power turbine stator assembly removal and transfer of T5 immersion thermocouple probes (if required) in GGM documents.

D. An engine TBO is maintained in accordance with Transport Canada Approved Service Bulletins (Ref. Chap. 72-00-00, DESCRIPTION AND OPERATION, Transport Canada Approved Service Bulletins). When the TBO expires, the engine is due for scheduled overhaul.

E. An engine or module with a valid TBO may be returned for unscheduled overhaul (Light Overhaul), i.e. unusual oil conditions, lightning strike, sudden stoppage, engine overspeed, etc. (Ref. 72-00-00, INSPECTION, Unscheduled Inspection).

6. Engine Part Nomenclature

For engine bearings, stations and flanges, refer to 72-00-00, DESCRIPTION AND OPERATION, Figure 4.

7. Directional References

The terms right and left, clockwise and counterclockwise, upper and lower and similar references will apply to the engine as viewed from the rear, with the engine in a horizontal position and the accessory gearbox facing the viewer.

8. Maintenance Concept

The maintenance functions detailed in this manual fall into two categories: Line Maintenance and Heavy Maintenance. Repairs beyond the levels detailed in this manual are not recommended as maintenance functions and should be done by an approved overhaul facility.

A. Line Maintenance

The scope of line maintenance consists of removal and installation of external components and engine accessories. All procedures in this manual are to be considered line maintenance in the absence of the words "(Heavy Maintenance Only)" appearing with the procedure title in Maintenance Practices.

B. Heavy Maintenance

Heavy maintenance details removal, installation and repair of components or parts normally considered beyond the capabilities of the average line maintenance facility.

9. Supplementary Publications

Personnel concerned with the maintenance of the PT6A-66D series engines should familiarize themselves with the contents of the Illustrated Parts Catalog (P&WC Manual P/N 3070904) which lists and describes the saleable parts of the engines and illustrates their inter-relationships.

Table 1 lists the Component Maintenance Manuals (CMM). Refer to the Illustrated Parts Catalog for component part numbers and supplier codes.

Table 1 Component Maintenance Manuals

10. Service Bulletins

Service bulletins will be issued as required to provide information or instructions for modifying engines or parts to the latest configuration.

11. Abbreviations and Symbols

The following is a list of abbreviations and symbols used throughout this manual.

AGB	Accessory Gearbox
AMS	Aerospace Material Specification
Assy	Assembly
ATA	Air Transport Association
beta	Range of propeller blade angle between fine pitch stop and maximum reverse pitch setting
BRG	Bearing
CCW	Counterclockwise

CG	Center of Gravity
CSU	Constant Speed Unit
CT	Compressor Turbine
CW	Clockwise
°C	degrees Celsius (Centigrade)
°F	degrees Fahrenheit
°R	degrees Rankine
°K	degrees Kelvin
del	Delta (P observed/P Standard Day)
del P	engine torquemeter pressure, in. Hg.
del T5	T5 Temperature Trim Value
DELRTH	Delta Root Theta
Dia	Diameter
Dim	Dimension
eshp	Equivalent shaft horsepower
FCU	Fuel Control Unit
FI	Flight Idle
FIR	Full Indicator Reading
FOD	Foreign Object Damage
FPI	Fluorescent Penetrant Inspection

FWD(Fwd)	Forward
G	Gravitational Constant
GGM	Gas Generator Module
GI	Ground Idle
Hg	Mercury
HP	High Pressure
hr	hour
HSI	Hot Section Inspection
ID	Inside Diameter
Imp	Imperial
in.	inch
in.Hg	Inches of Mercury
IPC	Illustrated Parts Catalog
ITT(T5)	Interturbine Temperature
kg	kilogram
lb.	pound
lb.in./lbf.in.	pound force inch
LH	Left-hand
LP	Low Pressure
Max.	Maximum

Min.	Minimum
mm	millimeter
NA	Not Applicable
Nf(NF)	Power Turbine Speed (rpm or %)
Ng(NG)	Gas Generator Speed (rpm or %)
No.	Number
Np	Propeller Speed (rpm or %)
OD	Outside Diameter
Pam	Ambient Barometric Pressure
Para.	Paragraph
PD	Pitch Diameter
P/N	Part Number
PP	Plenum Pressure
pph	pounds per hour
Psgb	Reduction Gearbox Static Pressure
psi	pounds per square inch
psig	Pounds per square inch (gage reading)
PS1	Inlet Static Pressure
PSM	Power Section Module
PT	Power Turbine

P&WA	Pratt & Whitney Aircraft
P&WC	Pratt & Whitney Canada Corp.
PWC	Special Tool Prefix Letters - Engine
Px	Control Pressure (Bleed Valve)
Py	Governor Servo Pressure
Po	Bypass Pressure
P1	Unmetered Fuel Pressure
P2	Metered Fuel Pressure
P3	Compressor Discharge Air Pressure
Ref.(REF.)	reference
RGB	Reduction Gearbox (Propeller)
RH	Right-hand
rpm	revolutions per minute
RTH	Root Theta
SB	Service Bulletin
SCFM	Standard Cubic Feet per Minute
SED	Small Exit Duct
sfc	specific fuel consumption (lbs/shp/hr)
SG	Specific Gravity
shp	shaft horse power

SCFM	Standard Cubic Feet per Minute
SED	Small Exit Duct
sfc	specific fuel consumption (lbs/shp/hr)
SG	Specific Gravity
shp	shaft horse power
SOI	Specific Operating Instructions
SPOP	Service Process Operation Procedure
T	Temperature
tam	Ambient Air Temperature
TBA	To be advised
TBO	Time Between Overhaul
theta	T observed/T standard day
TIG	Tungsten Inert Gas (Welding method)
T1	Engine Inlet Temperature
T5 (ITT)	Inter-turbine Temperature
TSN	Time Since New
UOS	Unless Otherwise Specified
USA	United States of America
Wf	Fuel Flow (lbs/hr)

List of Tables

1 Component Maintenance Manuals

SPECIAL TOOLS/FIXTURES AND EQUIPMENT

1. General

This section gives data about the special tools and the fixtures and equipment required to maintain the engine.

2. Special Tools

Refer SIL GEN-022 for the list of tool suppliers and send a purchase order for the special tools, listed in Table 1.

Table 1 Special Tools

When ordering special tools, include the prefix 'PWC' as a component of the tool part number, e.g. PWC32073, Sling.

For information and ordering, contact:

Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada
J4G 1A1

Attention: Manager Publications (05MS1)

3. Special Equipment

Special equipment listed in Table 2 is considered as any equipment, material , fixture which is not PWC derived and is not considered a consumable material.

Table 2 Special Equipment

List of Tables

1 Special Tools

2 Special Equipment

1. General

This section gives data about the consumable materials listed in this manual.

2. Consumable Materials

The term Consumable Material shall be defined as an expendable substance which is not separately obtained from Pratt & Whitney Canada and which may be applied to the engine or its parts during maintenance.

In many instances, products such as cleaning materials, are mentioned by their trade names to assist the operator in identifying the product types. These names are representative examples only and their inclusion does not necessarily exclude the use of other equivalent products.

Specification numbers applying to consumable materials are basic numbers and shall be interpreted to include all revisions and amendments thereto.

Alternative materials are included if they are known and they have a letter added after the basic item number (eg: PWC03-001A). You can use these alternative materials unless differently specified in the manual. If the alternative material item number is identified in the manual, you must use the alternative material only. If you must use the basic item number material, an asterisk is shown after the number (eg: PWC03-001*).

Material Safety Data Sheets (MSDS) containing information about trade name, safety hazards, health hazards, reactivity, spill or leak procedures, special protection information, special precautions, and transportation and labelling are available from the manufacturer of the products. Read all MSDS prior to using the consumable materials.

Table 1 lists consumable materials and supplier codes used in the maintenance of the engine.

A supplier code with a (m) after the code is the manufacturer of the material and a supplier code with a (s) after the code is a supplier/distributor of the material.

Table 1 Consumable Materials

3. Suppliers and Supplier Services

The names of any companies provided in Table 2, as a possible source for required services or supplies, are furnished for information purposes only. Pratt & Whitney Canada, Corp. does not endorse the work performed or supplies procured from these companies. Further, Pratt & Whitney Canada, Corp. does not accept responsibility, to any degree, for the selection of such companies for such work performed or supplies procured.

The codes given are the Manufacturer's Commercial Agency of Government Entity (CAGE) number. A supplier used by Pratt & Whitney Canada (P&WC) and Pratt and Whitney America (PWA), who does not have a CAGE No., is given a SXXXX code by PWA. A supplier used only by P&WC, who does not have a CAGE No., is given an AXXXX code by P&WC.

Table 2 Supplier Codes and Addresses

List of Tables

1 Consumable Materials

2 Supplier Codes and Addresses

1. General

The Airworthiness Limitations section specifies mandatory Rotor Component Service Life Limits required for type certification. The Airworthiness Limitations section is approved by the Canadian Minister of Transport and specifies maintenance required by any applicable airworthiness or operational rule unless an alternative program has been approved by the Canadian Minister of Transport.

For Rotor Component Service Life Limits, refer to the latest revision of P&WC S.B. No.14002.

61-20-00
PROPELLER GOVERNING - DESCRIPTION AND OPERATION

1. General

A propeller governor installation, comprising propeller governor and related parts, is installed at the 12 o'clock position on the front housing of the reduction gearbox. The governor is driven by the propeller shaft through an accessory drive shaft, to control the propeller speed and pitch settings as dictated by the cockpit control settings and flight conditions.

2. Propeller Governor

A. Description (Ref. Fig. 1)

The governor is a base-mounted centrifugal type designed for use with hydraulic constant speed propellers, of single or double-acting design depending on airframe installation. The pitch of the propeller is varied by the governor to match the load torque to engine torque in response to changing flight conditions.

Oil pressure is used to decrease propeller pitch. Pitch change in the increase pitch direction is accomplished by the use of springs and propeller counterweights on single-acting propeller types. The governor is equipped with an integral Beta valve, which selects propeller blade angle while the aircraft is operating in the Beta control range, and a pneumatic orifice that bleeds compressor discharge air from the main fuel control unit, thereby limiting and controlling turbine speed while operating in the constant speed range. On some governors, a speed biasing coil raises the speed setting of the governor to synchronize the "slave" engine with the "master" engine. A feathering valve may be incorporated to effect rapid dumping of oil from the propeller servo and rapid propeller feathering.

The load on an aircraft turboprop engine is its propeller. The amount of load varies with the angle or pitch of the propeller blades. A propeller in low pitch decreases the load on the engine and allows the engine to increase speed. Constant engine speed, therefore, is achieved by controlling the load to the engine by varying the pitch of the propeller blades.

B. Operation (Ref. Fig. 2)

(1) Oil Supply

Engine oil is supplied to a gear-type engine driven oil pump in the base of the governor. Maximum oil pressure in the governor is limited by the governor relief valve. When pressure reaches the allowable maximum, the relief valve opens and the oil recirculates through the pump.

(2) On Speed

The pilot valve plunger moves up and down in the hollow drive gearshaft to control the flow of oil to and from the propeller servo. When the pilot valve plunger is centered (i.e., the plunger covers the oil discharge ports in the drive gearshaft), no oil flows to or from the propeller servo, but is recirculated through the pump. The propeller blade angle and engine speed remain constant. This is the "on speed" condition.

The greater of two forces moves the pilot valve plunger up or down. The centrifugal force developed by the rotating flyweights is transformed into an upward force which tends to lift the plunger. This centrifugal force is opposed by the downward force of the speeder spring which may be varied by the speed adjusting lever. When the opposing forces are equal, the plunger is stationary.

(3) Underspeed

An underspeed condition occurs as the result of an increase in propeller load or movement of the control lever in the "increase rpm" direction. The flyweight force thus becomes less than the speeder spring force. The flyweights move in, lowering the pilot valve plunger and uncovering the ports in the drive gear shaft which allows oil to flow to the propeller pitch changing servo. The propeller blades move in the decrease pitch direction against the force of the propeller counterweights. With load on the engine reduced, engine speed increases, and the centrifugal force developed by the rotating flyweights is increased. The flyweight toes lift the pilot valve plunger to cover the control ports and shut off the flow of oil. The forces acting on the engine-governor-propeller combination are again balanced, and the engine has returned to the speed called for by the governor control lever setting.

(4) Overspeed

An overspeed condition occurs as the result of a decrease in propeller load or movement of the control lever in the "decrease rpm" direction. The flyweight force thus becomes greater than the speeder spring force. The flyweights move out, raising the pilot valve plunger and aligning the ports which allows oil to drain from the propeller servo, through the governor, to the sump. As the propeller blades move in the "increase pitch" direction, load on the engine is increased, and engine speed is reduced. The centrifugal force lowers the pilot valve plunger to its centered position. The pilot valve plunger once more covers the ports in the drive gear shaft, blocking the flow of oil to or from the propeller servo, and the system is again in equilibrium.

(5) Feathering

When the governor speed adjusting lever is pulled back against the minimum rpm stop, the pilot valve plunger is raised by the pilot valve lift rod. This allows the propeller counterweights and feathering spring (in the propeller hub) to force the oil out of the propeller servo into the engine sump, and the blades rotate to the feathered position.

To let the propeller move rapidly into a fully feathered position, a propeller servo pressure dump valve is incorporated in the head of the governor. Servo pressure is applied to the normally closed valve, while the valve poppet is mechanically linked to the feathering adjustment stop. When the speed select lever contacts the stop, increased pressure on the lever moves the stop and valve poppet to the rear and allows servo pressure oil to flow into an external line connected to the gearbox sump.

(6) Beta Valve

The propeller governor Beta valve plunger is operated by the propeller reversing linkage of the turboprop engine installation. Outward movement of the valve plunger will first block off porting of the propeller governing oil to the propeller servo. Further valve plunger movement will dump the oil to sump. Outward motion is limited by a mechanical stop. Movement in the opposite direction will not affect normal propeller control. When propeller speed is less than the propeller governor speed setting, the propeller governor supplies more oil to the propeller servo piston to further decrease propeller pitch until the feedback linkage pulls the Beta valve plunger outward and blocks the propeller oil supply, thus preventing further pitch change. As a higher power setting is selected by the pilot, the propeller comes out of the Beta range, and blade pitch will automatically increase to maintain the speed setting which has been established by the propeller governor speed adjusting lever.

(6) Beta Valve

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(7) Airbleed Orifice

The airbleed orifice serves to protect the engine against possible propeller overspeed. The airbleed section of the propeller governor is open to the compressor discharge pressure (CDP) sensor of the main fuel control. The airbleed lever assembly is raised or lowered as flyweight action changes with speed variation. The airbleed lever assembly operates the orifice lever assembly which seals against the airbleed orifice. Opening of the orifice bleeds off CDP from the fuel control, resulting in a lower CDP signal being received in the CDP sensor, and fuel to the engine is accordingly reduced. The speed at which the orifice opens is dependent on the setting of the propeller governor speed adjusting lever and the setting of the airbleed lever. Normally the airbleed orifice will be opened at approximately 6% above the propeller governor speed setting with the airbleed lever at maximum position and approximately 4% under propeller governor speed setting at the minimum position. In reverse thrust operation, the propeller reversing linkage through the reset arm, resets the airbleed lever to a setting below the propeller governor control lever setting. Propeller speed is then controlled by the airbleed orifice. Power supplied by the gas generator is reduced to allow a propeller speed approximately 5% under the speed set by the propeller governor.

(8) Speed Biasing Coil

The magnetic speed biasing coil is actuated by a signal generated by a pulse "pick up" on the propeller shaft. Actuation of the coil causes the pilot valve plunger to move, altering the flow of oil to the propeller servo. This affects the propeller pitch setting, thus changing propeller speed.

3. Fault Isolation

For detailed fault isolation of the propeller governor, refer to Chapter 72-00-00, FAULT ISOLATION.

List of Figures

Figure 1 Propeller Governor Installation

Figure 2 Propeller Governor Schematic, On Speed Condition

Figure 1 Propeller Governor Installation

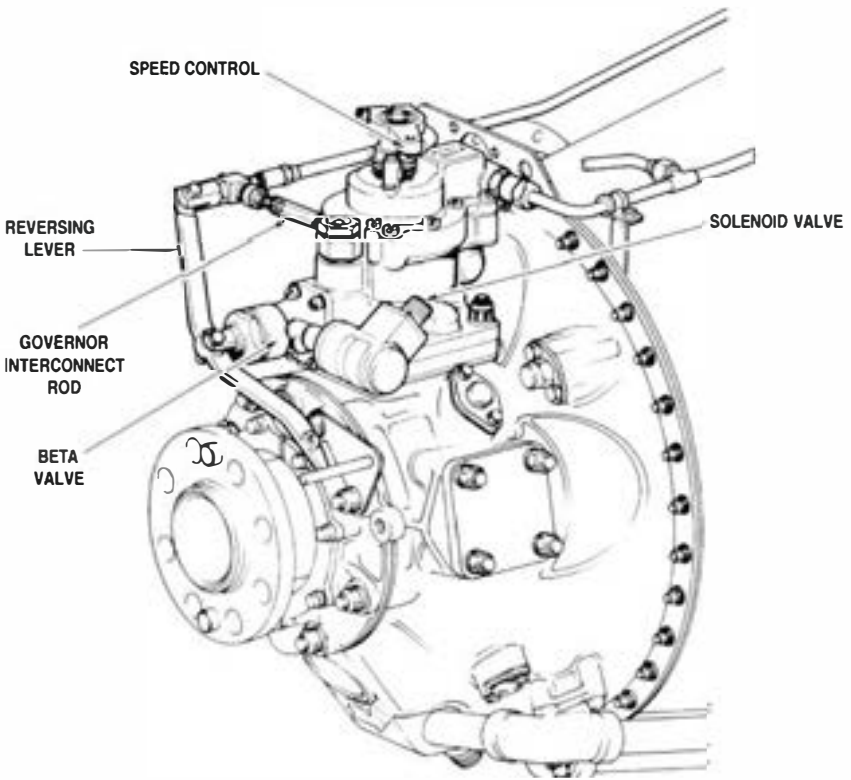
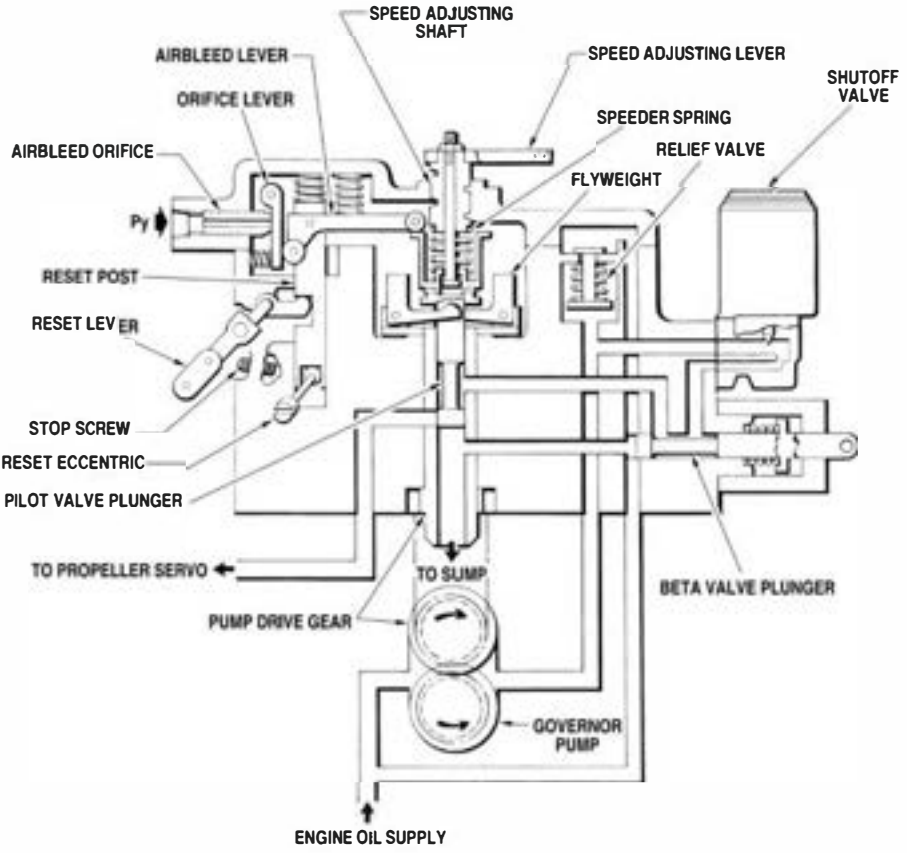


Figure 2 Propeller Governor Schematic, On Speed Condition



61-20-00
PROPELLER GOVERNING - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install protector caps and plugs on disconnected tubes, component openings and electrical connectors.

C. Lockwire used shall, unless otherwise specified, comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-014	Isopropyl, Alcohol

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC30114-35	Wrench

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Propeller Governor

(1) Remove electrical connector and speed control rod from governor (Ref. Aircraft Maintenance Manual).

(2) Remove cotterpin, nut and bolt fastening bushing and reversing lever (1, Fig. 201) to push/pull control assembly front clevis.

(3) Move reversing lever (1) forward to clear Beta valve clevis (2).

(4) Remove cotterpin, nut (4), washer (5) and bolt (6) fastening governor interconnect rod (3) to governor reset arm (7).

(5) Loosen Py air tube coupling nut at nipple (2, Ref. Fig. 202).

(6) Loosen nuts (3), with wrench (PWC30114-35), and remove nuts, washers (4) and governor.

(7) Remove gasket (5) and inspect (Ref. Inspection/Check).

(8) If governor is to be replaced, remove nipple (2).

(9) Install suitable protective caps/covers on all openings.

B. Installation of Propeller Governor

(1) If new or replacement governor is being installed, install new lubricated preformed packing (1, Fig. 202) on nipple (2) and install in governor. Tighten nipple 65 to 75 lb.in.

(2) Install gasket (5), with raised surface up, on gearbox studs.

(3) Install governor. Rotate propeller shaft slightly to engage governor drive splines. Make sure governor and gasket are mounted flush.

(4) Install washers (4) and nuts (3). Tighten nuts 125 to 135 lb.in. with wrench (PWC30114-35).

CAUTION: DO NOT EXCEED THE TORQUE LIMITS OF 125 TO 135 LB. IN. FOR PROPELLER GOVERNOR INSTALLATION. OVER-TORQUE CAN LEAD TO DISTORTION OF THE PROPELLER GOVERNOR AND POSSIBLE SEIZURE OF THE INTERNAL PUMP WHICH DELIVERS OIL TO THE PROPELLER.

(5) Install washers (4) and nuts (3). Tighten nuts 125 to 135 lb.in. with wrench (PWC30114-35).

(6) Install bushings in reversing lever (1, Fig. 201). Move lever rear to engage governor Beta valve clevis (2) and push/pull control assembly front clevis.

(7) Install reversing lever (1) to Beta valve clevis (2) using pin, washer and cotterpin.

(8) Install reversing lever (1) to push/pull control assembly front clevis using bolt and nut. Tighten nut 12 to 18 lb.in. and install cotterpin.

(9) Install governor interconnect rod (3) to governor reset arm (7), with bolt (6), washer (5) and nut (4). Tighten nut 12 to 18 lb.in. and install cotterpin.

(10) Install electrical connector and speed control rod (Ref. Aircraft Maintenance Manual).

(11) Check system rigging (Ref. Aircraft Maintenance Manual).

(12) Check governor operation (Ref. Adjustment/Test).

6. Cleaning/Painting

A. Cleaning of Gasket

(1) Clean with solvent (PWC11-014).

7. Inspection/Check

A. Inspection of Propeller Governor

(1) Examine mounting flange and body for cracks and other defects. Cracks are not acceptable.

(2) Examine for broken or damaged lockwire. If broken, have unit bench-checked for tightness/integrity of connections and lockwire before placing in service.

(3) Examine fluid ports for damage.

B. Inspection of Electrical Connectors and Leads

(1) Examine threads for damage. Chase threads to remove minor damage. Replace governor if threads are badly damaged or crossed.

(2) Check output terminal pins; replace governor if pins are loose or bent.

(3) Check leads for damage to outer covering.

C. Inspection of Governor Gasket

(1) Examine for tears in, and deterioration of gasket material.

(2) Examine for breakdown of bond between asbestos/rubber material and steel plate core.

(3) Examine mounting holes for elongation.

(4) Examine screen for damage and looseness.

8. Adjustment/Test

A. Procedure

(1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and do checks associated with Installation/Replacement of Propeller Governor (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

List of Figures

Figure 201 Removal/Installation of Propeller Governor Linkage

Figure 202 Removal/Installation of Propeller Governor

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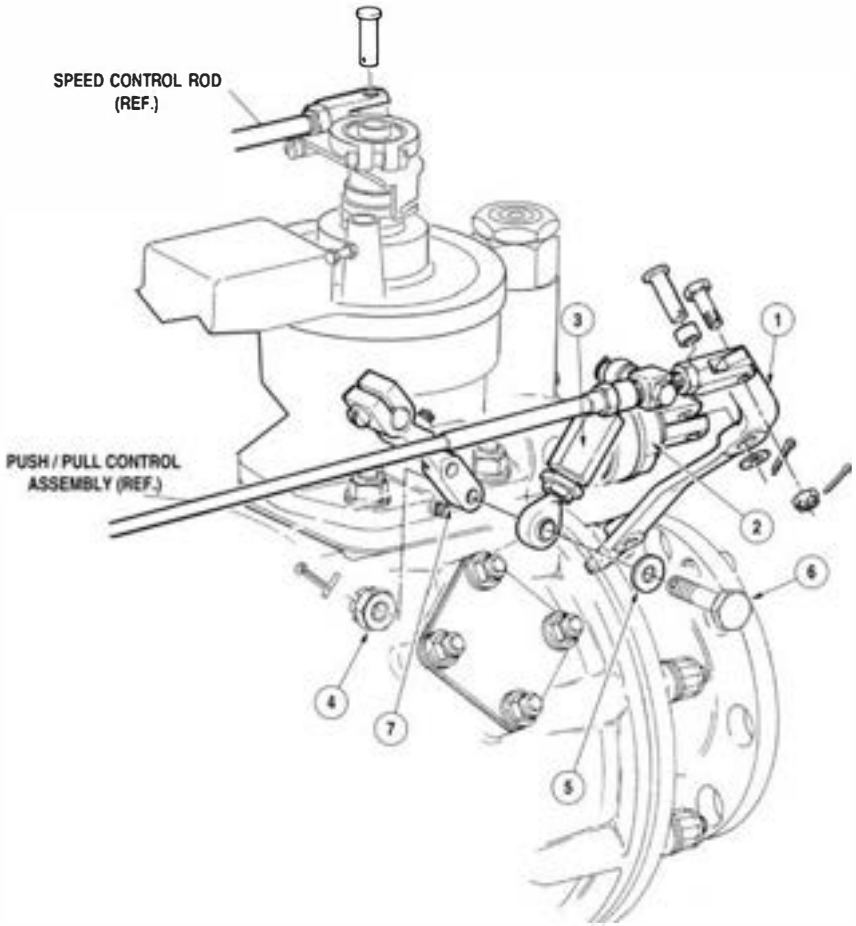
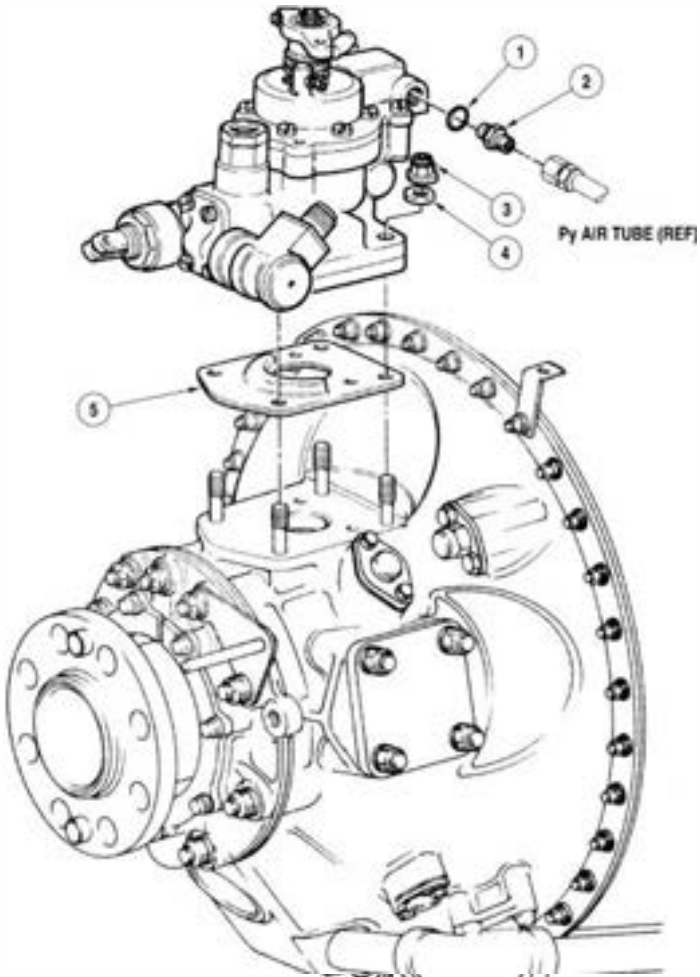


Figure 202 Removal/Installation of Propeller Governor



STANDARD PRACTICES - MAINTENANCE PRACTICES

1. General

A. During disassembly, tag and mark all parts, clips, and brackets as to their location and position to prevent incorrect installation.

B. During removal of tubes or engine parts, look for indications of scoring, burning or other undesirable conditions. Tag unserviceable parts and units for investigation and possible repair.

C. Extreme care shall be taken to prevent dust, dirt, lockwire, nuts, washers or other foreign matter from entering the engine. It cannot be overemphasized that this precaution applies whenever work is done on the engine either on the wing or off the wing. Suitable plugs, caps, and other coverings shall be used to protect all openings as they are exposed. Dust caps used to protect open tubes against contamination shall always be installed over tube ends and not in the tube. Flow through the lines may be blocked if lines are inadvertently installed with dust caps in the tube ends.

D. If at any time, items are dropped into the engine, the assembly process must stop until the dropped articles are located, even though this may require a considerable amount of time and labor. Before assembling or installing any part, be sure it is thoroughly clean.

E. Lockwire, lockwashers, tablocks, tabwashers, or cotterpins must never be reused. All lockwire and cotterpins must fit snugly in holes drilled in studs and bolts for locking purposes. Install a cotterpin so that the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Only lockwire and cotterpins made of corrosion resistant steel shall be used. Bushing plugs shall be lockwired to the assembly boss or case. Do not lockwire the plug to the bushing.

F. Replace all gaskets, packings, and rubber parts at reassembly. Make sure that new nonmetallic parts to be installed (such as an oil seal) show no sign of having deteriorated in storage.

NOTE: For preformed packing lubricating requirements, refer to Paragraph 12..

G. To protect critical areas of engine parts (such as compressor and turbine disks) against scratches and nicks, tool surfaces contacting these areas must be covered with protective material.

H. During replacement of components, note condition of any removed preformed packings. Pieces accidentally torn or cut from packings must be retrieved, regardless of size, even if this entails a systematic disassembly and cleaning of the system. Make sure that new packings are free of cuts, flashings and deformities which may be sheared off at installation.

I. When installing engine parts that require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.

J. Whenever pressure sensitive tape has been applied to any part, the tape must be removed and the part thoroughly cleaned of all tape residue prior to being subjected to high temperature during engine run. Test results indicate that all tapes are capable of causing surface attack and/or reduction in tensile ductility as temperature increases. Do not leave tape or tape residue on engine parts.

K. If any part has been coated with corrosion preventive compounds, all traces of the compound and accumulated foreign matter must be removed.

2. Safe Handling of Engine Parts with Suspected Hexavalent Chromium Residue

A. General

(1) This procedure gives the safety instructions that are applicable for assemblies and components that may contain hexavalent chromium (Cr(VI)) residue.

(2) Hexavalent Chromium (Cr(VI)) compounds may form on certain engine hot section and other parts as a result of interactions at engine operating temperatures with certain dry film lubricants or assembly consumables, atmospheric dust (e.g., calcium oxide and/or calcium hydroxide) drawn into the engine during operation, and chromium at the surface of nickel-based and stainless-steel alloy parts. The formation of Cr(VI) may be most prevalent on parts that operate in the temperature range 750 °F to 1800 °F (399 °C - 982 °C). Even if residue is not visible, Cr(VI) residue may be present on the surface of parts operating at those temperatures. Visible residue may range from pale white-beige to yellow, orange, light brown and/or dark brown. Hexavalent Chromium (Cr(VI)) may also appear as a powder or staining.

(3) Exposure to high levels of airborne, oral or dermal Cr(VI) compounds can be associated with an increased health hazard, and should be avoided. For additional information concerning potential adverse health effects associated with Cr(VI) exposure, refer to your local occupational/environmental health and safety agency, for example, https://www.osha.gov/hexavalent-chromium.

(4) Engine maintenance personnel or others who may come into contact with potentially-affected engine parts should comply with applicable governmental regulatory guidelines to minimize possible worker exposure to Cr(VI) residue.

B. General Work Practices

WARNING: EXPOSURE TO HIGH LEVELS OF AIRBORNE, ORAL OR DERMAL HEXAVALENT CHROMIUM COMPOUNDS CAN BE ASSOCIATED WITH AN INCREASED HEALTH HAZARD, AND SHOULD BE AVOIDED. ENGINE MAINTENANCE PERSONNEL OR OTHERS WHO MAY COME INTO CONTACT WITH POTENTIALLY-AFFECTED ENGINE PARTS SHOULD COMPLY WITH APPLICABLE GOVERNMENTAL REGULATORY GUIDELINES TO MINIMIZE POSSIBLE WORKER EXPOSURE TO HEXAVALENT CHROMIUM RESIDUE.

(1) Avoid generating airborne dust and avoid skin and eye contact with any residue found on engine parts. Compressed air should not be used to remove residue or clean parts. Operations such as grinding, buffing or media blasting should be conducted after part cleaning and removal of residue, and only with appropriate controls in place to limit potential exposure to Cr(VI).

(2) If potentially-contaminated component parts are to be moved or transported, take precautions to minimize direct contact with or release of residue during handling and transportation.

C. Personal Protection and Hygiene

(1) Wear disposable nitrile or neoprene gloves and eye/face protection whenever inspecting or handling hot section parts to minimize possible exposure to Cr(VI) residue. Follow good personal hygiene (hand washing) after glove removal.

(2) In case of contact with the residue and/or stain, wash any areas of your skin that have not been protected with personal protective equipment and contact your local Environmental Health Safety (EHS) representative.

(3) Avoid food and beverage consumption and smoking in work areas where Cr(VI) may be present.

(4) If your clothing has the potential to become contaminated, wear protective disposable coveralls.

D. Cr(VI) Determination of Residue

(1) Contact your local EHS and/or Industrial Hygiene (IH) representative for approved methods to determine if residue contains Cr(VI).

E. Handling and Removal of Suspected or Confirmed Cr(VI) Residue

(1) Contact your local EHS representative and/or IH representative for guidance and instruction on handling and/or removal of suspected or confirmed Cr(VI) residue.

F. Shipping Guidance

(1) Contact your local EHS, IH representative and/or shipping representative for guidance on shipping engine material with suspected or confirmed Cr(VI).

G. Managing Suspected Hexavalent Chromium-Contaminated Waste Packaging Guidance

(1) Contact your local EHS and/or IH representative for guidance on managing suspected or confirmed Cr(VI) contaminated waste.

H. Unwanted Material Disposal

(1) Contact your local EHS and/or IH representative for guidance on disposing waste that has or potentially came in contact with the Cr(VI) residue, such as rags, Q-tips/brushes, wastewater, gloves, and disposable coveralls. These should be treated and properly disposed of according to local waste regulations.

3. Removal/Installation

CAUTION: DO NOT BEND, TWIST OR FORCE HYDRAULIC AND PNEUMATIC TUBES, WHETHER RIGID OR FLEXIBLE, TO ACHIEVE ALIGNMENT WITH MATING FITTING. ADJUST FITTING TO ALIGN WITH TUBE. CLAMP AND FASTEN TUBE ONLY WHEN IT IS INSTALLED IN POSITION WITH NO NOTICEABLE TENSION OR LOAD.

A. Replacement of Straight Nipples, Straight Adapters, Bulkhead Couplings and Tube Connector Nipples.

(1) Remove fittings from engine lines or accessory units.

(2) Remove preformed packings from fittings and discard.

(3) Lubricate new preformed packing with light film of lubricant (Ref. Lubrication of Preformed Packings).

(4) Install preformed packing on fitting and screw fitting in boss or flange, as applicable.

CAUTION: EXCESSIVE TIGHTENING WILL RESULT IN DAMAGE TO THREADS OF MATING PARTS.

(5) Tighten fitting in boss to torque value detailed in relevant assembly instruction.

(6) Install jam nut on flange mounted fittings and tighten to recommended torque (Ref. Table 201).

B. Replacement of Elbows, Elbow Adapters (Ref. Fig. 201).

(1) Remove fittings from engine lines or accessory units.

NOTE: Before removal, note angular position of fitting on engine or unit.

(2) Remove preformed packings, packing retainers (back-up rings) and discard. Discard jam nuts from fittings.

(3) Lubricate new preformed packings, packing retainer (back-up ring) and thread of elbow fitting with light film of lubricant (Ref. Lubrication of Preformed Packings).

(4) Install jam nut, new packing retainer and preformed packing on elbow fitting, pressing packing retainer into counterbore of jam nut.

(5) Turn jam nut down elbow fitting until preformed packing is seated in non-threaded annulus of fitting.

(6) Turn jam nut outward until preformed packing is pushed firmly against first lower thread of fitting.

(7) Install elbow fitting into boss on unit, allowing jam nut to turn with fitting until preformed packing contacts boss mating face. This point will be recognized by increase in force.

(8) With fitting in this position, hold jam nut stationary and turn elbow fitting into boss a further 1½ turns.

NOTE: From this position the elbow fitting may be further turned inward to a maximum of one turn to facilitate alignment of fitting. Should the fitting tighten in the jam nut before completion of initial 1½ turns or during final alignment, the jam nut may be allowed to turn with the fitting for the remainder of the distance.

(9) With elbow fitting in correct alignment position, tighten jam nut to recommended torque (Ref. Table 201).

NOTE: Metal-to-metal contact between jam nut and boss must be obtained without exceeding recommended torque and there must be no extrusion of preformed packing or packing retainer.

Table 201 Torque Values for Jam Nuts

4. Standard Torques

A. General

(1) Torque values given in the manual are to be interpreted:

(a) Pound-inches at room temperature.

(b) Angle of turn, in degrees.

(c) Stretch values in inches.

(2) Unless otherwise specified, thread lubricant shall be engine oil and shall be applied to parts which are to be tightened.

(3) If the part to be tightened is hot, allow sufficient time for the part to reach temperature equilibrium with the surrounding area before final torquing.

(4) Flange bolts shall be drawn up evenly. This can be achieved by having two mechanics working simultaneously 180 degrees apart.

(5) Tightening applications should be done slowly and evenly for consistency and the best possible accuracy. Check for adequate torque of self-locking fasteners before reuse. Discard fastener if locking capability is impaired. Do not repair self-locking fasteners.

(6) Six-point crowfoot adapters are recommended for applying torque values above 110 lbf.in. to tube fittings (Ref. Fig. 202).

(7) Self-locking nuts, self-locking bolts, and self-locking helical coil inserts shall be capable of meeting torque requirements in Table 202.

Table 202 Torque Check for Reuse of Self-Locking Nuts, Bolts and Helical Coil Inserts (Pound-inches at Room Temperature and Lubricated With Engine Oil)

5. Torque Indicating Devices

A. General

(1) Check torque indicating devices before using, and calibrate by means of weights and a measured lever arm to make sure that there are no inaccuracies. Checking one torque wrench against another is not sufficient. Some wrenches are quite sensitive to the way they are supported during a tightening operation, and every effort must be made to adhere to the instructions furnished by the respective manufacturers.

B. Torque Wrench and Extensions

(1) Occasionally, it is necessary to use a special extension, or adapter wrench together with a standard torque wrench (Ref. Fig. 203). In order to arrive at the resultant required torque limits, the following formula shall be used:

T - Desired torque on the part.

E - Effective length of special extension or adapter.

L - Effective length of torque wrench.

A - Distance through which force is applied to part.

R - Reading on scale or dial of torque wrench.

$$R = \frac{LT}{A} = \frac{LT}{L + E}$$

Example:

A torque of 1440 lb.in. is desired on a part, using special extension having a length of three inches from center to center of its holes, and a torque wrench measuring 15 inches from center of handle or handle swivel pin to center of its square adapter. Then:

$$R = \frac{LT}{L + E} = \frac{15 \times 1440}{15 + 3} = 1200 \text{ lb.in.}$$

(2) With the axis of the extension or adapter and the torque wrench in a straight line, tightening to a wrench reading of 1200 lb.in. will provide the desired torque of 1440 lb.in. on the part.

6. Torque Recommendations

A. Lubricated Parts

(1) All nut, bolt and screw torques should be obtained using a thread lubricant. The lubricant should be engine oil, or equivalent, unless otherwise specified. Torque requirements for interference fit application, such as studs and pipe plugs, may be obtained with or without lubrication, unless otherwise specified.

(2) Antigalling compound should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures molybdenum disulfide in either paste or powder mixed with engine oil or grease may be used. Particular applications of molybdenum disulfide are indicated in the individual text portions of this manual, as applicable. Make sure antiseize and antigalling compounds are applied in a thin even coat, and that excess is completely removed to avoid contamination of adjacent parts, passages or surfaces where the compound may cause malfunctioning, or failure, of engine.

(3) The torque values given within the text apply to nuts where the height of the nut is approximately equal to the major diameter of the thread. Torque values do not apply to hollow bolts and screws.

B. Nuts, Bolts and Screws

(1) Bolts and nuts on flanges with metal tubular gaskets must be initially torqued to the required torque and then retorqued until torque values given in relevant assembly instruction remain constant.

C. Self-locking Nuts

(1) The locking force for self-locking nuts and helical coil inserts must be checked at assembly. The force must not be less than the values shown (Ref. Table 203) unless otherwise specified.

(2) When checking self-locking fasteners, make sure the fastener is not seated. This ensures that only the force necessary to overcome the friction holding the thread is measured.

NOTE: Self-locking nuts should be checked for effectivity of self-locking feature before reinstallation. Reject suspect nuts as necessary.

Table 203 Locking Torque for Self-locking Nuts and Helical Coil Inserts

(2) With the axis of the extension or adapter and the torque wrench in a straight line, tightening to a wrench reading of 1200 lb.in. will provide the desired torque of 1440 lb.in. on the part.

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(1) Bolts and nuts on flanges with metal tubular gaskets must be initially torqued to the required torque and then retorqued until torque values given in relevant assembly instruction remain constant.

C. Self-locking Nuts

(1) The locking force for self-locking nuts and helical coil inserts must be checked at assembly. The force must not be less than the values shown (Ref. Table 203) unless otherwise specified.

(2) When checking self-locking fasteners, make sure the fastener is not seated. This ensures that only the force necessary to overcome the friction holding the thread is measured.

NOTE: Self-locking nuts should be checked for effectivity of self-locking feature before reinstallation. Reject suspect nuts as necessary.

Table 203 Locking Torque for Self-locking Nuts and Helical Coil Inserts

D. Power Torque Wrench

(1) The retaining nut for the power turbines is removed and installed with a power torque wrench and appropriate adapter, refer to TOOLS/FIX/EQUIP section, Special Tools table.

(2) The power torque wrench employs a high ratio geartrain operated by a handcrank (supplied with the tool) or a pneumatic ratchet drive tool. A 3/4-inch square drive bar (also supplied with the tool) transmits the output torque of the geartrain to the socket wrench on the nut being turned. Two 1/2-inch diameter pins on each space adapter transmit the counter-acting load. Input and output shafts of the wrench rotate in the same direction.

(3) When using a countertorque adapter, the direction of the input drive is opposite to that required on the nut being turned, i.e., when tightening a right hand thread nut with socket and adapter, the input drive must be turned counterclockwise; when loosening, the reverse rotation applies.

(4) To tighten a nut, using the power torque wrench and appropriate countertorque adapter, proceed as follows:

(a) Install socket wrench on nut.

(b) Install appropriate countertorque adapter on part being assembled.

NOTE: Observe instructions marked on adapter denoting direction of rotation required when torquing and untorquing.

(c) Install power torque wrench on adapter, and engage both pins.

(d) Insert 3/4-inch output drive bar into wrench output shaft, and turn until bar engages socket wrench.

(e) Turn ratchet (located on front face of power wrench) in same direction as that required to turn output driveshaft.

(f) Insert input drive source (handle or power-operated wrench) in input shaft, and turn in same direction as that required for output shaft.

(g) Continue turning until torque indicator reaches required reading on scale.

NOTE: Since the torque indicator is calibrated in pounds-feet, the appropriate conversion must be made when torquing to values specified in pounds-inches.

(h) To remove power wrench, reverse direction of rotation of input drive until indicator returns to zero (green band); this removes the holding pressure on the wrench, allowing it to be withdrawn from the adapter.

(i) Remove power wrench, adapter and socket wrench.

(5) To untorque, repeat the preceding steps (a) through (i), except for rotational direction of ratchet and input shaft, which must be reversed.

E. Lockwire and Cotterpin Requirements

(1) When tightening a castellated nut, alignment of the slot must be obtained without exceeding the maximum torque. If this is not possible, replace nut with another one. After tightening nut to recommended torque, nut must not be loosened to permit insertion of lockwire or cotterpin. If slot in nut or lockwire hole in bolt or screw is not correctly aligned at the minimum torque value given, the nut, screw or bolt should be further tightened to next alignment position, but maximum torque value given must not be exceeded. Should alignment still be impossible without exceeding maximum torque, back off nut, screw or bolt one-half turn and retorque.

F. Slotted, Steel Locknuts (Prevailing Torque Type)

(1) Effective locking of slotted, steel locknuts on bolts or studs requires full engagement of all locknut threads. The chamfered section of the locknut ID does not exert force on the bolt or stud; therefore, it is not necessary that the bolt or stud be flush with, or protrude from, the outer face of the locknut.

G. Standard and Stepped Studs

(1) When the torque required to drive a stud to the correct protrusion does not reach the minimum value given, or exceeds the maximum value given, a new stud must be selected.

H. Hose, Tubing and Threaded Couplings

(1) If leakage occurs at a coupling, do not attempt to correct by overtorquing. Disassemble fitting and check for nicks, burrs and/or foreign matter. Use new parts to rectify.

7. Locking Devices

A. Keywashers (Tab and Cup Type) (Ref. Fig. 204)

CAUTION: KEYWASHERS ARE TO BE USED ONCE ONLY. INSTALL NEW KEYWASHER(S) AT EACH ASSEMBLY.

CAUTION: DO NOT USE SHARP EDGED TOOLS TO BEND OR SET KEYWASHER TABS. TAB DETACHMENT MAY OCCUR WITH SUBSEQUENT DAMAGE TO ENGINE.

(1) The terms keywasher, tabwasher and cupwasher are interchangeable, as used in this manual.

(2) When bending or setting the tabs on these washers, do not use sharp-pointed tools. Use of such tools can lead to subsequent failure of the locking tabs which, on becoming detached, can pass through the engine causing extensive damage.

(3) Key and tab washers typically have an anti turn tang that inserts into the engine part accepting the bolt. During torquing of bolt, it is important to make sure this tang is loaded in a counter clockwise direction within its hole so that the bolt and washer do not turn during operation.

(4) Assembly Requirements for Cupwashers:

(a) Examine cupwasher for freedom from deep score marks (especially in the undercut adjacent to tangs) and for freedom from prior assembly/handling damage, i.e., bent tangs or prior stake marks.

(b) Examine contact surfaces for excessive roughness, burrs, or scores that may cause the washer to bind on the nut.

(c) Examine the nut for burrs, nicks or scratches on face which contacts the cupwasher that could cause the nut to pick up on the washer.

(d) The cupwasher must be lubricated on the nut side only, the opposite face must be clean and dry.

(e) With cupwasher placed against shaft slots opposite to direction of nut tightening, screw nut fingertight.

(f) With an approved silver pencil, make an alignment mark on cupwasher outside diameter and the component immediately adjacent to cupwasher.

(g) Tighten the nut in the normal manner.

(h) If alignment mark has moved , remove and discard cupwasher.

(i) Repeat procedure with new cupwasher.

(j) Stake cupwasher.

B. Retaining Rings

CAUTION: THOROUGHLY INSPECT ALL RETAINING RINGS, INCLUDING SPIROLOX, FOR CONDITION. DISTORTED RINGS ARE NOT ACCEPTABLE AND MUST BE REPLACED.

(1) Retaining rings must be installed using approved retaining ring pliers. Internal type rings must not be compressed beyond the point where the ends of the ring meet. External type rings must be expanded just enough to allow installation without becoming bent. After installation, make sure that each ring is completely seated, without looseness or distortion in its groove.

C. Lockwire

(1) Except where otherwise specified, the wire is heat and corrosion resistant steel wire of 0.025 inch diameter.

(2) Lockwire must be tight after installation to prevent failure due to rubbing or vibration.

(3) Lockwire must be installed in a manner that tends to tighten and keep a part locked in place thus counteracting the natural tendency of the part to loosen.

(4) Lockwire must never be overstressed. It will break under vibrations if twisted too tightly. The lockwire shall be pulled taut when being twisted, but shall have

(5) Lockwire ends must be bent toward the engine, or part, to avoid sharp or projecting ends which might present a safety hazard or vibrate in the air stream.

(6) Internal wiring must not cross over or obstruct a flow passage when an alternate method can be used.

(7) Check the units to be lockwired to make sure they have been correctly torqued and that the wiring holes are properly positioned in relation to each other. When there are two or more units, it is desirable that the holes in the units be in the same relationship to each other. Never overtorque or loosen units to obtain proper alignment of the holes. It should be possible to align the wiring holes when the units are torqued within the specified limits. However, if it is impossible to obtain a proper alignment of the holes without either over or under torquing, select another unit which will permit proper alignment within the specified torque limits.

(8) To prevent mutilations of the twisted section of the wire when using pliers, grasp the wire at the ends or at a point that will not be twisted. Lockwire must not be nicked, kinked, or mutilated. Never twist the wire ends off with the pliers and when cutting off ends, leave at least three complete turns after the loop, exercising extreme care to prevent the wire ends from falling into the engine. The strength of the lockwire holes is marginal; never twist the wire off with pliers. Cut the lockwire close to the hole, exercising extreme care.

(9) Figure 205 illustrates a typical lockwiring procedure. Although there are numerous lockwiring operations performed on these engines, practically all are derived from the basic examples shown in Figure 206.

D. Safety Cable (Ref. Figs. 207 and 208)

(1) General:

(a) Safety cable is installed through two or more parts in such a way that as the fastener loosens the safety cable will tighten. By tightening, the safety cable will not permit the fastener to loosen or turn. The safety cable system is made up of two components: the safety cable/ferrule kit (PWC05-344) and a crimping tool (PWC90025) (Ref. Fig. 207).

(b) The safety cable is available in one size, 0.032 inch (0.81 mm) diameter, and is made of stainless steel material. One end of the cable will have a cable end fitting swaged to it. The cable end fitting is made of stainless steel material. The strands of the cable on the opposite end of the cable are fused together to prevent the cable from fraying.

(c) The ferrules are made of stainless steel material and are purchased in a spring-loaded, disposable cartridge. When the safety cable is installed the ferrule will be crimped on the open end of the cable.

(d) The hand operated crimping tool comes in two different lengths. The crimping pressure of the tool is set by the manufacturer. The primary parts of the crimping tool are the nose assembly and the tool body. This tool is used to crimp the ferrule on the end of the safety cable. The crimping tool will cut the safety cable even with the ferrule at the same time the ferrule is crimped.

(e) Where safety cable is specified, it may be replaced with lockwire. Use lockwire as specified in Table 204.

Table 204 Safety Cable Substitution

(2) Basic Installation Rules:

(a) It is not permissible to re-use safety cable or a ferrule. The safety cable and ferrule must be new for every application.

(b) Unless specified differently in assembly procedure, safety cable should be installed in double- or triple-bolt patterns. The double-bolt pattern is preferred when you apply safety cable to an even number of fasteners.

(c) The maximum allowable span of safety cable between two end points is 6 inches (152.4 mm), unless otherwise specified.

(d) Any damages (such as fray, nicks, kink or any damage to the safety cable) to any portion of the safety cable prior to, during or after installation is not permitted.

CAUTION: DO NOT USE SAFETY CABLE IF THE HOLES ARE MORE THAN 0.100 INCH (2.54 mm) DIAMETER. THE FERRULES ON THE END OF THE CABLE ARE 0.106 - 0.108 INCH (2.69 - 2.74 mm) DIAMETER AND WILL FALL THROUGH HOLES LARGER THAN THIS.

(e) Always install safety cable through the safety cable holes provided on the fastener.

(f) Do not decrease or increase the torque on the parts to correctly align the holes for the cable.

(g) Install safety cable so that any tendency for a fastener to loosen is counteracted by more tension on the cable.

(h) It is recommended that there be no sharp turns more than 90° when the cable is passed through a fastener. Installation of safety cable should be with either a positive or neutral pull.

(i) Cable flex limits are specified in Figure 211. These values are the maximum flex limits between the end points when light finger pressure of approximately 2 pound (8.9 N) is applied at midspan.

(j) Cut off excess cable from crimped ferrule after installation of safety cable.

(k) Maximum length of cable beyond crimped ferrule is 0.031 inch (0.787 mm).

(l) Where specified, apply and crimp an aluminum seal to the load bearing portion of the safety cable.

(m) After installing the seal, make sure that it is snug on the cable and that it cannot be moved without showing evidence of tampering.

(n) After installing the seal, an inspection stamp or other means of identification shall be applied to the seal.

(3) Installation (Ref. Fig. 209):

(a) Install ferrule cartridge into crimper tool body (PWC90025).

(b) Do a visual inspection of the holes to be used to find all damage. If the hole is damaged, replace the part or, if possible, use another hole to install safety cable.

NOTE: Keep the safety cable as straight as possible when you locking the fasteners or parts together.

(c) Insert the free end of the safety cable (PWC05-344) into the hole of the part. Pull the cable through the hole until the cable end fitting is against the part.

NOTE: On a double-bolt pattern, do not safety cable in a negative pull direction. Make sure the safety cable has a positive or neutral pull.

(d) Insert the end of the cable through the second part. Choose the hole in the part that permits the cable to be as straight as possible. Pull the cable through the second part. If three parts must be safety cabled, do the same procedure for the third part.

(e) The nose can be changed to four different positions at 90° increments. To select the position, push the nose in towards the tool, rotate to the desired position, and release the nose. If the nose does not lock into the indexed position, turn it slightly until it does (Ref. Fig. 210).

(f) Install the free end of the safety cable through a ferrule (PWC05-344). Use the safety cable to pull the ferrule out of the ferrule cartridge.

(g) Put the end of the safety cable through the crimping head of the crimping tool. Make sure the large hole in the crimping head is on the same side as the ferrule. Move the crimping tool along the safety cable until the crimping head is against the part. Make sure the ferrule goes inside the hole in the crimping head.

(h) Install the free end of the cable into the cable entrance. Continue to push the cable into the cavity. When the free end of the cable appears at the bottom of the tool, grab the cable and pull the slack from the cable until resistance is felt.

NOTE: Grip the cable as close to the free end as possible during insertion to prevent buckling of the cable.

(i) When all slack is removed from the cable, make sure the tool is snugly against the fastener by using several short strokes of the handle. Release the handle to the full open position and fully close the handle to affect crimping and cutting.

CAUTION: IT IS IMPORTANT ON THIS FINAL STROKE TO HOLD THE TOOL AS STEADY AND PERPENDICULAR TO THE CABLE AS POSSIBLE WHILE ENSURING THAT A FULL STROKE IS USED TO MAINTAIN A CONSISTENT TENSIONING OF THE CABLE.

(j) After crimping and cutting, release the tool handle and slide the tool off the crimped ferrule. Pull the excess cable from the tool.

(k) Remove and discard unused safety cable from the bottom of the crimping tool.

(4) Verification (Ref. Fig. 211):

(a) Push against the safety cable with light finger pressure halfway between the locked parts. If the cable feels loose, do a dimensional check to make sure the safety cable is serviceable as follows:

1 Measure the distance between the locked parts. Write this measurement down as Dimension A. If three parts are locked together, measure the distance between each of the parts and add the two measurements together to get Dimension A.

2 Push against the safety cable with light finger pressure halfway between the two locked parts. Measure the distance the safety cable moves laterally. Writes this measurement down as Dimension C.

3 Compare the dimensions written down to the limits given.

CAUTION: DO NOT TRY TO BREAK THE SAFETY CABLE. IF THE SAFETY CABLE MUST BE REMOVED, CUT THE SAFETY CABLE TO AVOID DAMAGE TO THE HOLES OF THE PART.

(b) If the safety cable is not within limits, cut the safety cable with wire cutters and remove the safety cable. Install new safety cable.

(c) Check that cable was installed through bolts correctly (Ref. Step (3)).

(d) Verify that cable was cut flush at the end of the ferrule with no strand extending more than 1/32 inch from the end of the ferrule.

(e) Visually inspect safety cable for kinks, frayed wires, or improper crimps. Remove and replace safety cable if problem exists.

(5) Indenter Adjustment (Ref. Fig. 212):

(a) Remove the nose assembly by removing the two socket head cap screws.

CAUTION: DO NOT ADJUST THE PUSHROD MORE THAN A QUARTER OF A TURN AT A TIME. SEVERE ADJUSTMENTS MAY DAMAGE THE TOOL.

(b) Adjust the pushrod adjustment screw using a 0.25 inch (6.4 mm) straight edge screw driver. Rotate the pushrod adjustment screw clockwise to loosen the crimp (enlarge the gaging dimension). Rotate the adjustment screw counterclockwise to tighten the crimp (reduce gaging dimension).

(c) Replace the nose assembly and the two socket head cap screws. Rotate each screw a small amount until tight to prevent binding.

CAUTION: TIGHTENING THE CRIMP INCREASES REQUIRED HAND FORCES DURING APPLICATION AND INCREASES CABLE ASSEMBLY TENSILE VALUES. LOOSENING THE CRIMP DECREASES REQUIRED HAND FORCES DURING APPLICATION AND DECREASES CABLE ASSEMBLY TENSILE VALUES.

(d) Check calibration as described in (Ref. Step. (6)).

(6) Indenter Calibration (Ref. Fig. 213):

NOTE: 1. Indenter calibration should be checked periodically and must be checked after the nose assembly has been removed or interchanged.

NOTE: 2. Do a pull-off load test as often as necessary to make sure the crimp done by the crimping tool meets the necessary requirements.

(a) Set up test block (PWC90026).

(b) Thread the cable into the 12 point screw and through the swivel, holding the lever in the home position. If the lever is not kept in the home position the results may be adversely affected. Cut the cable by making sure to close the handles completely.

(c) Apply approximately 2 lbs. force to the cable with your finger at the line marked test area. If the cable touches either the side or bottom surface of the test area then remove the cable from the test block and use another cable as described in (Ref. Step. (6)(b)).

(d) Place a 3/8 inch drive torque wrench into the square drive hole, orientating the test block and torque wrench on a flat surface. Apply the proper pull-off load as shown in Table 205. Release torque when minimum pull-off load is achieved.

NOTE: Do not apply additional tension to safety cable than that is required to achieve minimum pull-off load.

(e) If the cable did not break or pull out of the ferrule after applying proper torque, remove the torque wrench and apply approximately 2 lbs. force to the cable with your finger at the line marked test area.

(f) If the cable breaks, touches either the side or bottom surface of the test area or pulls out of the ferrule, then the crimp is unacceptable and the tool indenter should be adjusted (Ref. Step. (5)).

Table 205 Safety Cable Minimum Crimp Requirements (Pull-off Load)

(7) Maintenance of Crimp Cavity:

(a) Debris can accumulate in the crimp cavity during use. This debris must be removed and the cavity oiled periodically depending upon use and environment.

NOTE: Ferrule sticking can occur if this procedure is not followed.

(b) Remove debris by gently scraping or brushing the crimp cavity.

(c) Blow any remaining debris from the cavity with air.

(d) Coat the cavity with a light film of any lightweight synthetic or petroleum based oil after the cavity has been thoroughly cleaned.

8. Identification of Hardware Material, Particularly Nuts and Bolts

A. A permanent type of material code designation has been adopted for use in these engines. Correct engine reassembly procedures require that particular attention be paid to the material requirements for nuts and bolts used in the hot section of the engine. In these areas, where parts must be of material which is resistant to high operating temperatures, special heat resistant alloys are employed. It is imperative that at reassembly of the engine or its components the properly coded part be reassembled in its original location, if serviceable.

B. The code system employs the use of a letter "C" for corrosion resistant steel for normal application and "H" for heat resistant alloys in hot section application. The stamped or embossed letter will be followed by a number of one or more digits, such as C1, C8, H3, and H12. Bolt code identification will usually appear on the top of the head and nut identification on one side of the hex (Ref. Fig. 215). When the application is an AN or MS six digit part number, the code identification "C" or "H" will be preceded by the letter "E" as in EC3 or EH10.

NOTE: All AN or MS six digit part numbers, when manufactured of material in the common temperature range (such as cadmium plated, low alloy steel parts), are also coded "E" to indicate, in part, close material quality control.

CAUTION: NEVER ASSEMBLE A MATERIAL CODED PART WITH A "C" IDENTIFICATION IN A LOCATION WHICH REQUIRES AN "H" CODED PART AND VICE-VERSA. NEVER USE CADMIUM PLATED NUTS, BOLTS OR ANY OTHER CADMIUM PLATED PART IN THE HOT SECTION OF THE ENGINE.

C. The adoption of this program will make it possible for service activities to avoid the assembly of parts, with similar physical appearance, in locations which require high heat resistant parts. In this regard, it is required, at time of disassembly (removal), that all similarly coded parts be segregated so that two, or more, physically similar parts with different code numbers will not be mixed; and so that, at subsequent reassembly (installation), the properly coded parts are replaced in their proper locations.

D. Parts from several engines should not be mixed at disassembly (removal) and cleaning, because, at the time of engine manufacture, production requirements may necessitate one or more material substitutions in a block of engines. Subsequent engine reassembly with indiscriminate mixing of hardware, may result in unnecessary confusion in sorting these parts for proper reassembly.

CAUTION: IT IS IMPORTANT THAT "J" THREADED HARDWARE BE CAREFULLY SEGREGATED AND MARKED AT DISASSEMBLY (REMOVAL) TO PREVENT MIXING WITH NON "J" THREADED PARTS.

E. Unified Controlled Radius Root "J" Threaded Bolts feature full root radius for external threads with increased minor internal threaded diameter. "J" threads ensure greater fatigue life, improved stress relaxation characteristics and show improvement in tensile strength over previous designs. This thread form is used extensively throughout engines. Engine bolts having "J" threads appear just like items threaded with conventional threads.

9. Stainless Steel Bolts with Reduced Pitch Diameters

At engine manufacture, it is the practice to provide bolts with reduced pitch diameter for use in the hot sections of engines. This will minimize the possibility of bolt and nut seizure and is standard practice for locations where the parts are subjected to elevated temperatures (Ref. Fig. 214).

10. Debris Analysis and Material Specifications

A. General

(1) Debris analysis monitors wear of oil-wetted engine parts. This procedure improves aircraft serviceability and dispatch reliability and reduces engine repair costs. This is achieved by identifying potential engine problems at the earliest possible stage, thus minimizing the possibility of in-flight shutdowns, away-from-base engine changes and secondary damage.

(2) Rapid wear or surface fatigue (e.g. on gear teeth contact surfaces, bearing raceways, rolling elements, housing bearing bores, etc.) or interference between rotating and fixed components (e.g. oil pump pinions, associated housings and labyrinth seals, etc.) produces debris. Magnetic debris over 100 microns in diameter is usually captured by the chip detectors. Magnetic and non-magnetic debris over 10 microns in diameter is usually captured by the oil system filters. For engine equipped with such devices, it is also possible to find debris on the magnetic pulse pick-up sensors.

(3) Analysis (form, appearance, dimensions, quantity and material) of the debris generated by oil wetted parts is necessary to provide the information needed to facilitate locating the source of the debris and determining any preventive maintenance action required.

B. Filter Patch Check Debris Inspection/Analysis

(1) The analysis should be done by a qualified laboratory (Ref. Para. F.). Operators may send the contaminated filter or the debris to the laboratory for the filter patch check and/or analysis and provide the following information:

(a) Engine model and serial number.

(b) Engine time since new (TSN) or time since overhaul or refurbishment (TSO or TSR).

(c) Time since last filter inspection.

(d) Filter location.

(e) Reason for filter removal, inspection and debris analysis.

(2) Reports supplied by the laboratory to the operator containing the results of the analysis must include:

(a) Information provided by the operator with the filter or debris.

(b) Total weight of debris.

(c) Material and amount of non-magnetic debris when classified as major (Ref. NOTE).

(d) Material, appearance, shape and amount of non-magnetic metallic debris.

(e) Material, appearance, shape and amount of metallic debris.

NOTE: The amount of individual constituents in the debris should be classified as:

- Major - when the weight of the constituent is more than 50% of the total debris weight.
- Minor - when the weight of the constituent is less than 50% of the total debris weight.
- Traces - when the weight of the constituent is less than 5% of the total debris weight.

(3) If bearing material (Ref. Table 206) is found, the operator must be advised as soon as possible by telephone and provided with a detailed written report.

C. Inspection/Analysis of Debris Collected on Chip Detector or Magnetic Pulse Pick-up Sensors

(1) The analysis should be done by a qualified laboratory (Ref. Para. F.).

(2) The operator must provide the laboratory with the following information:

(a) Engine model and serial number.

(b) Engine time since new (TSN) or time since overhaul or refurbishment (TSO or TSR).

(c) Locations where debris were found.

(d) Reason for inspection (scheduled or unscheduled).

(3) Reports supplied by the laboratory to the operator containing the results of the analysis must include:

(a) Information provided by the operator when submitting the material for analysis.

(b) Type(s) of material found.

D. Identification of Metal Particles

(1) General

(a) When unidentified particles of metal are found, they may be either steel, tin, aluminum, magnesium, silver, bronze, titanium, or cadmium. In some cases the type of metal may be determined by the color and hardness of the pieces. However, when the particles cannot be positively identified by visual inspection and knowledge of the exact character of the metal is desired as an aid to troubleshooting, a few simple tests will determine the kind of metal present.

WARNING: USE EXTREME CARE IN HANDLING ACIDS.

(b) The following equipment and chemicals are required to make these tests:

a source of open flame

permanent magnet

two ounces of solution containing ten percent ammonium nitrate (PWC05-011) and water

electrical soldering iron

two ounces each of 50 percent by volume hydrochloric acid (PWC05-196) or (PWC05-196A) and concentrated nitric acid (PWC05-195)

sodium hydroxide pellets (PWC05-056)

watch glass

white porcelain spot plate

ammonium biflouride crystals (PWC05-009)

5 to 10 percent hydrofluoric acid (PWC05-004) or concentrated sulfuric acid (PWC05-074)

3 to 10 percent hydrogen peroxide (PWC05-038)

concentrated phosphoric acid (PWC05-006)

(2) Procedure

NOTE: The following test procedure is recommended for determining the character of unknown metal particles. For best results, follow the steps as outlined:

(a) Steel - the particles of many steels can be isolated by means of the permanent magnet. Magnetic steel or iron is attracted by the magnet.

(a) Steel - the particles of many steels can be isolated by means of the permanent magnet. Magnetic steel or iron is attracted by the magnet.

(b) Titanium:

WARNING: THE FOLLOWING CHEMICALS ARE HAZARDOUS AND REQUIRE SPECIAL HANDLING. IT IS RECOMMENDED THE FOLLOWING TESTS BE DONE BY QUALIFIED LABORATORY PERSONNEL.

1 Place a piece, or pieces of the metal to be identified, on a white porcelain spot plate. A piece of titanium or titanium-bearing metal should be placed on another spot plate to observe and verify the results obtained.

2 Add several crystals of ammonium bifluoride (PWC05-009) and 5 to 10 drops of water to the metal particles. (Two or three drops of a 5 to 10 percent hydrofluoric acid solution (PWC05-004) can be used instead).

NOTE: Solid ammonium bifluoride is crystalline and can be conveniently stored in a dry area and used as required.

3 Let stand 20 to 30 minutes, or until the solution becomes slightly discolored.

4 Add two or three drops of 1:1 sulfuric acid (one part demineralized water (PWC05-073) to one part sulfuric acid PWC05-074).

5 Let stand 20 to 30 minutes, or until solution becomes more discolored.

6 Add three to four drops of 3 to 10 percent hydrogen peroxide (PWC05-038). Solution must not be too old.

7 If titanium is present, a yellowish color will develop. This yellow color will become progressively darker with time, if allowed to set.

8 Add two to three drops of concentrated phosphoric acid (PWC05-006), and stir to discharge any yellow color due to the possible presence of iron.

9 Any light yellow to orange coloration indicates the presence of titanium.

WARNING: NEVER TRY TO BURN MORE THAN A FEW PARTICLES OF METAL SUSPECTED TO BE MAGNESIUM. DUST IS EXPLOSIVE.

(c) Magnesium - a simple test for these particles is burning. Magnesium will burn with a bright white flash.

(d) Cadmium - place the remaining particles in the solution of water and ammonium nitrate (PWC05-011). If all or any of the particles dissolve in this solution, they are cadmium. After this test, rinse and dry any remaining particles.

(e) Tin - the tin particles can be distinguished by their low melting point. With a clean soldering iron, heated to 260°C (500°F) and tinned with 50-50 solder (50 percent tin - 50 percent lead), a tin particle dropped on the iron will melt and fuse with the solder.

(f) Aluminum - when a particle of aluminum is placed in hydrochloric acid (PWC05-196), 50 percent by volume, it will fizz with rapid emission of gas bubbles and gradually disintegrate and form a black residue (aluminum chloride). Silver and bronze do not noticeably react with hydrochloric acid.

(g) Aluminum Paint - use this procedure to determine whether or not the material is aluminum silicone paint, aluminum chips, or silver particles.

1 Make a solution by adding one pellet of sodium hydroxide (PWC05-056) to three ccs of water.

2 Place several drops of this solution on a watch glass and drop in the suspected particles.

3 If the particles are aluminum silicone paint, there will be a mild reaction in the form of gas bubbles and some visible gas as the particles change to sodium aluminate.

4 If the particles are aluminum chips, the reaction will be much more active with many more gas bubbles forming and more visible gas.

5 If the particles are silver, there will be no reaction.

(h) Silver - when a silver particle is placed in nitric acid, it reacts rather slowly, producing a whitish fog in the acid.

(i) Bronze - when a bronze (or copper) particle is placed in nitric acid, a bright green cloud is produced.

E. Material Specifications

(1) To facilitate the identification of components which are the source of debris found in the oil system, the material specifications are listed in Table 206. The common contaminants found in the oil system are listed in Tables 207 and 208.

Table 206 Material Specification (Engine Components)

Table 207 Common Contaminants - Non-organic Material

Table 208 Common Contaminants - Organic Material

F. Laboratories

(1) Chip and flake analysis must be done by approved laboratories; refer to Service Information Letter No. GEN-123 for the list of approved oil laboratories.

11. Marking of Parts

A. General

(1) Marking of engine parts, assemblies, or weldments shall be applied so as to ensure maximum legibility and durability of mark but in a manner that will not affect

11. Marking of Parts

A. General

(1) Marking of engine parts, assemblies, or weldments shall be applied so as to ensure maximum legibility and durability of mark but in a manner that will not affect function or serviceability of part. Only applicable Pratt & Whitney Canada marking methods shall be used.

NOTE: Contact your local P&WC representative if you are not sure which method of marking would be suitable.

(2) Except where otherwise specified, reidentification of parts shall be accomplished adjacent to, or in a location similar to that of, original marking.

(3) All marking characters, unless otherwise specified, shall be 0.060 to 0.160 inch high. In special cases, when marking area is governed by size or configuration of part, characters not less than 0.016 inch nor more than 0.250 inch in height are permitted.

(4) Electric-arc scribing, particularly hand arc scribing, whereby characters are produced by the action of an electric arc between the surface and an electrode (scriber), has been found unsuitable for jet engine parts and must not be used.

(5) Acid etching, whereby characters are formed by action of an acid on the surface of the part, is not recommended because of its possible corrosive effect.

(6) Soapstone shall not be used to mark engine parts.

B. Permanent Marking

(1) General

(a) Marking should be done as close to original marking as possible. Permanent methods of marking are those in which marking is legible during entire service life of part.

(b) Permanent markings shall not extend onto any radius, chamfer, sharp edge, or fillet adjoining designated marking surface.

(2) Methods

CAUTION: DO NOT ELECTROLYTICALLY ETCH ANODIZED SURFACES.

(a) Electrolytic Etch - Characters are produced by electrolysis confined to area of characters by a stencil. This technique is sometimes used as a temporary method. Do not confuse it with electric-arc scribing.

(b) Vibration Peening - Characters are produced by a vibrating, radius-tipped, conical tool.

Manual - tool is hand-guided and has a single tip.

Mechanical - tool is mechanically guided and has a single tip, or has multiple tips producing one or more complete characters simultaneously.

This method is not usually permitted if hardness of part at time of marking is higher than Rockwell C45 or equivalent. It may be used on parts harder than Rockwell C45 when specifically permitted.

NOTE: Vibration peening marking method can be substituted for marking parts originally marked by diamond drag or roll marking.

C. Temporary Marking

(1) General

(a) Temporary methods of marking are those in which the marking will identify parts during ordinary handling, and storage, and final assembly.

CAUTION: LEAD AND/OR METALLIC PENCILS, OR ANY TEMPORARY MARKING METHOD LEAVING A DETRIMENTAL DEPOSIT OF CARBON, ZINC, COPPER, LEAD, OR SIMILAR RESIDUE WHICH MAY CAUSE A REDUCTION IN FATIGUE STRENGTH AS A RESULT OF CARBURIZATION OR INTERGRANULAR ATTACK WHEN THE PART IS SUBJECTED TO INTENSE HEAT, SHALL NOT BE USED. IN THE EVENT THAT AN UNAUTHORIZED MARKING MATERIAL IS USED, THE MARK MUST BE THOROUGHLY REMOVED BY A PROCEDURE DICTATED BY THE MARKING METHOD AND THE PART MATERIAL.

(b) When using a marking pencil, marks shall not be applied to carbon seal plate surfaces or to mating surfaces of finished machined parts. Heavy deposits of marking material could adversely affect clearance and runout.

(2) Methods

CAUTION: ANODIZED SURFACES MUST NOT BE ELECTROLYTICALLY ETCHED.

(a) Electrolytic Etch - Characters are produced by electrolysis confined to area by a stencil. This is primarily a permanent marking method. However, where specified, it may also be used for temporary marking.

(b) Ink Marking

1 Characters are produced by applying, by any means, an ink which does not injure the surface. Inks used in marking may have a light etching action, providing etching does not injure the surface.

NOTE: Ordinarily, ink stamping and electrolytic etching, when used as a temporary marking method, may be applied to any surface which, after assembly, does not move relative to a contacting surface.

(3) Marking Materials, Hot and Cold Section Engine Parts

(a) Felt Wick Pen (PWC05-048A) and Tex-Rite Instant Dry Ink (PWC05-046).

(b) Marks-A-Lot Marker (PWC05-048B).

(c) Brushpen No. 57 (PWC05-048) and Tex-Rite Instant Dry Ink (PWC05-046), black , red , and purple.

(d) Micro Supreme Dye, Purple No. 142 (PWC05-002)

(e) Berol Verithin Pencil, Red No. 750 (PWC05-018F). May be used on parts which are not directly exposed to the gas path. This type of mark is easily obliterated and, therefore, less durable.

(f) Eberhard Faber Spectracolor Pencil, Silver No. 1428,(PWC05-018) or Berol Verithin Pencil, Silver No. 753 (PWC05-018A).

(4) Marking Materials, Cold Section Engine Parts Only

Dykem Ink (PWC05-046C) KX425 (Black) or KXX122 (White).

Carters Ink (PWC05-027) No. 451 (Black).

(5) Marking Materials, Hot Section Engine Parts Only. Use layout dye (PWC05-041) (lightly applied) to mark parts which are directly exposed to engine gas path such as turbine blades and disks, turbine vanes, and combustion chamber liner.

12. Lubrication of Preformed Packings

A. General

CAUTION: APPLICATION OF LUBRICANT PLUS PROPER ASSEMBLY, WILL PREVENT DAMAGE TO PREFORMED PACKINGS. DAMAGED PREFORMED PACKINGS CAN CAUSE ENGINE MALFUNCTION.

(1) Prior to installation it is recommended that all preformed packings be coated with lubricant to the following specifications:

(a) Preformed packings used in fuel and/or oil system, use engine oil (PWC03-001).

(b) Preformed packings used in air system, use calibrating fluid (PWC03-002).

13. Touch-up Solution

WARNING: REFER TO THE MATERIAL SAFETY DATA SHEETS BEFORE YOU USE THESE MATERIALS FOR INFORMATION SUCH AS HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES. SOME OF THESE MATERIALS CAN BE DANGEROUS. YOU CAN GET THE DATA SHEETS FROM THE MANUFACTURERS OR THE SUPPLIERS OF THESE MATERIALS.

A. Chrome Pickle Solution (PWC05-161) (Magnesium RGB, AGB Housing and Compressor Inlet Case Only) (Ref. Table 209)

(1) Fill a suitable container with tap water to no more than 1/2 of the volume of the solution required.

(2) Slowly and carefully add the necessary quantity of sodium dichromate (PWC05-055). Stir to dissolve the sodium dichromate.

(3) Slowly and carefully add the necessary quantity of nitric acid (PWC05-195). Stir to mix the solution.

(4) Fill the remainder of the container with tap water to the specified volume required.

Table 209 Chrome Pickle Solution

B. Preparation of Chromate Conversion Solution (PWC11-019) (Ref. Table 210)

WARNING: REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(1) Fill applicable container to 3/4 level with tap water.

(2) Slowly and carefully add the necessary quantity of conversion salts (PWC05-198).

(3) Slowly and carefully add the necessary quantity of hydrochloric acid (PWC05-196). Mix the solution fully.

(4) Slowly and carefully add the necessary quantity of wetting agent (PWC05-162). Mix the solution fully.

(5) Fill the container to operating level. Mix the solution fully.

(6) Add hydrochloric acid (PWC05-196) or a combination of sodium hydroxide (PWC05-057) and 16 oz. of water (PWC05-073) to adjust pH, as necessary. Mix the solution fully.

Table 210 Chromate Conversion Solution (PWC11-019)

C. Chromate Repair of Magnesium Casings

(1) Before you start the procedure, cover the openings with applicable caps or put debris collector to keep out debris from the compressor or from other openings. This must have a lanyard attached to make sure that it does not fall into the compressor cavity accidentally.

(2) Clean the surface to be repaired with one of the combination that follows:

(a) A swab soaked in isopropyl alcohol (PWC11-014B).

(b) A crocus cloth (PWC05-061).

(c) An isopropyl alcohol hand-wipe or other applicable hand-wipe chemical.

(3) Remove the corrosion with one of the steps that follows:

(a) A small non metallic wire brush.

(b) A stainless steel or aluminum brush.

(c) A crocus cloth (PWC05-061).

(d) An abrasive cloth with aluminum oxide or glass grit (do not use silicon carbide abrasive).

(e) For better results, it is permitted to use a swab soaked in a chromic acid solution (PWC05-197) and at a temperature of 122.5 ± 40.5 °C (252.5 ± 72.5 °F).

(4) Flush with clean water at room temperature.

(5) Flush with clean hot water at a temperature of 60 °C (140 °F) minimum.

(6) Dry with clean low pressure compressed air at 200 kPa (29 psig).

(7) Use a swab or brush to apply chromate conversion solution (PWC11-019) or chrome pickle solution (PWC05-161) at a temperature of 23 ± 6 °C (73.5 ± 10.5 °F) for 30 to 45 seconds to prepared surface. Frequently apply the solution again to make sure that the surface is always wet with solution during the treatment.

(8) As an alternative to chrome pickle solution or chromate conversion solution you can use the consumables that follows:

(a) Alodine T 871 (PWC05-418) - pen applicator for a non-hexavalent chromium based solution.

(b) Henkel Alodine T Magnesium Treatment Kit (PWC05-419).

(9) Clean the repaired area with clean water and a swab until you remove the yellow stains.

(10) Put the part in an oven or increase the temperature of the part to 131 ± 46 °C (267.5 ± 82.5 °F) for 20 to 30 minutes.

D. Restoration of Protective Coating on Painted Surfaces

NOTE: The instructions that follow are not applicable for flanges, engine mount pads or accessories mount pads.

(1) Apply touch-up solution on bare metal surfaces, refer to Para. 13. (A.), (B.) and (C.).

(2) Apply masking tape to the area not to be painted.

(3) Apply two coats of epoxy primer (PWC13-001). Wait for one hour between the two coats. Let the part to dry in air at room temperature for eight hours minimum after the second coat.

(4) Apply three coats of aluminized epoxy enamel (PWC05-037). Wait 15 to 30 minutes between each coat. Let the last coat dry in air at room temperature for 24 hours minimum.

(5) Remove the masking tape, then do a check that the protective coating is fully applied on the bare metal surfaces.

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STANDARD PRACTICES - INSPECTION

1. General

A close and complete inspection is important to prolong engine life and give maximum performance. Check for loose or missing parts and inspect any engine part or component that has been worn or damaged. Damage to engine parts may result from improper clearance, lack of lubrication, undesired movement of parts which are bolted, pressed together, overloaded, uneven load distribution, heat, shock, extension of minor damage such as scratches, tool marks, grinding cracks, nicks, etc. Damage to engine parts may also result from presence of foreign matter such as grit, chips, moisture, chemicals, etc., or from incorrect techniques during removal and installation.

All inspection procedures should be done in a well-lighted, clean and dust-free area. Benches should be clean to keep previously cleaned parts free of dirt and dust. All parts shall be suitably identified and tagged to indicate repair or replacement. Although most parts will require only a visual inspection, a certain number will require use of gages and other measuring equipment. Some damage may only be detected by magnetic particle, or fluorescent penetrant inspection methods. Methods of inspection for specific parts and components are detailed in relevant sections of this manual.

2. Inspection

A. General

(1) Examine parts for alignment, distortion, foreign matter, looseness, out-of-roundness, sharp edges, scratches, taper, warping and wear. Additionally, check the following:

(a) Holes in cases, manifolds, pipes and tubes for obstructions.

(b) Gear teeth and splines for contact patterns.

(c) Magnesium parts for corrosion.

(d) Mounting pads, parting and seating surfaces, for smoothness and flatness. Use pencil carbon paper whenever a smear-type indication of surface smoothness is required.

(e) Plugs for tightness.

(f) Studs, dowels, and similar protruding parts for alignment and projection length.

(g) Protective surface coatings for completeness.

(h) Threads for condition.

B. Inspection Terms

(1) For definitions of the inspection terms used throughout this manual, refer to Table 601.

Table 601 Inspection Terms

C. Inspection Gages

NOTE: When an inspection procedure requires a very accurate measurement, a micrometer, vernier caliper or a dial indicator must be used.

(1) If a micrometer or vernier is to be used, check gage for accuracy before making measurement. Ensure that contacting surfaces are clean and contacting faces of part to be measured are free of dirt and burrs. When using depth gages, ensure anvil is held tight and square against part to be measured.

(2) If a dial indicator is used, ensure indicator base is anchored firmly and that any swivel connections are tightened securely.

(3) When taking measurements with feeler gages, ensure final size of feeler is a reasonably snug fit.

D. Inspection of Fuel, Oil and Air Filters

(1) When determining the condition of engine fuel, oil lubrication and pneumatic systems, removed filters must be inspected for condition, contamination and other defects before the application of any allowable cleaning procedures. Clogged filters could be cause for downstream low pressure in systems.

NOTE: Other engine components will normally be cleaned prior to carrying out inspection procedure.

E. Inspection of Fuel, Oil and Air Tubes

NOTE: The following criteria is considered standard. Specific instructions for inspection and limits where applicable will be called out in the appropriate chapter/section/unit.

(1) Cracked tubing must be replaced. No repair is permitted.

(2) Minor scratches having no appreciable depth are acceptable. Scratches to 0.005 inch deep must be smoothed out. Replace tubing with scratches over 0.005 inch deep.

(3) Individual nicks to 0.062 inch long by 0.010 inch wide and 0.003 inch deep are acceptable. Nicks to a maximum 0.005 inch deep must have sharp edges removed. Replace tubing with nicks greater than 0.005 inch deep.

(4) Round bottom dents on straight sections of tubing are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(5) Minor isolated pitting to 0.003 inch deep is acceptable. Clusters of pitting should be removed to maximum 0.005 inch deep. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(6) Staining on tubing and surface corrosion is acceptable if removable by light polishing with abrasive cloth and oil.

F. Inspection of Welded Repairs

(1) Inspect weld repair for quality, uniformity, undercutting, cracking and flux removal. Welds must be blended into adjacent metal in gradual, smooth curves. Welds must be sound, clean, free from foreign material, and from internal and external defects which would adversely affect strength of weld.

(2) Nominal welds (those not requiring finishing) must exhibit bead conditions as shown in Figure 601, Detail A. Finished welds must exhibit bead conditions as shown in Detail B.

G. Inspection of Rotating Components

(1) Life limited (critical) rotating components exhibiting cracks are unserviceable and shall not be repaired.

(2) Handle rotating components with extreme care to prevent damage or contamination of the material.

(3) Wear lint free gloves when touching rotating components.

(4) Make sure close attention is paid to areas such as counterweight holes and blade slots where imperfections are difficult to find.

(5) Use suitable clean, protective containers for storing and transporting components.

(6) Inspect components in accordance with the criteria specified in the relevant Chapter/Section/Subject.

(7) Any observed conditions not defined in this manual are not acceptable for repair.

(8) Evaluation of the surface should take into consideration the need for repairs and the limits to which repairs may be made to determine the suitability for continued use of the component.

(9) Unrepairable components shall be quarantined to prevent further use.

(10) It is important to have suitable lighting. The minimum recommended illumination for close and difficult inspection is 100 foot-candles measured at the inspection table top.

table top.

(11) Unless otherwise specified, magnification shall not be used. A magnification of 3 to 4X may be used as an aid to evaluate and confirm an observed condition in detail.

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Figure 601 Weld Repair - Inspection

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601 Inspection Terms

70-00-00
STANDARD PRACTICES - CLEANING

1. General

A. Gas turbine cleaning can be categorized into two broad areas, namely specific parts cleaning and field cleaning (i.e., compressor washing).

B. Specific parts cleaning is primarily to remove contaminants which might conceal minor cracks and other defects which, if not detected, could eventually lead to failure of a component or part. Engine components or parts should be cleaned only as necessary to perform required inspection and repair. Overcleaning of components or parts is unnecessary and should be avoided. The cleaning methods given in the following text are adequate for all maintenance levels. For compressor washing methods, refer to Chapter 71-00-00, CLEANING.

2. Cleaning

A. General

(1) Prior to engine disassembly, make sure that the work area is clean.

(2) Benches on which engine parts are placed must be clean and free from grit, metal filings, etc., which may contaminate engine oil systems, fuel systems or hardware.

(3) Clean plastic bags should be available in which oil system and fuel system parts may be stored until ready for reassembly.

(4) Clean plastic caps or covers should be used to protect exposed tubes or bearing areas.

(5) At reassembly make sure that all parts are clean and new packings installed.

B. Precautions

NOTE: The choice of cleaning agents should be limited to the consumables listed in CONSUMABLE MATERIALS section. The toxicity of cleansing agent will, however, depend on the type of contamination encountered on part to be cleaned.

CAUTION: TAKE PARTICULAR CARE IN SELECTING CLEANING METHOD TO MAKE SURE THAT ANODIZING AND OTHER PROTECTIVE COATINGS ARE NOT REMOVED FROM PARENT METAL. DO NOT USE ALKALIES ON ALUMINUM, MAGNESIUM, ALUMINIZED AND PAINTED AREAS.

(1) Wear rubber gloves, apron or coveralls and face shield or goggles, when working with solvents.

(2) Use the least toxic of available cleaning materials which will satisfactorily accomplish work.

(3) Do all cleaning operations in a well ventilated work area.

(4) Make sure that adequate and usable fire fighting and safety equipment is conveniently located and available to all personnel.

(5) Do not smoke or expose a flame within 50 feet of cleaning area.

(6) Make sure that all degreasing agents are thoroughly removed from all parts after cleaning.

(7) Do not use steel brushes for any cleaning operation, except when specifically detailed within this manual. Use a stiff bristle fiber brush.

C. Cleaning Before Welding

(1) Surfaces to be welded must be free from protective coatings, dirt, grease, oil and other contaminants, and as free as practicable from oxide formation. Wire brushes and abrasives may be used to remove protective coatings and oxides, except that the final step in removing oxides from aluminum alloys, preferably, should consist of chemical treatment immediately prior to welding. Wire brushes, when used for cleaning corrosion-resistant alloy, must have bristles of austenitic, corrosion-resistant steel. No undesirable deposit or residue must remain on surface to be welded after cleaning operation.

STANDARD PRACTICES - REPAIR

1. General

A. The primary purpose of repair is to enable a component or engine part to be reworked to a condition which will provide safe operation. Approved repair schemes are detailed in the relevant sections of this manual using the various consumables listed in CONSUMABLE MATERIALS section.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-061	Cloth, Abrasive
PWC05-147	Electrode, Welding
PWC05-161	Solution, Touch-up (Chrome Pickle)
PWC05-197	Acid, Chromic
PWC11-014	Alcohol, Isopropyl
PWC11-019	Solution, Chromate Conversion Magnesium Alloy

3. Special Tools

The special tools listed below are used in the following procedures.

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31771	Spreader

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Welder, AC/DC with high frequency controls	P and H model, DA-300-HF-GW
Torch, with recirculating water	Linde HW-9 or Linde HW-10 or Airco H20A or H35B
Cups, ceramic various sizes	
Regulator, argon gas	Airco 8407
Flowmeters (2 of)	Airco 830-1327

5. Welding

CAUTION: WELDING MUST BE DONE BY QUALIFIED PERSONNEL ONLY, USING SAFE WELDING PRACTICES, ADEQUATE VENTILATION, AND PROTECTIVE EQUIPMENT. DO NOT WELD IN CONFINED AREAS WITHOUT PROPER VENTILATION.

A. General

The following procedures apply to components that have been removed from the engine. Weld repair of components still installed on the engine, is not permitted under any circumstance.

A tungsten inert gas fusion welding process must be used when repairing cracks in engine parts. Argon or helium gas may be used in inert gas welding; however, argon is preferred by Pratt & Whitney Canada because its greater density reduces its rate of diffusion with the atmosphere.

Inert gas welding is a gas arc welding process which uses inert gas to protect the weld area from the surrounding atmosphere. The heat necessary for welding is provided by a very intense electric arc which is struck between a non-consumable thoriated tungsten (tungsten and thorium alloy) electrode and the metal part. On repairs where a filler material is required, a welding rod, of appropriate material, is fed into the weld area and melted with the base metal in the same manner as in conventional gas welding.

B. Clean Before Welding

(1) Refer to CLEANING.

C. Procedure

WARNING: IF AN OXYGEN REGULATOR IS USED WITH ARGON GAS, DO NOT REINSTALL THE REGULATOR ON AN OXYGEN CYLINDER. ARGON GAS CONTAINS OIL AND THE POSSIBILITY EXISTS OF AN EXPLOSION DUE TO THE PRESENCE OF OIL IN THE REGULATOR

(1) Connect one argon gas flowmeter to torch and connect other flowmeter, if necessary, behind crack as a backup when ready to weld.

(2) Connect torch to arc welder for straight polarity.

(3) Insert a 1/16 inch diameter thoriated tungsten electrode (PWC05-147) into torch, allowing approximately 5/16 inch of electrode to protrude from ceramic cup. The ceramic cup used must not be smaller than a No. 6 for the HW-10 torch, in order to provide a sufficient amount of inert gas to the weld area where cleanliness of the surface beader is important.

NOTE: A plain tungsten electrode may be used, but a needle point must be maintained on the electrode for more positive starting of arc. Where possible, the electrode must be kept clean of material pickup.

(4) If it is necessary to protect underside of weld from contamination, possible weld porosity, or poor surface finish, attach argon gas line behind crack to be welded. This may be accomplished by fabrication of small box-like fixtures having edges shaped to fit contours of part to be welded and using a suitable connection to secure gas line. Seal fixture to part in order to conserve gas leakage to minimum.

NOTE: The amount of gas pressure to provide sufficient backup must be determined. This pressure should not allow the gas to stir the weld puddle. Do not use flux when

(5) When high frequency controls are used, it is not necessary to strike an arc. Hold torch vertically to work so that the shielding gas (argon) forms a protective envelope around the weld. It is preferable to have area to be welded in a horizontal position.

(6) When high frequency controls are not used, strike arc and hold electrode tip approximately 1/8 to 1/4 inch above surface to be welded until a puddle is formed. Add welding rod, as applicable, and proceed as in conventional gas welding.

NOTE: Test welds, using corresponding material of same thickness and joint design, should be made to determine correct gas pressure and arc welding settings.

(7) Because a high percentage of steel parts used in the engine are fabricated from 12 percent chromium corrosion-resistant steels, which are characterized by their susceptibility to air hardening, field repair of cracks by fusion welding is a special problem. The high temperature at which fusion weld repairs are made and the subsequent air cooling of the part, or parts, from these temperatures usually results in an increase in material hardness and a loss in ductility. Parts on which fusion weld repairs have been made have a tendency to crack because the steel structure becomes unstable, brittle and highly stressed. The structure of the material can be improved by reheating the parts and controlling the cooling rate.

D. Clean After Welding

(1) Refer to CLEANING.

E. Local Stress Relief

(1) Components which are not highly stressed may be repaired by fusion welding. It is possible to partially restore the original properties of such welded parts through use of local heat treatment. The localized heat may be applied by neutral flame of an oxyacetylene torch. Extend the stress relief one inch minimum beyond the welded area. After the desired heat has been applied to the part for the correct length of time, reduce temperature of part gradually.

F. Inspection of Welding

(1) Refer to INSPECTION.

6. Blend Repairs

A. Repair Procedure

(1) Blend repair using carborundum stones.

CAUTION: DO NOT POLISH WITH POWER TOOLS.

(2) Polish blended area using abrasive cloth (PWC05-061).

(3) Blend all repairs and finish smoothly.

(4) Lines, scratches or sharp edges which may cause a concentration of stress are not permitted.

B. Definitions

BLENDING	An operation that removes an irregularity or imperfection from a surface and results in restoring the surface to a smooth acceptable condition.
GRINDING	An operation that removes material by the use of an abrasive material to produce a predetermined size.
POLISHING	A finishing operation which produces a smooth surface finish.

C. General

Repairs are defined as freehand smoothing , deburring and/or polishing. It does not include machining or machine grinding.

Repair only defined damage within the limits specified in the relevant Chapter/Section/Unit. Undefined damage shall render the component unserviceable.

Do repairs in a direction so that the finishing marks follow the lay of the original manufacturing machining marks.

Restore surface finish of repaired area to the original manufacturing finish.

Make sure repaired area conforms to the original manufacturing shapes, profiles, contours and radii.

Make sure local repairs extend over an area 10 times the depth of damage.

Maintain a smooth transition between repaired areas and adjacent areas.

Make sure local repairs extend over an area 10 times the depth of damage.

Maintain a smooth transition between repaired areas and adjacent areas.

Make sure repaired area is 1/3 deeper than the damage to ensure removal of damage.

Examine all repaired components.

D. Air Gun

The air gun is hand held, with an adjustable spindle speed, and drives a suitable mandrel.

Use a piece of abrasive cloth, rotary file, abrasive disk or wheel of appropriate shape, dimensions and grit size for hand grinding rotating components.

Adjust the rotation of the hand blending wheel to obtain the required surface finish.

Do not allow the wheel to exceed 2000 RPM to prevent local overheating of the material.

Adjust the applied pressure of the wheel to produce a maximum of 0.0005 inch of material removal in each pass.

A light, equal pressure on the wheel gives the best results as it permits the abrasive to cut easily without loading up and overheating.

E. Preparation of Chromate Conversion Solution (PWC11-019)(Ref. Table 801)

WARNING: REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(1) Fill suitable container to 3/4 level with tap water.

(2) Slowly and carefully add required amount of conversion salts (PWC05-198).

(3) Slowly and carefully add required amount of hydrochloric acid (PWC05-196) and stir to mix.

(4) Slowly and carefully add required amount of wetting agent (PWC05-162) and stir to mix.

(5) Fill container to operating level and stir to mix.

(6) Add hydrochloric acid (PWC05-196) or a combination of sodium hydroxide (PWC05-057) and 16 oz of water (PWC05-073) to adjust pH, as necessary. Stir to mix.

Table 801 Chromate Conversion Solution (PWC11-019)

F. Preparation of Chrome Pickle Solution (PWC05-161) (Ref. Table 802)

WARNING: REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(1) Fill container 1/2 full with tap water.

(2) Add sodium dichromate (PWC05-055) slowly and carefully to the water. Stir to dissolve.

(3) Add nitric acid (PWC05-195) slowly and carefully . Stir to mix.

(4) Fill remainder of the container with tap water. Stir to mix.

Table 802 Chrome Pickle Solution (PWC05-161)

G. Procedure

(1) Clean surface to be repaired with a swab soaked in isopropyl alcohol (PWC11-014) and/or crocus cloth (PWC05-061).

(2) Remove corrosion with a swab or brush, soaked in a hot 82 to 163°C (180-325°F) chromic acid solution (PWC05-197).

(3) Rinse with clean water at room temperature.

(4) Rinse with clean water heated to 60°C (140°F) minimum).

(5) Dry with clean low pressure compressed air at 200 kPa (29 psig).

(6) Apply chromate solution (PWC11-019) or chrome pickle solution (PWC05-161) at a temperature of 17 to 29°C (55-85°F) for 30 to 45 seconds to prepared surface, with a swab or brush. Repeat application frequently to make sure surface is continually wet with solution during the treatment.

(7) Swab area with clean water until successive swabs are no longer stained yellow.

(8) Dry part in oven or with local heating for 20 to 30 minutes at 85 to 177°C (185-350°F).

7. Threaded Inserts

A. Replacement of Threaded Inserts

CAUTION: BEFORE USING INSERTS, IN ANY PART OF THE ENGINE, REFER TO THE P&WC INSTRUCTIONS FOR CONTINUED AIRWORTHINESS FOR APPROVED LOCATIONS AND PART NUMBER OF INSERT.

(1) Remove unserviceable insert using an approved extraction tool.

(2) Clean out hole and make sure swarf and other foreign matter is removed.

(3) Install new threaded insert into threaded hole using installation tool. The insert outer thread must be between one and one-half threads below the surface of the hole or counterbore, whichever applies.

(4) Cut off driving tang at notch using approved tang removal tool and remove tang from holes.

(5) Inspect repaired hole.

8. Studs

A. General

When necessary, oversize studs are to be installed in place of those which are broken, stretched, loose or have damaged external threads. Whenever a stud which is already oversize requires replacement, install the next oversize stud. Use correct stud drivers to install new studs and torque to appropriate value (Ref. Tables 803 or 804, as applicable).

Before installing new studs, refer to associated Illustrated Parts Catalog, for approved locations and part numbers. When threads of a stud hole are damaged beyond dimensions suitable for fitting a maximum oversize stud, it is usually possible to do repairs by the installation of a helical coil (Ref. Subpara. A.) or key-type insert. Consideration should, however, be given to reduction of thickness of walls or parent metal around insert and the required strength. Specific problems should be referred to P&WC Service Department (Ref. INTRODUCTION, Customer Support).

B. Replacement of Studs

(1) Remove damaged stud using an approved method.

(2) Examine stud hole for condition; on worn stud holes use oversize studs.

(3) Install stud using an approved stud driver to correct protrusion height; make sure torque limits (Ref. Tables 803 or 804, as applicable) are not exceeded.

Table 803 Standard Stud Torque Limits

Table 804 Stepped Stud Torque Limits

C. Repair of Damaged Stud Hole

(1) Make sure damaged hole is suitable for repair (Ref. Subpara. B. preceding).

(2) Measure core depth of existing hole.

(3) Select relevant size drill and drill hole to measured depth (Ref. Step (2) preceding).

(4) Using relevant special tap, thread hole one thread deeper then insert to be fitted.

(5) Where applicable, counterbore hole to required angle and depth.

(6) Clean out hole and ensure freedom from metal chippings and other foreign matter.

(7) If part being repaired is magnesium, treat tapped hole with chrome pickle touch-up solution (PWC05-161):

(a) Clean area to be treated with abrasive cloth (PWC05-061) and/or cloth impregnated with isopropyl alcohol (PWC11-014).

(b) On rough surfaces, remove corrosion using wire brush or abrasive paper.

(c) On finished surfaces, remove corrosion using swab or brush impregnated with chromic acid (PWC05-197) at 85° to 93°C (180° to 200°F).

(d) Rinse with clean cold water.

(e) Rinse with clean hot water.

(f) Dry using clean, dry compressed air.

(g) Apply chromate solution (PWC11-019) or chrome pickle solution (PWC05-161) to area to be treated using a clean cloth. Repeat swabbing at frequent intervals to make sure treated area is maintained wet with solution during treatment.

(h) Thoroughly rinse touched up area by swabbing several times with clean cloth moistened with water.

(i) Dry using clean, dry compressed air.

(8) Using appropriate size threaded insert, install insert into repaired stud hole (Ref. Para. A.).

9. Shanknuts

A. Replacement (Ref. Fig. 801)

CAUTION: AVOID DAMAGE TO FLANGE.

(1) Using a suitable drill, partially remove the flared end of shanknut.

(2) Remove shanknut body with a parallel pin punch at drilled end to shear weakened flare, and retrieve the case.

(3) Install new shanknut (Ref. IPC) and hold against flange.

(4) Lightly lubricate tapered portion of spreader (PWC31771) with oil (PWC03-001) and screw into shanknut until shank end is flared against flange.

(5) Remove spreader and examine flared end of shanknut for correct forming with no evidence of deformation or cracks.

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Figure 801 Shanknut Replacement

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801 Chromate Conversion Solution (PWC11-019)

802 Chrome Pickle Solution (PWC05-161)

803 Standard Stud Torque Limits

804 Stepped Stud Torque Limits

71-00-00
POWER PLANT - ADJUSTMENT/TEST

1. General

This section contains information for engine ground running and for checks and adjustment/test procedures to verify integrity of installed/replaced items.

Specific checks and the order in which they are to be done after installation or replacement of components are defined in Table 501.

Minimum checks to be done before troubleshooting procedures are done on an engine, are defined in Table 502.

Engine operating limits are given in Table 503 and Table 504 (BS1354).

Engine temperature limits and corresponding maintenance requirements are given in Figure 501.

Figure 502 defines inadvertent engine cut-off and relight during taxi and corresponding inspection requirements. For unscheduled inspection procedure, refer to Chap. 72-00-00, INSPECTION, Unscheduled Inspection.

Engine torque limits and related maintenance requirements are given in Figure 503 and Figure 504 (BS1354).

Figure 505 defines gas generator (Ng) overspeed areas.

2. Pre-operational Check

A. Procedure

(1) Open engine cowlings (Ref. Aircraft Maintenance Manual) and examine engine mounts, air inlet screen and compressor wash spray ring.

(2) Examine all linkages to engine and to accessories mounted on engine, for attachment.

(3) Examine all fuel and oil tubes, lines and connections for attachment and leaks. No leaks are permitted, except at normal seepage drains.

(4) Examine all pneumatic line connections and filters for attachment.

WARNING: TURN ELECTRICAL POWER OFF.

(5) Examine all electrical connectors for proper attachment. Check installation of remote mounted ignition exciter.

CAUTION: DO NOT MOVE COCKPIT POWER CONTROL LEVER INTO PROPELLER REVERSE POSITION OR DAMAGE TO LINKAGE WILL RESULT. REVERSE MAY ONLY BE SELECTED WITH ENGINE RUNNING AND PROPELLER TURNING.

(6) Check cockpit controls for freedom of movement and verify full travel of control linkages on engine.

NOTE: Individual airframe installations may prevent full application of this check with electrical power off and engine not running. Refer to individual aircraft operating instructions.

(7) Check engine oil level and service as necessary (Ref. 72-00-00, SERVICING, Lubricating Oil System). Check locking of filler cap after servicing.

(8) Close engine cowlings (Ref. Aircraft Maintenance Manual).

(9) Check fuel system has been serviced with proper fuel (Ref. Service Bulletin SB14004, Listing of Engine Fuels and Additives).

(10) If engine is to be started, remove propeller restraining device. Check area is clear for engine motoring.

Table 501 Checks after Component Installation/Replacement

Table 502 Minimum Checks Required before Troubleshooting

Table 503 PT6A-66D Engine Operating Limits

Table 504 PT6A-66D (BS1354) Engine Operating Limits

3. Pre-start Checks

A. Procedure

NOTE: Cockpit labels and names of controls may differ according to airframe manufacturer. The terminology used in this and subsequent paragraphs is that of Pratt & Whitney Canada.

(1) Power Control Lever - GROUND-IDLE.

(2) Propeller Control Lever - FEATHER.

(3) Fuel Condition Lever - OFF.

(4) Engine Manual Override - OFF.

(5) Engine Master Switch - ON.

(6) Fuel System Shutoff Valve - OPEN.

(7) Fuel Boost Pump Switch - ON.

(8) Fuel Inlet Pressure - Five psig minimum.

(9) Bleed Air - OFF.

A. Procedure

NOTE: This procedure is used any time it is deemed necessary to remove internally trapped fuel and vapor or if there is evidence of a fire within the engine gas path. Air passing through the engine serves to purge fuel, vapor or fire from the combustion section, compressor turbine, power turbines and exhaust system.

(1) Propeller Control Lever - FEATHER.

(2) Fuel Condition Lever - OFF.

(3) Power Control Lever - GROUND-IDLE.

(4) Ignition Switch - OFF.

(5) Engine Master Switch - ON.

(6) Fuel System Shutoff Valve - CLOSED.

(7) Fuel Boost Pump Switch - ON.

(8) Engine Starter Switch - ON.

WARNING: SHOULD A FIRE PERSIST, AS INDICATED BY SUSTAINED T5, CLOSE THE FUEL SYSTEM SHUTOFF VALVE AND CONTINUE MOTORING.

(9) Maintain starter operation for the desired duration. Observe starter limits (Ref. Starter Manufacturer's Manual).

(10) Engine Starter Switch - OFF.

(11) Fuel Boost Pump Switch - OFF.

(12) Engine Master Switch - OFF.

NOTE: Allow required cooling period for starter before any further operation is attempted.

(13) Check all oil and fuel lines and connections for leaks. No leaks are allowed except at normal seepage drains.

(14) Check engine oil level and service as necessary (Ref. 72-00-00, SERVICING, Lubricating Oil System).

5. Wet Motoring Run

WARNING: MAKE SURE PERSONNEL, OTHER AIRCRAFT AND EQUIPMENT ARE CLEAR OF DANGER ZONE NEAR ENGINE.

CAUTION: THIS PROCEDURE IS USED STRICTLY FOR MAINTENANCE PURPOSES AND IS NOT PART OF NORMAL ENGINE START PROCEDURE. AFTER A WET MOTORING RUN, A DRY MOTORING RUN (REF. PARA. 4.) MUST BE DONE BEFORE AN ENGINE START IS ATTEMPTED.

A. Procedure

(1) Propeller Control Lever - FEATHER.

(2) Fuel Condition Lever - OFF.

(3) Power Control Lever - GROUND-IDLE.

(4) Ignition Switch - OFF.

(5) Engine Master Switch - ON.

(6) Fuel System Shutoff Valve - OPEN.

(7) Fuel Boost Pump Switch - ON.

(8) Engine Starter Switch - ON.

NOTE: Observe starter motor operating limits.

(9) After stabilized Ng and positive oil pressure, set the Fuel Condition Lever to GROUND-IDLE for 10 seconds.

(10) Fuel Condition Lever - OFF.

(11) Engine Starter Switch - OFF.

(12) During rundown, check that flow divider and dump valve and gas generator case drain valves are functioning.

(13) Fuel Boost Pump Switch - OFF.

(14) Fuel System Shutoff Valve - CLOSED.

(15) Engine Master Switch - OFF.

(16) Check oil lines, fuel lines and connections for leaks. No leaks are allowed except at normal seepage drains.

(17) Allow starter cooling period (Ref. Starter Manufacturer's Manual), then follow with dry motoring run (Ref. Para. 4.).

6. Engine Starting

A. Procedure

WARNING: MAKE SURE PERSONNEL, OTHER AIRCRAFT AND EQUIPMENT ARE CLEAR OF DANGER ZONE NEAR ENGINE.

(1) Do pre-start checks (Ref. Para. 3.).

(2) Engine Starter Switch - ON.

(3) Engine Oil Pressure - Check for indication.

(4) Ignition Switch - AUTO.

NOTE: Minimum Ng to get satisfactory light is 13% (4870 rpm).

CAUTION: WHENEVER THE GAS GENERATOR FAILS TO LIGHT UP WITHIN 10 SECONDS AFTER MOVING FUEL CONDITION LEVER TO GROUND-IDLE POSITION, SHUT OFF FUEL, STARTER AND IGNITION. LET THE FUEL TO DRAIN FOR 30 SECONDS, FOLLOWED BY 15 SECOND DRY MOTORING RUN BEFORE ATTEMPTING ONE MORE START. IF STARTER LIMITS PERMIT, IT IS NOT NECESSARY TO DO RUNDOWN AFTER DRY MOTORING RUN. IF, FOR ANY REASON, A START ATTEMPT IS DISCONTINUED, ALLOW THE ENGINE TO COME TO A COMPLETE STOP TO PERMIT GAS GENERATOR DRAIN VALVES OPERATION, AND THEN DO A DRY MOTORING RUN. DO THE COMPLETE START SEQUENCE AGAIN. MONITOR THE STARTER LIMITS. (REF. STARTER MANUFACTURER'S MANUAL.)

(5) As the gas generator speed passes through or has stabilized above the minimum light-off speed (Ng ≈ 13%), move fuel condition lever to LO-IDLE position.

(6) Make sure that Ng accelerates to ground-idle (Ref. Para. 10.), and T5 starting limit is not more than the specified limits (Ref. Table 503).

(7) For BS1354: Make sure that Ng accelerates to ground-idle (Ref. Para. 10.), and T5 starting limit is not more than the specified limits (Ref. Table 504).

(8) When engine attains ground-idle:

(a) Engine Starter Switch - OFF.

(8) When engine attains ground-idle:

(a) Engine Starter Switch - OFF.

(b) Select HI-IDLE and make sure that the engine accelerates normally (Ng ≈ 69 ± 2%).

(9) If OAT < 0 °C or if the engine start time is more than the maximum recommended start time or hangs:

(a) Shut the engine down.

(b) Start the engine again as per Steps (1) thru (4).

(c) After the gas generator has reached a stabilized speed (Ng ≈ 13%), move the fuel condition lever to HI-IDLE position.

(d) Make sure that the engine accelerates normally (Ng ≈ 69 ± 2%) and T5 starting limit is not more than the specified limits (Ref. Table 503 and Table 504 (BS1354)).

NOTE: If the start condition often necessitate the use of High Idle start schedule, it is suggested to use it as the initial start procedure.

(10) Before proceeding to ground run, do at least two feathering cycles to purge the propeller governor and propeller hub. Keep the power control lever in LO-IDLE position.

7. Engine Shutdown

A. Procedure

WARNING: IF THERE IS FIRE WITHIN THE ENGINE AFTER SHUTDOWN, PROCEED IMMEDIATELY AS DESCRIBED UNDER DRY MOTORING RUN (REF. PARA. 4.).

(1) Power Control Lever - GROUND-IDLE.

NOTE: Allow engine to stabilize for minimum of two minutes at minimum obtainable T5.

(2) Propeller Control Lever - FEATHER.

(3) Fuel Condition Lever - OFF.

(4) Fuel Boost Pump Switch - OFF.

(5) Fuel System Shutoff Valve - CLOSED.

(6) Engine Master Switch - OFF.

(7) Make sure that the compressor decelerates freely. The compressor rundown time must not be less than 20 seconds from the ground idle.

8. Post-shutdown Checks

A. Procedure

(1) Check all engine oil lines and connections for leaks. None are allowed, except at normal seepage drains.

NOTE: Allowable oil seepage is 3 cc/hour at each accessory drive pad, and 5 cc/hour at the propeller shaft. All seal leakages shall be included in total oil consumption (Ref. Chapter 72-00-00, ENGINE DESCRIPTION AND OPERATION, Engine Data).

(2) Do a check of all engine fuel tubes and connections for leaks. No leaks are permitted other than leakage at seal drain port (Ref. 73-10-02, FUEL PUMP - MAINTENANCE PRACTICES).

(3) Check engine oil level and service as necessary (Ref. Chapter 72-00-00, SERVICING, Lubricating Oil System).

WARNING: SHUT DOWN ENGINE BEFORE PERFORMING ANY ADJUSTMENTS ON ENGINE ASSOCIATED EQUIPMENT. THIS IS ESSENTIAL DUE TO CLOSE PROXIMITY OF PROPELLER AND EXHAUST NOZZLES.

(4) Check all engine mounted and off-mounted accessories and linkages for proper mounting.

(5) Check oil-to-fuel heater installation (Ref. 73-10-01, MAINTENANCE PRACTICES).

9. Propeller Governor Checks

NOTE: The following checks are to be done after the engine has been started using the proper procedures (Ref. Paras. 3. and 6.), and then shutdown (Ref. Para.7.), before any adjustments are made.

A. Feathering Operation Check

(1) Set Power Control Lever to ground-idle speed (Ref. Para. 10.).

(2) Set Propeller Control Lever to feather. If Ng changes more than 100 rpm, replace propeller governor (Ref. 61-20-00, MAINTENANCE PRACTICES, Removal/Installation).

B. Underspeed Fuel Governing Check (Ref. Fig. 506)

(1) Disconnect and hold propeller governor reset lever against minimum stop.

(2) Set Propeller Control Lever - MAX.

(3) Accelerate engine slowly and check that Np obtained is 94% to 96%. Refer to Aircraft Maintenance Manual for specific Np requirements. Make sure that Max. torque is not exceeded (Ref. Tables 503 and 504).

(4) Adjust underspeed as follows:

(a) Remove lockwire.

(b) Loosen locking screws.

(c) Turn the adjustment screw such that the index mark on the screw head turns either towards (for increased Np) or away from (for decreased Np) the arrow mark.

NOTE: This adjustment is very sensitive. Use the index mark on the screw head as a reference point. Adjust in $^{1}/_{12}$ increments maximum.

(d) Torque locking screws 10 to 14 lbf.in. and lockwire.

10. FCU Checks

NOTE: 1. The following checks are to be done after the engine has been started using the proper procedures (Ref. Paras. 3. and 6.), and then shutdown (Ref. Para. 7.), before any adjustments are made.

NOTE: 2. Adjustments must be done under conditions representative of normal operation as instructed in relevant Aircraft Maintenance Manual (i.e., specified loads).

A. Ground-idle Speed Check

(1) Set Power Control Lever - GROUND-IDLE.

(2) Set Propeller Control Lever - MAX.

(3) Set Fuel Condition Lever - GROUND-IDLE.

(4) Ground-idle speed must be as follows:
54 to 58% Ng (20,250 to 21,750 rpm).

(5) Adjust engine ground-idle speed (Ref. Fig. 507):

(a) Loosen FCU lever clamp screw.

(b) Loosen either upper (increase) or lower (decrease) adjustment screw, as required.

(c) Tighten opposing screw an equal amount to screw loosened in step ((a)).

NOTE: Speed setting shaft tab must be held firmly between opposing adjustment screws. One "flat" of screws will alter ground-idle approximately 2%. Adjusting ground-idle speed will effect flight-idle speed.

(d) Tighten adjustment screws 13 to 16 lb.in. and lockwire.

(e) Tighten FCU lever clamp screw 32 to 45 lb.in. and lockwire.

B. Flight-idle Speed Check

(1) Set Power Control Lever - GROUND-IDLE.

(2) Set Propeller Control Lever - MAX.

(3) Advance Fuel Condition Lever - FLIGHT-IDLE.

(4) Flight-idle speed must be 67 to 71% Ng (25,250 to 26,750 rpm).

(5) Adjust flight-idle speed as follows (Ref. Fig. 507):

(a) Remove lockwire from cam follower adjustment nuts.

(b) Loosen front nut (increase) or rear nut (decrease) and tighten opposing nut an equal number of turns to change Ng as required. Check follower roller is correctly aligned with cam.

NOTE: One complete turn of adjustment nuts will alter Ng by approximately 1.5%.

(c) Tighten adjustment nuts 56 to 70 lb.in. and lockwire.

C. Manual Override System Static Check (Ref. Fig. 507)

(1) As part of the periodic inspection (Ref. 72-00-00, INSPECTION, Periodic Inspection), check the static operation of the manual override system, with the engine shutdown:

(a) Set cockpit Manual Override Control lever - OFF. Make sure the Manual Override lever on the FCU contacts the stop at the normal position.

(b) Set cockpit Manual Override Control lever to the maximum forward position. Make sure the cockpit Manual Override Control lever does not bind and the Manual Override Lever on the FCU contacts the stop at the maximum override position.

NOTE: Some resistance to movement of the cockpit Manual Override Control lever is normal.

(c) If either stop is not reached, check/adjust the airframe rigging (Ref. Aircraft Maintenance Manual).

D. Manual Override System Operational Check

CAUTION: OTHER THAN THE FOLLOWING CHECK, USE OF THE MANUAL OVERRIDE SYSTEM IS RESTRICTED FOR EMERGENCIES ONLY.

CAUTION: WHEN USING THE MANUAL OVERRIDE SYSTEM, THE ENGINE RESPONSE MAY BE MORE RAPID THAN WHEN USING THE POWER LEVER. A RAPID INCREASE IN MANUAL OVERRIDE LEVER POSITION TOWARDS MAXIMUM IS TO BE AVOIDED, AS THIS CAN CAUSE ENGINE SURGE, ENGINE OVER-TEMPERATURE, Ng OVER-SPEED OR OVER-TORQUE.

(1) Following an FCU or engine change (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501) or as part of an annual airframe zone inspection (Ref. Aircraft Maintenance Manual), check the serviceability of the manual override system as follows:

(a) Do the Manual Override System static check (Ref. Para. 10.C.).

(b) Set Manual Override Control lever - OFF.

(c) Start the engine (Ref. Paras. 3. and 6.).

(d) Slowly advance Manual Override Control lever observing ITT, torque and Ng at all times. Keep Ng maximum increase under 4% per second.

NOTE: Some movement of the Manual Override Control lever, resulting in no increase in engine power, is normal.

(e) Slowly increase Ng until a 15% increase above ground-idle speed is obtained. This indicates proper functioning of the Manual Override System.

(f) Slowly reduce the Manual Override Control lever to OFF, keeping Ng decrease less than 4% Ng per second.

11. Oil Pressure Check

A. Procedure

(1) Start engine (Ref. Paras. 3. and 6.).

(2) Run engine at some convenient gas generator speed above 72% Ng to stabilize oil temperature within the operating range.

(3) After instrument readings have stabilized, make sure that oil pressure is in limits (Ref. Table 503).

(4) For BS1354: After instrument readings have stabilized, make sure that oil pressure is in limits (Ref. Table 504).

(5) For BS1323: Use the Figure 508 to set the oil pressure.

(6) Shut down engine (Ref. Para. 7.), and adjust oil pressure regulating valve (Ref. Fig. 509):

NOTE: Do adjustment only after replacement of oil filter.

(a) Remove nuts (1), washers (2), cover (3) using and packing (5). Discard packing.

(b) Rotate seat (6) CW to increase, or CCW to decrease oil pressure.

(c) Lubricate and install packing (5) on cover (3).

(d) Align lock (4) to engage slot in seat (6) and install cover (3), washers (2), nuts (1). Tighten nuts 36 to 40 lb.in.

12. Engine Performance Check

A. General

Engine Performance Checking Chart allows engine performance to be checked on the ground over a wide range of ambient temperatures without engine overtorque or overtemperature. Engine performance checks should be done after aircraft delivery, installation of replacement engine, before and after Hot Section Inspection, and at regular intervals thereafter.

In addition to any in-flight condition monitoring checks that may be performed, periodic ground performance checks should be implemented, and changes in engine performance noted.

All forms of engine deterioration are accompanied by an increase in T5 and Wf at a given power. Compressor deterioration is, in most cases, due to dirt deposits and causes an increase in Ng at a given power setting. This form of deterioration can be remedied by field cleaning (Ref. POWER PLANT - CLEANING, Internal Washing).

NOTE: 1. Deviations from the predicted values in the Aircraft Maintenance Manual are not cause by themselves for engine rejection. Do troubleshooting (Ref. 72-00-00, FAULT ISOLATION) and additional testing (Ref. Aircraft Maintenance Manual), as required.

NOTE: 2. A single performance parameter outside the expected value usually means a fault in the indicating system. An engine fault is usually indicated by two or more performance parameters outside the expected values.

B. Procedure

(1) Determine engine performance parameters:

(a) Obtain ambient air temperature (Tam).

(b) Obtain field barometric pressure (not corrected to sea level).

(c) From relevant engine performance checking chart, obtain T5, Ng, Wf and target torque for ambient conditions. Record values.

(2) Check engine performance:

(a) Do not use P3 air or power extraction from operation of aircraft auxiliaries.

(b) Start engine (Ref. Paras. 3. and 6.). Run at ground-idle for five minutes to stabilize operating temperatures.

(c) Set propeller control lever to 91% Np and power control lever to target torque setting previously determined from performance checking chart. Allow engine instrumentation to stabilize.

(d) Record and compare observed Wf, Ng and T5 with values previously recorded.

(e) Value of Wf, T5 and Ng should not deviate from limits on chart.

NOTE: Limits on the chart cover normal engine deterioration, which should not necessarily be cause for engine rejection, until all possible troubleshooting has been completed (Ref. 72-00-00, FAULT ISOLATION).

(f) Maintain record to monitor engine performance.

13. Torquemeter Function Check

A. Procedure

(1) Determine and record pressure altitude.

NOTE: Pressure altitude (PA) can be obtained by contacting local flight service for uncorrected pressure reading, or by setting altimeter to 29.92 Hg. Position of needle indicates pressure altitude in feet. Do not use sea level pressure.

(2) Determine and record indicated outside air temperature (Tam) in degrees Celsius.

NOTE: To make sure test is accurate, determine and record Tam immediately before engine start.

(3) Using flight manual chart, determine target torque at which to set engine using PA and Tam recorded at step (1) and (2) respectively. Record values.

(4) Start engine (Ref. Paras. 3. and 6.) and run for two minutes. Do not exceed engine operating limits.

(5) Place generator, bleed air and air conditioning OFF.

(6) Check that propeller control lever is in high pitch.

(7) Check that oil temperature is above 60°C.

(8) Set Ng 500 rpm above ground-idle (Ref. Engine Operating Limits), and record Ng, Np, and Tq.

(9) Accelerate engine slowly and uniformly at a rate of 2000 rpm per second until target Tq recorded at step (3) is reached, and let engine stabilize for two minutes.

(10) Reduce Ng slowly and uniformly at a rate of 2000 rpm per second until Ng set at step (8) is reached. Record Ng, Np, and Tq.

(11) Repeat steps (8) thru (10).

NOTE: 1. The engine torque indication system functions correctly when the difference between Tq recorded in steps , (8) , (10) , and (11) is equal to or less than 150 lb.ft.

NOTE: 2. If the difference between the torque settings is more than 150 lb.ft., check aircraft indicating system. If the aircraft system is okay, the power section should be removed and sent to an approved overhaul facility and the torquemeter piston, cylinder and servo valve inspected for wear, scoring, or fretting, etc.

(12) Shut down engine (Ref. Para.7.).

14. Acceleration Check

A. Procedure

(1) Start engine (Ref. Paras. 3. and 6.), and operate at ground-idle for five minutes.

(2) Set Power Control Lever to Flight-Idle and hold to let engine stabilize, then move PCL rapidly, less than one second, to Take-Off.

(3) Engine must accelerate/respond without hesitation or surge. If requirements are not met, check P3 filter and forward air tube for contamination/blockage. Clean as necessary.

(4) Shut down engine (Ref. Para 7.).

15. Torque Limiter and Solenoid Valve Function Check(BS1198)(Ref. Fig. 510)

CAUTION: DO NOT EXCEED ENGINE OPERATING LIMITS OF SPEED AND TEMPERATURE.

CAUTION: DO NOT EXCEED TORQUE SETTING OR MAINTAIN MAX TORQUE CONDITION FOR MORE THAN FIVE SECONDS.

A. Procedure

(1) Make sure that the flaps lever is set to the "UP" position (Ref. Aircraft Maintenance Manual).

(2) Start engine.

(3) With propeller control lever set at Max rpm, advance power control lever to takeoff power.

(4) Slowly retard propeller control lever until torque ceases to increase. Record torque. Torque should be between 107 to 111%.

(5) If the torque does not fall within the limits specified in step (4), shut down engine (Ref. Para. 7.) and adjust torque limiter (Ref. Fig. 510):

(a) Remove lockwire and loosen nut from torque limiter adjustment screw.

(b) Use an Allen key to turn adjusting screw clockwise to increase torque and counterclockwise to decrease torque. One quarter turn of screw changes torque approximately 3.3%.

NOTE: This adjustment is extremely sensitive; several attempts may be required to achieve required torque setting.

(c) Torque locknut 20 to 25 lb.in. and lockwire, make sure that adjusting screw position is unchanged.

(d) Repeat torque limiter check as in steps (3) and (4).

(6) Decrease the engine power until the torque reaches 80%.

(7) Move the flaps lever to the "850 SHP" position (Ref. Aircraft Maintenance Manual).

NOTE: This will de-energize (Close) the solenoid valve.

(8) Set the propeller control lever to Max rpm and slowly advance the power control lever until the torque increases to 120%.

(9) Move the flaps lever to the "UP" position (Ref. Aircraft Maintenance Manual).

(10) Check that the torque decreases below 111%.

(11) Shut down engine (Ref. Para. 7.).

16. Torque Limiter Function Check (BS1323)

CAUTION: TORQUE LIMITER FUNCTION CHECK IS DONE ABOVE NORMAL ENGINE OPERATING LIMITS AND IF NOT CORRECTLY DONE, THERE IS RISK OF ENGINE OVERTORQUE. THIS CHECK CAN GIVE INCORRECT TORQUE INDICATION (LOW INDICATION), DO NOT DEPEND ONLY ON TORQUE INDICATION BUT RATHER ON NG SPEED. THE NG MUST NOT BE MORE THAN 97%.

CAUTION: DO NOT EXCEED TORQUE SETTING OR MAINTAIN MAXIMUM TORQUE CONDITION FOR MORE THAN 15 SECONDS, WHEN THE BELOW PARAMETERS ARE COMPLIED WITH.

A. Procedure

(1) Make sure oil pressure is between 122 and 125 psi (as close as possible to 125 psi) and MOT not above 98 °C. If oil pressure is not within the limits, adjust the oil pressure as necessary (Ref. Para. 11.).

(2) Set the flaps lever to "UP" position (Ref. Aircraft Maintenance Manual).

(3) Start the engine (Ref. Paras. 3. and 6.).

(4) Advance the power control lever until the torque increases to 103% for 10 seconds.

(5) Slowly continue to advance the power lever and monitor the Ng and torque increase. Ng and torque must increase together. If there is increase in Ng only or the Ng increases above 97%, stop the test and contact P&WC for assistance.

(6) When the increase in torque stops (with Ng also stops to increase), record the torque. Torque must be 108%.

(7) If the torque is not in the limits given in Step (6), shutdown the engine (Ref. Para. 7.) and adjust the torque limiter (Ref. Fig. 510) as follows:

WARNING: PUT ON EYE PROTECTION WHEN YOU CUT THE SAFETY WIRE. PIECES CAN BREAK AND CAUSE INJURY.

(a) Remove the lockwire and loosen the nut from the torque limiter adjustment screw.

(b) Turn the adjustment screw with an allen key clockwise to increase the torque and counterclockwise to decrease the torque. One-quarter turn of screw changes the torque approximately to 3.3%.

NOTE: This adjustment is very sensitive, turn the adjustment screw until you get necessary torque setting.

WARNING: PUT ON EYE PROTECTION WHEN YOU CUT THE SAFETY WIRE. PIECES CAN BREAK AND CAUSE INJURY.

(c) Torque the locknut 20 to 25 lbf.in. and safety it with a lockwire. Make sure that there is no change in the adjustment screw position.

(d) Do the torque limiter check again (Ref. Steps (3) thru (6)).

(8) Shutdown the engine (Ref. Para. 7.).

17. Torque Limiter Function Check (BS1354)

CAUTION: TORQUE LIMITER FUNCTION CHECK IS DONE ABOVE NORMAL ENGINE OPERATING LIMITS AND IF NOT CORRECTLY DONE, THERE IS RISK OF ENGINE OVERTORQUE. THIS CHECK CAN GIVE INCORRECT TORQUE INDICATION (LOW INDICATION), DO NOT DEPEND ONLY ON TORQUE INDICATION BUT RATHER ON NG SPEED. THE NG MUST NOT BE MORE THAN 97%.

CAUTION: DO NOT EXCEED TORQUE SETTING OR MAINTAIN MAXIMUM TORQUE CONDITION FOR MORE THAN 15 SECONDS, WHEN THE BELOW PARAMETERS ARE COMPLIED WITH.

A. Procedure

(1) Set the flaps lever to "UP" position (Ref. Aircraft Maintenance Manual).

(2) Start the engine (Ref. Paras. 3. and 6.).

(3) Advance the power control lever until the torque increases to 103% for 10 seconds.

(4) Slowly continue to advance the power lever and monitor the Ng and torque increase. Ng and torque must increase together. If there is increase in Ng only or the Ng increases above 97%, stop the test and contact P&WC for assistance.

(5) When the increase in torque stops (with Ng also stops to increase), record the torque. Torque should be between 109 to 110%.

(6) If the torque is not in the limits given in Step (5), shutdown the engine (Ref. Para. 7.) and adjust the torque limiter (Ref. Fig. 510) as follows:

(6) If the torque is not in the limits given in Step (5), shutdown the engine (Ref. Para. 7.) and adjust the torque limiter (Ref. Fig. 510) as follows:

WARNING: PUT ON EYE PROTECTION WHEN YOU CUT THE SAFETY WIRE. PIECES CAN BREAK AND CAUSE INJURY.

(a) Remove the lockwire and loosen the nut from the torque limiter adjustment screw.

(b) Turn the adjustment screw with an allen key clockwise to increase the torque and counterclockwise to decrease the torque. One-quarter turn of screw changes the torque approximately to 3.3%.

NOTE: This adjustment is very sensitive, turn the adjustment screw until you get necessary torque setting.

WARNING: PUT ON EYE PROTECTION WHEN YOU CUT THE SAFETY WIRE. PIECES CAN BREAK AND CAUSE INJURY.

(c) Torque the locknut 20 to 25 lbf.in. and safety it with a lockwire. Make sure that there is no change in the adjustiment screw position.

(d) Do the torque limiter check again (Ref. Steps (2) thru (5)).

(7) Shutdown the engine (Ref. Para. 7.).

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504 PT6A-66D (BS1354) Engine Operating Limits

71-00-00
POWER PLANT - CLEANING

1. General

A. Engine cleaning procedures include compressor desalination wash, compressor performance recovery wash, compressor turbine desalination wash, fuel nozzle cleaning, and engine external wash.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC04-001	Grease, Synthetic
PWC05-005	Emulsifier
PWC05-053	Plastic Sheet
PWC05-073	Water, Demineralized
PWC06-036	Compound, Anti-seize
PWC11-001	Cleaner, Alkaline
PWC11-001A	Cleaner, Alkaline
PWC11-001B	Cleaner, Alkaline
PWC11-001C	Cleaner, Alkaline
PWC11-001F	Cleaner, Alkaline
PWC11-001G	Cleaner, Alkaline
PWC11-001H	Cleaner, Alkaline
PWC11-001I	Cleaner, Alkaline

PWC11-001J	Cleaner, Alkaline
PWC11-003	Cleaner, Detergent
PWC11-003B	Cleaner, Detergent
PWC11-003C	Cleaner, Detergent
PWC11-003D	Cleaner, Detergent
PWC11-003E	Cleaner, Detergent
PWC11-014	Isopropyl Alcohol
PWC15-011	Corrosion-Inhibiting Solution
PWC15-015	Corrosion-Inhibiting Solution

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC32271	Tube, Spray
PWC32677-100	Washcart, Compressor
PWC32677-300	Washcart, Compressor/fuel nozzles

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Shut off Valve	Local Purchase
Pressure Gauge	
Steel Tank	
Steel Tubing	
Nitrogen or Compressed Air	
Pressure Gauge Adapter	
Test Rig Adapter	
Shut off Valve	

5. Engine Washing

A. General

Depending on the operating environment and the types of deposits in the engine gas path, the following washes can be used to remove salt or dirt and other baked-on deposits that accumulate over a period of time and cause engine performance deterioration and as well as corrosion or sulphidation (Ref. 72-00-00, ENGINE - INSPECTION).

B. Types of Internal Wash

NOTE: Internal Engine washes must be done during motoring. They are done at 10 to 25% Ng and water or cleaning mixture, depending on ambient temperature (Ref. Table. 702), is injected into engine intake at a rate of 2 to 3 gal/minute (7.6 to 11.3 l/minute). Washing during a motoring cycle makes sure emulsion fluid remains in liquid form.

Compressor Desalination Wash:
This wash is used to remove salt deposits. Light dirt deposits may also be removed by this wash. The wash fluid is drinking quality water, provided minimum standards are met (Ref. Para. E.). Use either an installed compressor wash ring or a hand held wash wand to inject water into the engine intake. Ref. Para. 6. A.for the complete procedure.

Compressor Turbine Desalination Wash:
This wash is used to remove salt deposits from the compressor turbine blades and stator. The wash fluid is drinking quality water, provided minimum standards are met (Ref. Para. E.). Water is injected through a wash tube installed into the gas generator igniter boss. Ref. Para. 6. C. for the complete procedure.

NOTE: When desalination washes are done in conjunction with each other it is a must that compressor wash be done first.

Compressor Performance Recovery Wash:
This wash is used to remove more stubborn deposits which cannot be removed during normal desalination washes. The wash fluid includes approved chemical additives (Ref. Table. 702). This wash must only be done when engine performance loss is noticeable or trend monitoring dictates. Ref. Para. 6. B. for the complete procedure.

External Engine Wash:
This wash is used as an effective method of tracing oil leaks and as well as removing salt and other environmental contaminants from the engine external surfaces. The wash fluid is drinking quality water, provided minimum standards are met (Ref. Para. E.). Ref. Para. 7. for the complete procedure.

C. Wash Schedule Recommendations

A regular wash is recommended for the engines that are operated in salt-laden or harsh environment (Ref. Table 701).

Environmental conditions change depending on engine operation and geographical location. Air pollution and salt-water exposure are examples of adverse environment. Chemical reactions with fuel and heat can cause severe corrosion, which can be significantly reduced through regular gas path washing.

Table 701 Wash Schedule Recommendations

D. Preparation of Solutions

Five liters (1.33 US gal.) of cleaning solution, and ten liters (2.66 US gal.) of rinse solution is required. The solution formulation is dependent upon prevailing ambient temperature and must be prepared in accordance with Table 702, for cleaning and Table 703 for rinse.

Table 702 Cleaning Solution Formulation

Table 703 Rinse Solution Formulation

Table 704 Mixture Formulation Chart

E. Equipment Required

(1) Washcart (PWC32677-100) or (PWC32677-300), or optional locally manufactured wash rig comprising the following (Ref. Fig. 701):

(a) Two stainless steel tanks.

(b) Mechanical agitator, or recirculation pump with relief valve, for mixture agitation.

(c) Two flow control valves for use with recirculation pump.

(d) Two air delivery shut-off valves.

(e) Two fluid delivery shut-off valves.

(f) One pressure gage located in air delivery line

(g) Suitable tubing to interconnect components.

NOTE: Valve and tubing connections are to be 5/16 inch ID minimum.

(2) Compressed air or nitrogen, regulated to 30 to 50 psig (207 to 345 kPa).

(3) A source of demineralized water (PWC05-073) to the following specifications.

(a) Appearance: free of suspended solids.

(b) Total solids: 10 ppm (mg/l) Max.

(c) Specific conductance: 11 micro-mho/cm Max.

(d) Silica content: 3 ppm (mg/l) Max.

(e) pH value: 5.0 to 7.5 inclusive.

(f) Intake filter not coarser than 10 microns.

(4) Drinking quality water criteria are as follows:

(a) Appearance: free of visible extraneous impurities.

(b) Total solids: 175 ppm (mg/l) Max.

(c) pH value: 6.0 to 8.0 inclusive.

(d) Chlorides: 15 ppm (mg/l) Max.

(e) Sulfates: 10 ppm (mg/l) Max.

NOTE: Drinking water quality varies according to location and season; these specifications are provided as a guide only.

6. Engine Motoring Washes

A. Compressor Desalination Wash

NOTE: P&WC recommends to do a compressor turbine desalination wash after the compressor desalination wash for salt-laden or harsh environment, since the compressor desalination wash will transfer salt deposits into the turbine (Ref. SIL No. PT6A - 206).

(1) Depending on ambient temperature, fill wash tanks with appropriate solution (Ref. Table 703).

(2) Connect compressed air regulated to 30 to 50 psig (207 to 345 kPa) to wash tanks.

(3) If compressor wash rig is not available, drinking water boosted by a centrifugal pump may be used.

(4) Remove or open engine cowlings, as applicable, to expose engine inlet screen. (Ref. Aircraft Maintenance Manual).

(5) Connect spray ring to pressurized tanks or to drinking water supply, as applicable.

NOTE: To prevent the precipitation of deposits due to the use of "hard" water, allow engine to cool below 65°C (150°F). Minimum duration for cooling is 40 minutes since last operation.

(6) Switch ignition and aircraft bleed air OFF.

(7) Check that propeller is not tethered and is free to turn.

CAUTION: IF YOU DO NOT REMOVE THE EXHAUST DUCT DRAIN, IT CAN RESULT IN COLLECTION OF WASH LIQUID AND CAUSE SEVERE RGB REAR HOUSING CORROSION WHICH CAN LEAD TO LOW OIL PRESSURE CONDITION DUE TO OIL LEAK FROM RGB HOUSING (REF.SIL NO. PT6A - 206).

(8) Pre-SB14293: Place the container under the exhaust duct drain port to collect fluid, and remove the cap assembly (2, Fig. 702), nipple (3) and gasket (4). Discard the gasket.

CAUTION: IF YOU DO NOT REMOVE THE EXHAUST DUCT DRAIN, IT CAN RESULT IN COLLECTION OF WASH LIQUID AND CAUSE SEVERE RGB REAR HOUSING CORROSION WHICH CAN LEAD TO LOW OIL PRESSURE CONDITION DUE TO OIL LEAK FROM RGB HOUSING (REF.SIL NO. PT6A - 206).

(9) Post-SB14293: Place the container under the exhaust duct drain port to collect fluid, and remove the drain plug (1) and the gasket (4). Discard the gasket.

CAUTION: DO NOT MOTOR FOR MORE THAN 30 SECONDS. MONITOR STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(10) Motor engine (starter only).

CAUTION: DO NOT SPRAY WASH MIXTURE OR WATER INTO THE ENGINE INTAKE AT A RATE MORE THAN THREE GALLON/MINUTE (11.3 LITER/MINUTE) TO PREVENT FCU CONTAMINATION.

(11) When Ng reaches 5% minimum, inject wash mixture or water into the engine at a rate of two to three gallon/minute (7.6 - 11.3 liter/minute).

(12) Stop motoring after 30 seconds.

(13) Shut off cleaning solution supply as soon as Ng falls to 5%.

CAUTION: DO NOT MOTOR FOR MORE THAN 30 SECONDS; OBSERVE STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(14) Motor engine if water/alcohol solution was used.

(15) Remove cleaning solution equipment and install cap on wash ring, if applicable. Tighten cap 110 to 120 lb.in. and lockwire.

(16) Make sure that wash fluid came out of the exhaust duct drain. Remove any obstruction from the drain fitting.

(17) Start the engine (Ref. 71-00-00, ADJUSTMENT/TEST), and run the engine at ground idle power, with the exhaust drain removed and until water stops draining from the exhaust drain (engine is completely dry), and check for air leaks. Do an engine "Acceleration Check".

(18) Shut down engine (Ref. ADJUSTMENT/TEST, Engine Shutdown).

(19) Apply a thin layer of anti-seize compound (PWC06-036) to the threads of the drain plug (1) (Post-SB14293) or nipple (3) (Pre-SB14293).

(20) Pre-SB14293: Install the new gasket (4) on the drain nipple (3), and install at the bottom of the exhaust duct. Torque nipple 65 to 75 lbf.in.

(21) Pre-SB14293: Install the cap assembly (2) and the safetywire.

(22) Post-SB14293: Install the new gasket (4) on the drain plug (1), and install in the drain boss at bottom of the exhaust duct. Torque the plug 65 to 75 lbf.in. and install the safetywire.

(23) Install or close cowlings (Ref. Aircraft Maintenance Manual).

B. Compressor Performance Recovery Wash

NOTE: P&WC recommends to do a compressor turbine desalination wash after the compressor performance recovery wash for the salt laden or harsh environment,since the compressor performance recovery will transfer the salt deposits into the turbine (Ref. SIL No. PT6A - 206).

(1) Depending on ambient temperature, fill wash tanks with appropriate cleaning solution (Ref. Table 702) and rinse solution (Ref. Table 703) in separate tanks.

(2) Connect compressed air supply, 30 to 50 psig (207 to 345 kPa) to wash tanks.

(3) Remove or open engine cowlings, as applicable, to expose engine inlet screen.

(4) Connect spray ring to pressure tanks.

NOTE: To prevent precipitation of deposits through inadvertent use of "hard water", allow engine to cool below 65°C (150°F). Minimum duration for engine cooling is 40 minutes since last operation.

(5) Switch ignition and aircraft bleed air OFF.

CAUTION: IF YOU DO NOT REMOVE THE EXHAUST DUCT DRAIN, IT CAN RESULT IN COLLECTION OF WASH LIQUID AND CAUSE SEVERE RGB REAR HOUSING CORROSION WHICH CAN LEAD TO LOW OIL PRESSURE CONDITION DUE TO OIL LEAK FROM RGB HOUSING (REF. SIL NO. PT6A - 206).

(6) Pre-SB14293: Place the container under the exhaust duct drain port to collect fluid, and remove the cap assembly (2, Fig. 702), nipple (3) and gasket (4). Discard the gasket.

CAUTION: IF YOU DO NOT REMOVE THE EXHAUST DUCT DRAIN, IT CAN RESULT IN COLLECTION OF WASH LIQUID AND CAUSE SEVERE RGB REAR HOUSING CORROSION WHICH CAN LEAD TO LOW OIL PRESSURE CONDITION DUE TO OIL LEAK FROM RGB HOUSING (REF. SIL NO. PT6A - 206).

(7) Post-SB14293: Place the container under the exhaust duct drain port to collect fluid, and remove the drain plug (1) and the gasket (4). Discard the gasket.

(8) Check that propeller is not tethered and is free to turn.

CAUTION: DO NOT MOTOR FOR MORE THAN 30 SECONDS. MONITOR STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(9) Motor engine (starter only).

CAUTION: AGITATE SOLUTION THOROUGHLY PRIOR TO INGESTION AND DURING WASH CYCLE, THUS PREVENTING SEPARATION OF KEROSENE. PREFERABLY, USE OF WITCONATE AS EMULSIFYING AGENT, OR ALTERNATIVELY, USE OF MECHANICAL AGITATOR OR RECIRCULATION PUMP WITH RELIEF VALVE (REF. FIG. 701) IS STRONGLY RECOMMENDED.

CAUTION: DO NOT SPRAY WASH MIXTURE OR WATER INTO THE ENGINE INTAKE AT A RATE MORE THAN THREE GALLON/MINUTE (11.3 LITER/MINUTE) TO PREVENT FCU CONTAMINATION.

(10) When Ng reaches 5%, inject cleaning solution into the engine at a rate of two to three gallon/minute (7.6 - 11.3 liter/minute).

(11) Stop motoring after 30 seconds.

(12) Shut off cleaning solution supply as soon as Ng falls to 5%.

(13) Allow cleaning solution to soak for 15 to 30 minutes.

CAUTION: DO NOT SPRAY RINSE SOLUTION INTO THE ENGINE INTAKE AT A RATE MORE THAN THREE GALLON/MINUTE (11.3 LITER/MINUTE) TO PREVENT FCU CONTAMINATION.

(14) Motor the engine. When Ng reaches 5%, inject rinse solution into the engine (half quantity only) at a rate of two to three gallon/minute (7.6 - 11.3 liter/minute).

(15) Repeat step (14) observing starter limitations.

(16) Motor engine if water/alcohol was used. Remove cleaning solution equipment and install cap on wash ring, if applicable. Tighten cap 110 to 120 lb.in. and lockwire.

(17) Make sure that wash fluid came out of the exhaust duct drain. Remove any obstruction from the drain fitting.

(18) Start engine (Ref. ADJUSTMENT/TEST). Operate the engine at 80% Ng for one minute or more to fully dry the engine. Air leakage not permitted. Do an engine acceleration check (Ref. ADJUSTMENT/TEST).

(19) Shut down engine (Ref. ADJUSTMENT/TEST).

(20) Apply a thin coat of anti-seize compound (PWC06-036) to the threads of the drain plug (1)(Post-SB14293) or nipple (3)(Pre-SB14293).

(21) Pre-SB14293: Install the new gasket (4) on the drain nipple (3), and install at the bottom of the exhaust duct. Torque nipple 65 to 75 lbf.in.

(22) Pre-SB14293: Install the cap assembly (2) and the safetywire.

(23) Post-SB14293: Install the new gasket (4) on the drain plug (1), and install in the drain boss at bottom of the exhaust duct. Torque the plug 65 to 75 lbf.in. and install the safetywire.

(24) Install or close cowlings (Ref. Aircraft Maintenance Manual).

C. Compressor Turbine Desalination Wash

(1) Depending upon the ambient temperature, fill the wash tank with the appropriate mixture (Ref. Table 703). Alternatively, at temperatures above 2°C (36°F), use a suitable hose connected to a drinking water tap.

(2) Connect compressed air or nitrogen supply, regulated to 30 to 50 psig (207 to 345 kPa) to wash tanks. If drinking water is used, connect through a centrifugal pump if water pressure is below 30 psig (207 kPa).

WARNING: RESIDUAL VOLTAGE IN IGNITION EXCITER MAY BE DANGEROUSLY HIGH. MAKE SURE IGNITION IS SWITCHED OFF. ALWAYS DISCONNECT COUPLING NUTS AT IGNITION EXCITER FIRST. ALWAYS USE INSULATED TOOLS TO REMOVE COUPLING NUTS. DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

(3) Remove the most accessible igniter (1, Fig. 703) and gasket (2) (Ref. 74-20-00, CABLES & SPARK IGNITERS - MAINTENANCE PRACTICES).

(4) Install spray tube (PWC32271) (3). Make sure that RGB inscribed on tang is pointing towards the reduction gearbox. Tighten finger tight.

CAUTION: SUPPORT DELIVERY HOSE TO PREVENT DAMAGE TO SPRAY TUBE.

(5) Connect pressurized tank or drinking water supply to spray tube (PWC32271) (3).

NOTE: Engine temperature must be below 65°C (150°F). Inadvertent use of hard water will result in the precipitation of deposits. The minimum cooling off period is 40 minutes since last engine operation.

(6) Switch aircraft bleed air and ignition OFF.

CAUTION: IF YOU DO NOT REMOVE THE EXHAUST DUCT DRAIN, IT CAN RESULT IN COLLECTION OF WASH LIQUID AND CAUSE SEVERE RGB REAR HOUSING CORROSION WHICH CAN LEAD TO LOW OIL PRESSURE CONDITION DUE TO OIL LEAK FROM RGB HOUSING (REF. SIL NO. PT6A - 206).

(7) Pre-SB14293: Place the container under the exhaust duct drain port to collect fluid, and remove the cap assembly (2, Fig. 702), nipple (3) and gasket (4). Discard the gasket.

CAUTION: IF YOU DO NOT REMOVE THE EXHAUST DUCT DRAIN, IT CAN RESULT IN COLLECTION OF WASH LIQUID AND CAUSE SEVERE RGB REAR HOUSING CORROSION WHICH CAN LEAD TO LOW OIL PRESSURE CONDITION DUE TO OIL LEAK FROM RGB HOUSING (REF. SIL NO. PT6A - 206).

(8) Post-SB14293: Place the container under the exhaust duct drain port to collect fluid, and remove the drain plug (1) and the gasket (4). Discard the gasket.

CAUTION: DO NOT MOTOR FOR MORE THAN 30 SECONDS. MONITOR STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(9) Do a dry motoring run.

CAUTION: WHEN USING ISOPROPYL ALCOHOL SOLUTION, DO ADDITIONAL DRY MOTORING RUN TO PURGE ENGINE. OBSERVE STARTER LIMITS.

(10) When Ng reaches 5%, inject water or isopropyl alcohol as applicable, into engine.

(11) Stop motoring run after 30 seconds.

(12) Shut off water or isopropyl alcohol as Ng decreases through 5%.

CAUTION: DO NOT MOTOR FOR MORE THAN 30 SECONDS. OBSERVE STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(13) Repeat washing cycles as necessary to remove contaminants from turbines.

(14) Disconnect pressurized tanks or drinking water supply from wash tube and remove spray tube (3, PWC32271).

(15) Install igniter (1, Fig. 703) and new gasket (2) (Ref. 74-20-00, CABLES & SPARK IGNITERS - MAINTENANCE PRACTICES).

CAUTION: DO NOT MOTOR FOR MORE THAN 30 SECONDS. OBSERVE STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(16) Do an additional 30 second dry motoring run if water/isopropyl alcohol has been used.

(17) Make sure that wash fluid came out of the exhaust duct drain. Remove any obstruction from the drain fitting.

(18) Start engine (Ref. ADJUSTMENT/TEST). Operate the engine at 80% Ng for one minute or more to fully dry the engine.

(19) Shut down engine (Ref. ADJUSTMENT/TEST).

(20) Apply a thin coat of anti-seize compound (PWC06-036) to the threads of the drain plug (1) (Post-SB14293) or nipple (3) (Pre-SB14293).

(21) Pre-SB14293: Install the new gasket (4) on the drain nipple (3), and install at the bottom of the exhaust duct. Torque nipple 65 to 75 lbf.in.

(22) Pre-SB14293: Install the cap assembly (2) and the safetywire.

(23) Post-SB14293: Install the new gasket (4) on the drain plug (1), and install in the drain boss at bottom of the exhaust duct. Torque the plug 65 to 75 lbf.in. and install the safetywire.

7. Engine External Wash

A. General

CAUTION: DO NOT USE GASOLINE OR SIMILAR TOXIC SUBSTANCES FOR EXTERNAL ENGINE CLEANING.

CAUTION: DO NOT ATTEMPT TO WASH AN ENGINE THAT IS STILL HOT OR RUNNING. LET ENGINE COOL FOR A MINIMUM OF 40 MINUTES AFTER SHUTDOWN.

Fresh water external washing is very effective in tracing possible origin of external oil leakage, and is recommended when the engine is contaminated with salt or corrosive chemicals such as those found in industrial smog. Demineralized water is not necessary. The engine should never be left in a contaminated condition overnight, or longer.

For engine operations in corrosive environments it is recommended to perform an external engine wash per the schedule in Table. 701.

NOTE: When you operate the engine in salt-laden or harsh environment, apply corrosion inhibitor on the external components for more protection (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

If water wash is ineffective, a petroleum solvent (varsol)/water emulsion may be used to remove oil and grime. Thoroughly rinse with water to remove all traces of cleaning fluid. Completely dry the engine using clean, dry compressed air. Lubricate reversing linkage rod end bearings with light grease (PWC04-001).

8. Inhibition of Engine Corrosion

A. Optional On-aircraft Internal Application of Engine Corrosion-Inhibiting Solution

(1) Procedure relocated to chapter 72-00-00, Inspection.

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ENGINE - DESCRIPTION AND OPERATION

1. Description and Operation

The PT6A Series power plant is a lightweight free turbine engine. The engine utilizes two independent turbine sections: one driving the compressor in the gas generator section and the second (two-stage power turbine) driving the propeller shaft through a reduction gearbox. The engine is self-sufficient since its gas generator driven oil system provides lubrication for all areas of the engine pressure for the torquemeter and power for propeller pitch control.

Refer to Fig. 1 and 2 for the main features of a typical engine, Fig. 3 for cross-sections and Fig. 4 for stations, flanges and bearings.

Inlet air enters the engine through an annular plenum chamber, formed by the compressor inlet case where it is directed forward to the compressor. The compressor consists of four axial stages combined with a single centrifugal stage, assembled as an integral unit. The engines are also equipped with a water wash ring at the compressor air inlet case.

A row of stator vanes, located between each stage of compression, diffuses the air, raises its static pressure and directs it to the next stage of compression. The compressed air passes through diffuser tubes which turn the air through ninety degrees in direction and convert velocity to static pressure. The diffused air then passes through straightening vanes to the annulus surrounding the combustion chamber liner assembly.

The combustion chamber liner consists of two annular weldments or wrappers bolted together at the front dome-shaped end, the outer wrapper incorporates an integral large exit duct. The liner assembly has perforations of various sizes that allow entry of compressor delivery air. The flow of air changes direction 180 degrees as it enters and mixes with fuel. The fuel/air mixture is ignited and the resultant expanding gases are directed to the turbines. The location of the liner eliminates the need for a long shaft between the compressor and the compressor turbine, thus reducing the overall length and weight of the engine.

Fuel is injected into the combustion chamber liner through 14 simplex nozzles arranged for ease of starting, and supplied by a dual manifold consisting of primary and secondary transfer tubes and adapters. The fuel/air mixture is ignited by spark igniters which protrude into the liner. The resultant gases expand from the liner, reverse direction in the exit duct zone and pass through the compressor turbine stator vanes to the single-stage compressor turbine. The stator vanes ensure that the expanding gases impinge on the turbine blades at the correct angle, with minimum loss of energy. The still expanding gases are then directed forward to drive the power turbine section.

The two-stage power turbine, consisting of the first-stage stator and turbine and the interstage stator and turbine, drives the propeller shaft via a reduction gearbox.

The compressor and power turbines are located in the approximate center of the engine with their respective shafts extending in opposite directions. This feature provides for simplified installation and inspection procedures. The exhaust gas from the power turbine is collected and ducted in the bifurcated exhaust duct assembly and directed to the atmosphere via twin opposed exhaust stubs.

Interturbine temperature (T5) is monitored by an integral bus-bar, probe and harness assembly installed between the compressor and power turbines with the probes projecting into the gas path. A terminal block mounted on the gas generator case at flange C, provides a connection point to cockpit instrumentation.

All engine-driven accessories, with the exception of the propeller governor, overspeed governor and Nf tachometer-generator, are mounted on the accessory gearbox at the rear of the engine. These components are driven by the compressor by means of a coupling shaft which extends the drive through a tube at the center of the oil tank. The rear location of accessories provides for a clean engine and simplifies maintenance procedures.

The propeller reversing installation normally comprises a single-acting hydraulic propeller that is controlled by a propeller governor, which combines the functions of a normal constant speed unit (CSU), a reversing valve and a power turbine (Nf) governor. Some installations may use double-acting propellers. An interconnect rod between the propeller governor Beta control valve and the governor reset arm enables the FCU and the propeller governor to modify engine power to maintain power turbine speed at a speed slightly less than the selected rpm when operating in the Beta control range.

2. Engine Data

For engine specifications, refer to Table1; for leading particulars, refer to Table 2.

For the front and rear accessory drives refer to Fig. 5, and Table 3 .

For engine fuel and lubrication system specifications and leading particulars refer to Table 4.

Table 1 PT6A-66D Engine Specifications (Sea Level Static Output - Standard Day)

Table 2 PT6A-66D Engine Leading Particulars

Table 3 Front and Rear Accessory Drives

Table 4 Fuel and Lubrication System Specifications

3. Transport Canada Approved Service Bulletins

The following Service Bulletins contain data recommended by Pratt & Whitney Canada and approved by the Canadian Minister of Transport.

Service Bulletin SB14001, Listing of Synthetic Oils.

Service Bulletin SB14002, Rotor Component Service Life.

Service Bulletin SB14603, Operating Time Between Overhauls.

Service Bulletin SB14004 , Listing of Engine Fuel and Additives.

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3 Front and Rear Accessory Drives

4 Fuel and Lubrication System Specifications

72-00-00
ENGINE, TURBOPROP - FAULT ISOLATION

1. General

A. For details on recommended procedures for engine system fault isolation, reference should be made to the Fault Isolation Charts, Figures 101 through 105, and Table 101.

B. The charts comprise a series of diagnostic tests and rectification sequences which will assist an operator in discovering, isolating and correcting various faults that may arise in the basic engine or any of its related systems during service.

C. Engine faults can be either obvious or hidden. If hidden faults are not detected, serious and considerable damage may occur to the engine. Therefore, it is essential to have a thorough knowledge of correct turbine gas temperature and other important details of engine operation. Before attempting to locate a fault or difficulty, or to work on an engine which has been malfunctioning during flight, consult flight log and any other available data that could help in diagnosing the fault.

D. To correctly isolate a fault, check all previous information of engine faults, if any, and work that has been performed on the engine. Check each probable source of fault by use of relevant diagnostic test sequences until defect has been isolated. Systematic checking, essential for thorough fault isolation, will save time and extend engine life.

2. Consumable Materials

Not Applicable

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Engine Condition Trend Monitoring (ECTM) System

A. General

Gas turbine/turboprop engine maintenance practices frequently include in-flight engine performance monitoring as a means of detecting mechanical deterioration in engine gas paths. A simple system, requiring almost no arithmetic calculation, has been devised for the PT6A engines to aid in early planning of indicated rectifications, and thus reduce the potential costs of primary and secondary damage resulting from fully developed failures, or from the risks of in-flight shutdowns, and flight cancellations.

New engines operate within a tolerance band, either above or below charted parameter values, and tend to deviate more from these values with time and deterioration of gas path components.

Abrupt changes, or gradual increased rate of change, of the normal deviations from charted parameter values are critical indicators of gas path component conditions. As such, changes are detectable before any drastic failure occurs.

The monitoring system should be introduced when engines are new or newly overhauled. This enables establishment of a performance base line before any deterioration takes place in the engine. For procedure refer to P&WC Publication SIL No. GEN-055.

6. Fault Isolation

To enable systematic fault isolation, engine faults are categorized. Each category consists of common related engine problems with appropriate diagnostic tests and rectification sequences. The categories of engine fault, and probable causes are detailed as follows:

A. Engine Starting

(1) To diagnose and rectify engine starting problems, refer to Engine Starting Fault Isolation Chart (Ref. Fig. 101).

B. Engine Operating

(1) To diagnose and rectify engine operating problems, refer to Engine Operating Fault Isolation Chart (Ref. Fig. 102).

C. Engine Performance

(1) To diagnose and rectify engine performance problems, refer to Engine Performance Fault Isolation Chart (Ref. Fig. 103).

D. Engine Lubrication

(1) To diagnose and rectify engine lubrication problems, refer to Engine Lubrication Fault Isolation Chart (Ref. Fig. 104).

E. Lubricating Oil Contamination

(1) To diagnose and rectify engine lubricating oil contamination, refer and to Engine Lubricating Oil Contamination Fault Isolation Chart (Ref. Fig. 105).

(2) The following NOTES are referred to in Figure 105:

NOTE: 1. Depending where the debris was found (i.e. strainer, main oil filter or chip detector) and the shape (i.e. tooth part, locking washer part etc.) a decision could be made concerning the removal of the affected module. Alternatively, remove engine.

NOTE: 2. If debris is NOT found at the 50-hour check, return the oil filter and chip detector inspections to operator's standard maintenance program intervals.

NOTE: 3. Results of previous laboratory analysis and origin of debris should be determined within 50 hours of original detection of debris.

NOTE: 4. Results of last sample must be known prior to continuing.

NOTE: 5. It should have already been determined that the engine and not RGB mounted accessories are generating the debris. If propeller governor or O/S governor failure occurred before the original debris detection and the material could be identified as a propeller or O/S governor material then the engine may not be generating the debris and therefore could remain in service.

NOTE: 6. Bearing inner and outer rings as well as rolling elements are made of steel AMS6440/6444 (52100) or AMS6490/6491 (M50). Bearing cages are made of steel AMS6414/6415 (4340) or bronze AMS4616, silver plated per AMS2412. When only bearing cage material is generated (major or minor filter contaminant), this may indicate cage wear due to lack of lubrication and/or bearing damage causing rolling element instability.

F. Engine Condition Trend Monitoring (ECTM) Shift

(1) To diagnose and rectify engine condition trend monitoring shift, refer to ECTM Shift Fault Isolation Chart (Ref. Table 101).

Table 101 ECTM Shift Fault Isolation

List of Figures

Figure 101 Engine Starting Fault Isolation Chart

Figure 102 Engine Operating Fault Isolation Chart

Figure 103 Engine Performance Fault Isolation Chart

Figure 104 Engine Lubrication Fault Isolation Chart

Figure 105 Engine Lubricating Oil Contamination Fault Isolation Chart

List of Tables

101 ECTM Shift Fault Isolation

72-00-00
ENGINE, TURBOPROP - SERVICING

1. General

A. For engine installation in airframe, refer to REMOVAL/INSTALLATION.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-053	Polyethylene Sheet
PWC05-070	Tape, Pressure Sensitive Adhesive
PWC05-077	Oil, Preservative
PWC05-107	Foam, Polyurethane
PWC09-003	Compound, Sealing

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC30269	Ring	
PWC32000	Bracket	
PWC32421	Sling, GG Module	
PWC34752	Adapter	
PWC51140	Engine Stand	Replaced by PWC70907
PWC51861-600	Sling	Full Engine
PWC70099	Sling, Power Section	Without Propeller
PWC70104	Sling, Power Section	With Propeller
PWC70907	Engine Stand	

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Lubricating Oil System

A. Lubricating Oil

The lubricating oils specified for use in PT6A turboprop engines are detailed in Pratt & Whitney Canada, (P&WC) Service Bulletin (Ref. 72-00-00, DESCRIPTION AND OPERATION, Transport Canada Approved Service Bulletins) and will be revised periodically to include recently approved oils. All oils listed in the bulletin are for use in commercially operated engines, and are approved for flight operation.

In cases when oils approved by P&WC are not available and other oils have to be substituted, an operator must obtain prior approval or recommendations for use of such oil from Pratt & Whitney Canada Corp.

B. Oil Level Check

To avoid overfilling of oil tank, and high oil consumption, an oil level check is recommended within 30 minutes after engine shutdown. Ideal interval is 15 to 20 minutes. If more than 30 minutes has passed, and the dipstick indicates that oil is needed, start the engine and run at ground-idle for five minutes, and recheck oil level.

C. Procedure

(1) Shut down the engine. Unlock the filler cap and dipstick from the filler neck at the 11 o'clock position on the accessory gearbox and remove the filler cap.

(2) Wipe dipstick with clean lint free cloth.

> CAUTION: WHEN FILLER CAP ASSEMBLY IS INSTALLED AND LOCKED, NO MOVEMENT IS ALLOWED.

(3) Install filler cap/dipstick and lock.

(4) Remove filler cap/dipstick.

(5) Check oil level against marking on dipstick and service as required. Normal oil level is between MAX HOT and one US quart (0.83 Imp. quart, 0.95 liters) below MAX HOT, with engine in horizontal attitude.

NOTE: Filling the oil to the maximum level may result in high consumption rate, with the oil exiting through the AGB breather. On some engines, this may also occur with the oil level at one or two US quarts below the maximum level. In such cases, operators are advised to service the oil to the level that results in acceptable consumption, down to 3 quarts below the maximum, if necessary. For engines with an oil sight gauge, keep the level within the green band. This practice is acceptable, due to the large usable oil quantity, and providing the oil level is monitored using the engine maintenance manual, making sure the consumption allowance and operation are within the recommended oil temperature and pressure.

(6) If oil level is too low to register on dipstick due to possible excessive consumption, or if low or fluctuating pressures have been recorded, refer to Fault Isolation, Engine Lubrication, for action to be taken, then proceed as follows:

(a) Fill oil tank to normal level and record quantity of oil added.

CAUTION: WHEN FILLER CAP ASSEMBLY IS INSTALLED AND LOCKED, NO MOVEMENT IS ALLOWED.

(b) Install filler cap/dipstick, make sure cap is locked.

(c) Run engine at ground-idle for approximately five minutes (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting).

(d) Check oil level (Ref. Steps (1) thru (6) preceding).

D. P&WC's Oil Analysis Technology Sampling Procedure

(1) General:

(a) This procedure is to provide instructions for collection of oil samples for the P&WC's oil analysis technology program.

NOTE: 1. P&WC's Oil Analysis Technology is an optional task. It can be done at the discretion of the operator.

NOTE: 2. The oil sampling kits are available through P&WC Customer Portal. Refer to P&WC SIL-GEN-153 or contact P&WC for more information.

NOTE: 3. P&WC's Oil Analysis Technology is complementary to oil filter/chip analysis, it is not replacing it. You can do the oil filter debris and chip analysis in any independent laboratory approved by P&WC per SIL GEN-123. Do chip/filter analysis during scheduled maintenance (filter and chip inspection) or in an unscheduled maintenance activity.

(b) Oil sampling is recommended within 15 to 30 minutes after engine shutdown. If the time after engine shutdown is more than 30 minutes, start the engine and operate at ground-idle for 5 minutes or until oil temperature is stable.

(c) Collect the oil sample before you do the engine oil service.

(d) After an engine oil system flush, a minimum of 20 hours of engine operation is recommended before you take an oil sample.

(2) Recommended Interval:

(a) For operators enrolled in the P&WC's Oil Analysis Technology program, it is recommended to take oil samples at aircraft MINOR interval, or annually, whichever occurs first.

NOTE: In order to be valid, oil sampling must be done in accordance with the engine oil system oil analysis procedure (Ref. Step (3)).

(b) Based on oil analysis results, P&WC can recommend a different sampling interval for a specific engine.

(c) In case of an unplanned removal for an oil system related issue, take an oil sample before removal if possible.

(3) Oil Sampling Procedure:

CAUTION: MAKE SURE THE AREA IS CLEAN IN ORDER TO PREVENT CONTAMINATION OF THE ENGINE OIL SYSTEM AND OIL SAMPLE. MAKE SURE THAT THE CONTAINER AND TOOLING ARE FREE OF DEBRIS AND CONTAMINANTS.

(a) Shut down the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(b) Unlock the filler cap and dipstick from the filler neck at the 11 o' clock position on the accessory gearbox. Remove the filler cap.

(c) Make sure that the plastic bottle is clean and dry.

NOTE: You can clean the plastic bottle with water and dry with compressed air.

(d) Record the applicable information on the bottle label and attach it on the bottle.

(e) Collect a sample of 60 ml (2 oz.) engine oil through the filler neck with the syringe and the flexible tube.

(f) Put the oil sample collected with the syringe into the plastic bottle.

NOTE: Do not use syringe and flexible tubes more than one time. Discard the used syringe.

(g) Make sure that the plastic bottle is sealed correctly and put it in a separate plastic bag supplied with the oil sampling kit.

(h) Fill the oil analysis sampling form P&WC 11914 or 12233 supplied in the oil sampling kit.

NOTE: Use one form for each engine sample.

(i) Put the sealed plastic bag with the oil sample bottle and the completed oil analysis sampling form into the shipping envelope and send in accordance with P&WC SIL-GEN-153.

(j) Do a check for the engine oil level and fill as necessary (Ref. Paras. 5.B. and 5.C.).

E. Oil Servicing (Ref. Fig. 301)

CAUTION: DO NOT MIX DIFFERENT VISCOSITIES OR SPECIFICATIONS OF OIL AS THEIR DIFFERENT CHEMICAL STRUCTURE CAN MAKE THEM INCOMPATIBLE.

NOTE: For list of approved synthetic lubricating oils, limits and instructions, refer to SB14001.

(1) Place suitable containers under engine.

(2) Remove chip detector (1, Fig. 301), valve housing (located at 6 o'clock position on front housing of reduction gearbox), oil drain plugs (2 and 3) or chip detector (5) as applicable on accessory gearbox housing.

(3) Remove drain plug (4) on oil-to-fuel heater (Ref. 73-10-01, Removal/Installation).

(4) Drain engine.

(5) Install new preformed packings on drain plugs (2 and 4, or 3), and chip detector(s) (1 or 5) as applicable.

(6) Install drain plugs on accessory gearbox housing and air inlet case. Tighten plugs 215 to 240 lb.in., and lockwire.

(7) Install chip detector into threaded boss in RGB or if applicable, in AGB. Tighten detector body 45 to 55 lb.in., and lockwire.

(8) Fill oil tank (Ref. Subpara. C.).

F. Oil System Flushing

CAUTION: IF THE ENGINE OIL SYSTEM HAS BEEN FILLED WITH AN UNAPPROVED OIL TYPE OR IF THE OIL SYSTEM HAS BEEN CONTAMINATED BY OTHER THAN METALLIC MATTER, THE SYSTEM MUST BE FLUSHED AND FILLED AGAIN WITH THE ORIGINAL OIL TYPE OR AN APPROVED OIL TYPE.

(1) Place suitable containers under engine.

(2) Remove chip detector from reduction gearbox front housing, and oil drain plug(s) from accessory gearbox housing and oil-to-fuel heater.

CAUTION: LIMIT ENGINE ROTATION TO MINIMUM TIME REQUIRED TO DRAIN OIL. ALSO OBSERVE STARTER OPERATING LIMITATIONS.

(3) With drains open, place fuel condition lever to CUT-OFF and ignition switch OFF. Motor engine with starter only and allow scavenge pumps to clear all lubricating oil.

(4) Install chip detector and drain plugs.

(5) Fill engine oil tank (Ref. Subpara. C.).

(6) Start engine and run at ground-idle (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) for a minimum of two minutes.

(7) Feather propeller.

(8) Shut down engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Shutdown).

(9) Repeat steps (1) through (3), preceding.

(10) Remove main oil filter and clean, or replace with new one, (Ref. 79-20-02, MAINTENANCE PRACTICES) according to type. Reinstall oil filter.

(11) Remove reduction gearbox oil strainer and clean (Ref. 72-10-00, MAINTENANCE PRACTICES). Reinstall strainer.

(12) Reinstall engine chip detector and drain plugs, and tighten and lockwire (Ref. Subpara. E.).

(13) Repeat steps (5) through (8), preceding.

(14) Check oil level and replenish, as necessary (Ref. Subpara. C.).

G. Oil Level Check and Replenishment Following Multiple Motoring Runs

(1) At low gas generator speeds (Ng) during motoring runs, oil leakage can occur from the compressor inlet case and in some cases the gas generator drains and exhaust duct. This is a result of the main oil pump efficiency being higher than the scavenge pump efficiency at low gas generator speeds (Ng), causing the accessory gearbox (AGB) and bearing cavities to flood with oil.

(a) Procedure:

1 Take note of the oil level. Do not add oil.

2 Place suitable container under engine.

3 Remove accessory gearbox oil drain plug and allow oil to drain completely.

4 Install drain plug.

5 Clean compressor inlet case and any other areas wet with oil (Ref. 71-00-00, POWER PLANT - CLEANING).

6 Check oil level and fill as necessary.

7 Start engine and run at FLIGHT - IDLE (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) for a minimum of ten minutes.

8 Check for oil leaks.

NOTE: It is normal to have additional oil leakage as the oil is scavenged back to the oil tank.

9 Repeat steps 5 through 8 above. If oil leak stops, return engine to service, otherwise refer to fault isolation for additional troubleshooting instructions.

6. Preservation, Depreservation and Unpreserved Engines Section

A. General

Preservation of engines in service depends on the period of inactivity and whether or not the engine may be rotated during the inactive period. An engine is considered inactive when it has not been operated either on the ground, or in flight for a minimum of ten minutes after the oil temperature has stabilized. The expected period of inactivity should be established and reference made to the Engine Preservation Procedures following.

The preservation done should be recorded in the engine log book and on tags fastened to the engine.

For an engine inactive in a severe environment such as very high temperature changes, high humidity, salt-laden or harsh atmosphere, it is recommended to preserve the engine to the next higher schedule or start the engine and operate more frequently for 10 minutes minimum.

If an engine has been preserved to a certain schedule, (91 days to 1 year) and then be inactive for more than 1 year, the engine should be depreserved, inspected and tested according to the 91 days to 1 year instructions, and the engine removed and stored in an engine container.

B. Engine Preservation Procedure

> CAUTION: ENGINE(S) REMOVED FROM SERVICE AND NOT PRESERVED PER THE PUBLISHED PROCEDURES, COULD POSSIBLY SUFFER CORROSION DAMAGE. THE ONLY METHOD TO DETERMINE IF SUCH DAMAGE HAS OCCURRED, IS TO DISASSEMBLE THE ENGINE PARTIALLY FOR VISUAL INSPECTION OF ALL COMPONENTS.

(1) Engines inactive 0 to 7 days.

(a) If the engine operated in a salt-laden or harsh environment, do a compressor and turbine desalination wash (Ref. 71-00-00, POWER PLANT - CLEANING).

(b) Engine may remain inactive with no preservation protection provided engine is sheltered, humidity is not excessively high and there is not extreme temperature changes that may produce condensation.

(c) Install inlet and exhaust covers.

(3) Engines inactive 29 to 90 days.

(a) Do 0 to 7 days, and 8 to 28 days procedures.

(b) Wash engine externally (Ref. 71-00-00, CLEANING).

(c) Do a compressor performance recovery/desalination wash and a turbine rinse.

(d) Examine all engine external protective coating, and touch-up/repair as necessary.

(e) Lubricate all linkages.

(f) Disconnect fuel inlet to oil-to-fuel heater and connect suitable oil supply line to oil-to-fuel heater fuel inlet. Blank off disconnected fuel supply line.

(g) Disconnect fuel line at flow divider inlet to prevent preservation oil from entering fuel manifold, and loosen line as required to permit drainage into a suitable container.

CAUTION: UNDER NO CIRCUMSTANCES PERMIT PRESERVATIVE OIL TO ENTER ENGINE WHERE IT MAY COME INTO CONTACT WITH THERMOCOUPLE PROBE ASSEMBLY. OIL CONTAMINATION OF PROBES MAY CAUSE COMPLETE FAILURE OF THERMOCOUPLE SYSTEM.

(h) Supply preserving oil (PWC05-077) at 5 to 25 psig at least 16°C (60°F).

CAUTION: OBSERVE STARTER MOTOR OPERATING LIMITS (REF. STARTER MANUFACTURER'S MANUAL).

(i) With ignition system OFF, fuel condition lever to GROUND-IDLE and power control lever to TAKE-OFF, carry out normal motoring run until all preservative oil is displaced. During motoring run, move power control lever from TAKE-OFF to

(j) After motoring run, check to see if preservative oil is coming from opened fuel line. If not, repeat motoring cycle until preservative oil flows from opened fuel line.

(k) Return power control lever to GROUND-IDLE and fuel condition lever to OFF. Reconnect fuel supply to oil-to-fuel heater and fuel line to flow divider inlet.

(l) Install caps, covers and plugs as necessary to prevent entry of foreign material and accumulation of moisture (Ref. Fig. 304).

(4) Engines inactive for periods exceeding 90 days.

(a) Do 0 to 7, 8 to 28 and 29 to 90 days procedures.

CAUTION: OBSERVE STARTER MOTOR OPERATING LIMITS (REF. STARTER MANUFACTURER'S MANUAL).

(b) Close normal fuel supply shutoff valve and motor engine with starter until oil pressure and Ng are indicated. Disengage starter.

(c) Drain engine oil (Ref. Para. E.).

(d) With drains open, motor engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) to permit scavenge pumps to clear engine, indicated by cessation of steady stream of oil from drains. To prevent excessive operation with limited lubrication, limit rotation to shortest possible time to accomplish complete draining.

(e) Remove oil filter element (Ref. 79-20-02, MAINTENANCE PRACTICES) and allow to drain.

(f) Let oil to drain to a slow drip, approximately one drip per half hour, then install oil filter and close drains.

(g) Remove covers from accessory drive pads. Spray exposed surfaces and gearshafts with engine oil (PWC03-001). Install the covers again on the accessory drive pads.

CAUTION: COMPOUND MUST NOT TO BE APPLIED TO ANY BOLT THREADS USED TO RETAIN ACCESSORIES. THESE THREADS MUST BE COATED WITH REGULAR ENGINE OIL AS REQUIRED BY NORMAL TIGHTENING PROCEDURES. UNDER NO CIRCUMSTANCES MUST THE COMPOUND BE USED IN, OR PERMITTED TO ENTER ANY AREA WHERE IT COULD CONTAMINATE THE ENGINE LUBRICATION SYSTEM.

(h) Coat all external flanges, bolts, and studs with compound (PWC09-003). In particular, pay special attention to the RGB and compressor inlet case flanges.

(i) Install caps, covers and plugs, as necessary to prevent entry of foreign material and accumulation of moisture (Ref. Fig. 304).

(j) Tag oil filler cap with date of preservation and enter date and type of preservation in engine log book.

(k) Install humidity indicator in air inlet and exhaust of engine compartment. Cover with suitable airtight moisture barrier. Provide inspection windows at each end for observation of humidity indicators.

NOTE: Inspection of a preserved unit should be carried out every two weeks if aircraft is stored outside, or every 30 days

NOTE: Inspection of a preserved unit should be carried out every two weeks if aircraft is stored outside, or every 30 days if aircraft is stored inside. If relative humidity, as indicated on humidity indicator, is less than 40 percent, no further action is required. If humidity indicated exceeds 40 percent, desiccant bags must be replaced or reactivated (Ref. Para. 7.D.).

(5) Engines inactive for periods exceeding one year:

(a) Do 0 to 7, 8 to 28, 29 to 90, and 91 days and over procedures.

(b) Remove the engine. Keep it in the shipping/storage container.

C. Engine Depreservation Procedure

(1) 0 to 7 days:

(a) No depreservation required.

(2) 8 to 28 days:

(a) Remove covers from inlet and exhaust openings, and moisture barriers.

(b) Make sure all engine openings are clear and unobstructed.

(c) Remove desiccant bags and racks if applicable.

(3) 29 to 90 days:

(a) Do 8 to 28 days procedure.

(b) Fill engine oil tank (Ref. Lubricating Oil System).

CAUTION: UNDER NO CIRCUMSTANCES PERMIT PRESERVATIVE OIL TO ENTER ENGINE WHERE IT MAY COME INTO CONTACT WITH THERMOCOUPLE PROBE ASSEMBLY. OIL CONTAMINATION OF PROBES MAY CAUSE COMPLETE FAILURE OF INDICATING SYSTEM.

(c) Disconnect fuel line at flow divider inlet to permit drainage into suitable container.

(d) Connect aircraft fuel supply.

(e) With ignition OFF, place power control lever to TAKEOFF and fuel condition lever to GROUND-IDLE.

CAUTION: OBSERVE STARTER MOTOR OPERATING LIMITS (REF. STARTER MANUFACTURER'S MANUAL).

(f) Do a normal 30 second motoring run, during which time move power control lever to GROUND-IDLE and return to TAKEOFF, fuel condition lever to OFF and return to GROUND-IDLE until clean fuel flows from line.

(g) Connect fuel inlet line to flow divider, tighten all coupling nuts 90 to 100 lb.in., and lockwire.

(h) Return PCL to GROUND-IDLE and fuel condition lever to OFF.

(4) 91 days and over:

(a) Do 8 to 28 days procedure.

(b) Examine all external cases for corrosion, and protective coating for wear. Repair as necessary.

(c) Remove compressor inlet screen, and examine case and visible flanges for corrosion. If corrosion is found, examine internals of AGB and RGB with borescope. If corrosion exceeds limits, send engine to an approved overhaul facility.

(d) Slowly rotate the propeller by hand, and check for stiffness, audible scraping, binding or rubbing (Ref. Unscheduled Inspection).

(e) Do 29 to 90 days procedures.

(f) Start the engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do the following:

Pre-operational Check

Pre-start Check

Dry Motoring Run

Wet Motoring Run

Shutdown Checks

Post-shutdown Checks

FCU Checks

Engine Performance Check

NOTE: During motoring, check for stiffness, audible scraping, binding and/or rubbing.

(g) After engine run, and completion of all checks, examine all drain valves for oil. If oil is found, send engine to an approved overhaul facility.

(h) Examine fuel filters and clean or replace as necessary (Ref. 73-10-02, MAINTENANCE PRACTICES).

(i) Examine oil filter, RGB oil strainer, and RGB and AGB chip detectors as applicable. If contamination is found, and the engine has no previous contamination history, send engine to an approved overhaul facility. Otherwise, refer to Chapter 79-20-02, MAINTENANCE PRACTICES.

D. Preservation of Power Section/Power Section Module (PS/PSM)

(1) Preservation is done as part of engine preservation before removal of PS/PSM.

(2) Install caps, covers and plugs as applicable to prevent entry of foreign material and moisture accumulation (Ref. Fig. 308).

E. Engine Unpreserved Procedure

NOTE: 1. Do the steps that follow for inactive engines not preserved as recommended in the "Engine Preservation Procedure".

NOTE: 2. If compressor or turbine wash performed, do a dry motoring and subsequent engine run (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(1) 0 to 7 days inactivity:

(a) If the engine operated in a salt-laden or harsh environment, do a compressor desalination wash and a turbine wash (Ref. 71-00-00, POWER PLANT - CLEANING).

(b) Make sure all engine openings are clear and unobstructed and no evidence of corrosion. Inspect engine externals for condition and corrosion.

(c) If further storage is required, preserve depending on the expected period of inactivity per applicable EMM.

(2) 8 to 28 days inactivity:

(a) Do 0 to 7 days unpreserved engine procedure requirement.

(b) For engines stored in an air conditioned environment, go to Step (d).

NOTE: An air conditioned unit is defined as an enclosed climate controlled environment with temperature maintained above 8 °C (46 °F) and not susceptible to rapid temperature changes.

(c) For other engines, do the following steps:

1 Prior engine start, do a Total Acid Number (TAN) test of oil in engine per related lubricating oil SB14001.

2 If TAN test is found acceptable, proceed to engine run (Ref. Step (d)).

3 If TAN test is above the limits, inspect the internal of the AGB and RGB using a borescope for presence of corrosion or internal coating flaking. If corrosion and/or flaking are found, remove the engine and send it to an approved facility for light overhaul.

4 If TAN test is above limits, drain and flush oil (Ref. Para. 5. F.).

(d) Run the engine at 80% TO power for 10 minutes.

(e) Remove and inspect oil filter and chip detector(s). If anything abnormal is found, refer to applicable EMM.

(f) Do a check for evidence of fuel and oil leaks at propeller shaft seal, accessory mounting pads, external tubes and hoses.

(g) If further storage is required, preserve depending on the expected period of inactivity per applicable EMM.

(h) After return to service, repeat inspection of oil filter and chip detector(s) after 10 hours. If anything abnormal is found, refer to applicable EMM otherwise return to standard periodic interval.

(3) 29 to 90 days inactivity:

(a) Do 0 to 7 days unpreserved engine procedure requirement.

(b) Prior engine start, do a Total Acid Number (TAN) test of oil in engine per related lubricating oil SB14001.

1 If TAN test is found acceptable, proceed to drain and flush oil (Ref. Step (c)).

2 If TAN test is above the limits, inspect the internal of the AGB and RGB using a borescope for presence of corrosion or internal coating flaking. If corrosion and/or flaking are found, remove engine and send to an approved facility for light overhaul.

3 If TAN is above the limits, replace the oil filter.

(c) Drain and flush oil (Ref. Para. 5. F.).

(d) Rotate propeller with your hand and check for binding. If binding, inspect per applicable EMM requirements (Ref. Inspection).

(e) Inspect the engine externals and linkages for condition and evidence of corrosion.

(f) Inspect the compressor for corrosion and cleanliness. Do compressor desalination wash, if dirty or salt laden (Ref. 71-00-00, POWER PLANT - CLEANING).

(g) Inspect the fuel filter.

(h) Disconnect fuel tube at inlet of flow divider and flush fuel system per a wet motoring run.

(i) Run engine at 80% TO power for 10 minutes and do acceleration check.

(j) Remove and inspect internal AGB scavenge pump inlet screen, oil filter and chip detector(s). If anything abnormal is

(k) Check for evidence of fuel and oil leaks at propeller shaft seal, accessory mounting pads, external tubes and hoses.

(l) If further storage is required, preserve depending on the expected period of inactivity per applicable EMM.

(m) After return to service, repeat the inspection of oil filter and chip detector(s) after 10 and 50 hours. If anything abnormal is found, refer to applicable EMM otherwise return to standard periodic interval.

(4) For period greater than 91 days to less than 1 year:

(a) Do the 0 to 7 day unpreserved engine procedure requirement.

(b) Prior engine start, do a Total Acid Number (TAN) test of oil in engine per related lubricating oil SB14001.

1 If TAN test is above limits, remove the engine and send to an approved facility for light overhaul.

2 If TAN is acceptable, inspect the internal of the AGB and RGB using a borescope for presence of corrosion or internal coating flaking. If corrosion and/or flaking are found, remove the engine and send to an approved facility for light overhaul.

(c) Replace the oil filter.

(d) Drain and flush oil (Ref. Para. 5. F.).

(e) Rotate propeller with your hand and check for binding. If binding, inspect per applicable EMM requirements (Ref. Inspection).

(f) Inspect the engine externals and linkages for condition and evidence of corrosion.

(g) Inspect the compressor for corrosion and cleanliness. Do compressor desalination wash, if dirty or salt laden (Ref. 71-00-00, POWER PLANT - CLEANING).

(h) Inspect fuel filter.

(i) Clean fuel nozzles, perform leak and functional test.

(j) Route FCU to an approved shop for inspection and functional test.

(k) Once the FCU installed (original unit or replacement), disconnect fuel tube at inlet of flow divider and flush fuel system per a wet motoring run.

(l) Run engine at 80% TO power for 10 minutes and do acceleration check.

(m) Remove and inspect internal AGB scavenge pump inlet screen, oil filter, and chip detector(s). If anything abnormal is found refer to applicable EMM.

(n) Check for evidence of fuel and oil leaks at propeller shaft seal, accessory mounting pads, external tubes and hoses.

(o) If further storage is required, preserve depending on the expected period of inactivity per applicable EMM.

(p) After return to service, repeat inspection of oil filter and chip detector(s) after 10 and 50 hours. If anything abnormal is found, refer to applicable EMM otherwise return to standard periodic interval.

(5) For periods of 1 year and greater (regardless of humidity and environment):

(a) Send the engine to an overhaul facility for light overhaul for non-preserved engine.

F. Regular Operation as Alternative to Preservation of Inactive Engines

(1) For engines installed on aircraft, running the engine once a week is an acceptable alternative to avoid the preservation procedures outlined above. This prevents stagnation of fuel in the fuel system, reduces humidity and condensation accumulation in the oil system.

(a) Run engine at 80% TO power or highest attainable for 10 minutes.

G. Accessories, Preservation and Depreservation

(1) General

(a) Preservation of an accessory depends on the period of inactivity and whether or not the unit is operated during the inactive period.

1 An accessory is considered active if an engine is involved in normal flight operations or if an engine is wet motored or run during preservation periods.

2 An accessory is not considered active if an engine is not wet motored or run during aircraft inactive periods.

(b) For accessory that remain on inactive engines in long term container storage (off-wing), the time accumulated in the container begins at the time of packaging.

(c) For accessories that have been removed from the engine and are on shelf for 28 days or more, refer to specific CMM for storage and preservation procedure.

NOTE: For fuel control unit that have been removed from the engine and are on shelf for 28 days or more (Ref. 73-20-00, FUEL CONTROL UNIT - MAINTENANCE PRACTICES).

(2) Preservation

(a) Retain shipping closures of replacement components for use when returning defective components.

(b) Fill components to be shipped, except electrical, with preservative oil (PWC05-077) and drain off excess oil.

(c) Install shipping closures and wrap assembly with polyethylene sheet (PWC05-053).

WARNING: REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL PROPERTIES, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(d) Safety the component in the shipping/storage container with the polyurethane foam (PWC05-107).

(e) Identify the shipping/storage container.

(3) Storage

(a) Accessory storage life is unlimited, providing the following procedures are carried out:

NOTE: Honeywell fuel control unit storage life is six years (Ref. Honeywell SIL-087).

1 Accessories installed on a stored engine.

a Fluid handling components (e.g., FCU, FDV, Fuel Pump, Fuel Heater, Fuel Nozzle, CSU): Preserve in accordance with Subpara. B., as applicable. Electrical connections must be connected. If connection is not possible, approved shipping covers must be installed on the connector and associated wiring harness.

b Electrical components (if applicable): No preservation required. Electrical connections must be connected. If connections is not possible, approved shipping covers must be installed on connector(s) and associated wiring harness.

c Bleed Valve: Component must be kept dry. Do not lubricate. Install approved shipping cover to seal opening.

2 Accessories stored off the engine

a Fluid handling components (e.g., FCU, FDV, Fuel Pump, Fuel Heater, Fuel Nozzle, CSU): Fill fuel system component with preservative oil (PWC05-077) and oil system component with engine oil (PWC03-001). Drain the excess oil. Install covers on all electrical connectors, air and oil passages. Put in a polyethylene bag and store in a dry location.

b Electrical components (if applicable): Install covers on all electrical connections. Put in a polyethylene bag and store in a dry location.

c Bleed Valve: Component must be kept dry. Do not lubricate. Install approved shipping covers to seal openings.

(4) Depreservation

(a) Remove and retain shipping parts of replacement assemblies for use when returning defective assemblies.

(b) Drain preserving fluids.

(c) Flush replacement assemblies with appropriate system fluid.

7. Storage and Shipping

A. General

The following information and procedures are necessary for storage, preservation and depreservation of an engine, power section/power section module (PS/PSM) or gas generator module (GGM). Refer to Removal/Installation for engine installation in the airframe.

B. Shipping/Storage Container (Ref. Fig. 302)

Use the shipping/storage container for shipping/storage of the engine or module as applicable. The shipping/storage container is made up of fiberboard, contains a wooden skid base, a metal cradle is attached to the base, a fiberboard cover, the sides of the container formed with a fiberboard inner and outer sleeve. Plywood sheeting gives more support to the container sides and the cover. You can use the base, plywood supports, cradle and the related hardware again and discard the fiberboard sleeve and cover. Use this container for shipment in a closed conveyance on the North American continent or overseas shipment by air and do not use for shipment by sea. To prevent the possible bearing damage such as brinelling, use of shipping/storage container/skid with shock mounts is necessary for all transportation.

Do not use the fiberboard container for outdoor storage. It provides protection against corrosion, if the container is correctly sealed and kept indoors in relatively dry areas and the humidity indicator color is monitored every 15 days (Ref. Para. 7. D.).

For shipping/storage container data, refer to Tables 301 and 302.

Table 301 Engine/GGM Shipping/Storage Container Data

Table 302 Power Section/PSM Shipping/Storage Container Data

C. Humidity Control

To maintain internal conditions within the protective envelope at a safe humidity level for storage, twelve (12) bags of desiccant material per engine, and eight (8) bags per module, are placed in the protective envelope. Each desiccant bag contains eight units (one unit equals one ounce).

A humidity indicator is installed within the protective envelope and is visible through a window in the fiberboard casing. The moisture level can thus be checked without disturbing the container or its contents.

At a safe humidity level (up to 40 percent relative humidity) the indicator color is blue. As internal humidity increases, the color gradually changes to pink. An all pink color indicates that humidity level is excessive. Replace the desiccant bags with freshly activated bags (Ref. Subpara. D. following).

D. Reactivation of Desiccant and Humidity Indicator

(1) Place bags of desiccant (Ref. IPC) and humidity indicator in a suitable oven controlled at 121°C (250°F). The humidity indicator may be removed when an all blue color has been attained. The desiccant bags should remain in the oven for two hours minimum.

(2) Allow oven to cool to room temperature (approximately 22°C (72°F)), and then remove bags and indicator as applicable.

(3) Immediately place desiccant bags in airtight polyethylene envelopes. Exclude all air and heat seal envelopes.

NOTE: Desiccant bags must be removed from polyethylene bags prior to installation in shipping/storage container.

E. Precautions

(1) When an engine is to be removed from, or installed in a shipping/storage container, the following precautions must be taken:

(a) Make sure a hoist of sufficient lifting capacity, plus safety factor, is available to lift loads as follows:

1 550 lb. (249 kg) when lifting engine only.

2 900 lb. (410 kg) when lifting engine in a fiberboard container.

3 275 lb. (125 kg) when lifting power section or gas generator module only.

4 275 lb. (125 kg) when lifting power section only.

5 A load of 475 lb. (220 kg) when lifting gas generator module in a container.

5 A load of 475 lb. (220 kg) when lifting gas generator module in a container.

6 525 lb. (240 kg) when lifting power section loaded in a container.

(b) Place shipping/storage container correctly on floor, directly beneath hoist.

(c) Allow free overhead space of at least 6 feet (2 meters), exclusive of distance from the top of the shipping/storage container or engine to the hoist.

F. Stacking Containers for Storage

(1) Instructions outlined in Tables 303 and 304 must be followed when stacking empty containers or containers with engines or power section/power section modules.

Table 303 Engine /GGM Shipping/Storage Container Stacking Limitations

Table 304 Power Section/Power Section Module Shipping/Storage Container Stacking Limitations

8. Removal/Installation of Engine from/in Shipping/Storage Container

CAUTION: IF ENGINE IS DROPPED, IN CONTAINER OR OTHERWISE, SEND ENGINE TO AN OVERHAUL FACILITY FOR LIGHT OVERHAUL. INDICATE "DROPPED ENGINE".

A. Removal of Engine from Fiberboard Shipping/Storage Container

(1) Remove strapping (6, Fig. 302) from around fiberboard container. Retain reinforcing corners (5). Remove tape (2), cover (3), support (4), and sleeve (7) from base (15).

(2) Cut protective envelope (12) and expose top of engine.

CAUTION: NEVER USE SLING AND LIFTING BRACKETS TO LIFT ENGINE ATTACHED TO SKID BASE.

(3) Install sling (1, Fig. 303) on hoist with lifting eye of sling adjusted to enable horizontal engine lift.

(4) Attach sling to engine lifting brackets (2 and 3) at flanges A and G respectively.

(5) Put the weight of engine on sling. Cut the safety cables, then remove the engine release pins (10 and 12).

(6) Maintain engine horizontal and raise until clear of cradle; remove engine front mounting brackets (9) and engine rear mounting bracket (11) together with associated hardware from engine.

(7) Install engine front mounting brackets (9) and engine rear mounting bracket (11) on cradle with pins (10 and 12).

NOTE: Retain associated hardware, place in bag and fasten to cradle. Retain cradle, skid base and associated hardware for reuse.

(8) Remove ignition exciter, complete in protective envelope, from box (13) and retain with engine.

NOTE: If engine has optional air bleed extension, remove from sealed box on bottom of container.

(9) Remove 12 desiccant bags from engine and retain for reactivation and reuse.

(10) Remove envelopes containing shipping and engine documents from box secured to skid base. Remove metal gasket for P2.5 aircraft adapter.

(11) Remove all shipping caps, covers and plugs from engine (Ref. Fig. 304).

(12) Retain moisture barrier/protective wrapping on engine air inlet screen until engine is installed in airframe.

B. Installation of Engine in Fiberboard Shipping/Storage Container

CAUTION: MAKE SURE OIL HAS BEEN COMPLETELY DRAINED FROM ENGINE.

(1) With engine mounted in stand (Ref. Para. 9.) and engine preservation completed (Ref. Para. 6.), apply a light coat of engine oil (PWC03-001) inside the propeller shaft bore and fit all blanking covers, plugs and caps (Ref. Fig. 304).

(2) Install moisture barrier/protective cover on air inlet screen with pressure sensitive tape (PWC05-070).

NOTE: Moisture barrier/protective cover may be of polyethylene sheet, aluminum foil, cotton-backed material or waxed paper.

(3) Make sure cradle and skid base are serviceable and new or serviceable fiberboard sleeve and lid are available.

(4) Remove engine from stand (Ref. Para. 9.).

CAUTION: DO NOT USE STANDARD COMMERCIAL HARDWARE TO FASTEN ENGINE SUPPORT BRACKETS TO ENGINE OR CONTAINER. USE OF HARDWARE OF LOWER STRENGTH THAN SPECIFIED COULD CAUSE SERIOUS ENGINE DAMAGE DURING SHIPPING.

(5) Remove ignition exciter and fasten ignition cables to engine with adjustable tiedown straps. Make sure cable end protective caps are fastened with pressure sensitive tape (PWC05-070).

(6) Make sure interior of protective envelope is free of dirt, oil, water or other contaminants.

(7) Install engine in new protective envelope (4, Fig. 303) aligning gaskets with lower engine mounting pads on each side of engine and accessory gearbox mounting pad.

(8) Attach engine front mounting brackets (9) to lower engine mounting pads on each side of gas generator case with bolts (7) and washers (8). Tighten 225 to 250 lb.in.

(9) Attach engine rear mounting bracket (11) to mounting pad at 6 o'clock position on accessory gearbox, with bolts (7) and washers (8). Tighten 50 to 70 lb.in.

(10) Place engine log book, log sheets and other relevant documents to be shipped with engine, in a waterproof envelope and seal with pressure sensitive tape (PWC05-070). Fastened to skid base.

(11) If engine has optional air bleed adapter installed, remove from engine and install cover. Insert adapter and seal in protective envelope, wrap in cushioning material and place in box (5), seal, and fasten to container bottom with pressure sensitive tape

(12) Lower the engine to cradle (6), then attach engine front and rear mounting brackets (9) and (11) to the cradle with three engine release the pins (10) and (12). Install the safety cables.

(13) Install humidity indicator (1, Fig. 302) in protective envelope (12), in correct position to be visible through fiberboard sleeve window.

(14) Remove sling and hoist from engine.

(15) Tie 12 (eight unit), freshly activated desiccant bags (Ref. IPC) to engine, evenly disposed over engine length, six on each side.

NOTE: Remove desiccant bags from protective envelopes before installation.

(16) Seal along top of envelope, using suitable hand-held sealing iron, leaving one corner open to evacuate air. Evacuate air, fold corner and seal.

(17) Place ignition exciter, with shipping caps installed, in protective envelope. Insert one four-unit desiccant bag in envelope. Seal envelope leaving one corner open, evacuate air from envelope, fold corner and complete heat sealing. Wrap in cushioning material, install in box (11), and fasten to bottom of container.

(18) Install fiberboard sleeves and plywood supports (7, 8 and 9) over engine and fit in position on skid base.

(19) Fold engine envelope and ensure humidity indicator aligns with window in sleeve. Fasten envelope folds with pressure sensitive tape (2).

(20) Close flaps of sleeve and seal with pressure sensitive tape (2).

(21) Place plywood support (4) and cover (3) on sleeve, fold flaps down and seal at each corner with pressure sensitive tape (2).

(22) Install cover horizontally with strapping (6) and four metal reinforcing corners (5).

(23) Install cover and sleeve to skid base with strapping (6) and reinforcing corners (5).

9. Removal/Installation of Engine from/in Maintenance Stand

CAUTION: IF ENGINE IS DROPPED, IN CONTAINER OR OTHERWISE, SEND ENGINE TO AN OVERHAUL FACILITY FOR LIGHT OVERHAUL. INDICATE "DROPPED ENGINE".

A. Removal

(1) For (PWC51140) or (PWC70907) engine stands:

WARNING: MAKE SURE FLOOR LOCK IS FULLY APPLIED IN LOCKED POSITION TO PREVENT MOVEMENT OF ENGINE STAND.

(a) Attach lifting bracket (2, Fig. 305, PWC50373) to lockplate (18) of mount ring at 12 o'clock location and secure with release pin (3).

(b) Attach sling (1, PWC51861-600) to lifting bracket (2) and take up weight of engine with hoist.

(c) Remove six bolts (19) and washers (20 and 21) attaching mount ring halve (PWC70334) to engine stand (17).

(d) Remove engine and lift clear of stand.

(e) Attach shackles (5) of engine sling to engine lifting brackets at Flanges C and G.

(f) Remove release pin (3) and remove lifting bracket (2, PWC50373).

(g) Remove bolts (16) securing mount ring halves (14 and 15, PWC70334) together.

(h) Remove cotterpins (13), nuts (12), washers (10 and 11) and bolts (9) securing mount ring halves to engine mount pads (6).

(i) Remove four bolts (7) and washers (8) securing engine mount pads (6) to gas generator case.

10. Removal/Installation of Power Section/Power Section Module (PS/PSM) from/in Container

CAUTION: IF PS/PSM IS DROPPED, IN CONTAINER OR OTHERWISE, SEND ENGINE/PS/PSM TO AN OVERHAUL FACILITY.

A. Removal

(1) Remove strapping (2, Fig. 306) from fiberboard container. Retain reinforcing corners (1). Remove cover (11) and sleeve (3) from base (5).

(2) Cut protective envelope (8) and expose top of PS/PSM. Cut envelope free of front PS/PSM support brackets (7, Fig. 307).

CAUTION: DO NOT TRY TO LIFT POWER SECTION ATTACHED TO SKID BASE.

(3) Locate mounting plate (14) of sling (15) on propeller mounting flange (12). Engage two dowels on flange with corresponding holes in plate, and fasten with four socket-head capscrews from rear of mounting flange.

(4) Attach hoist (1) to lifting eye (2) on sling, and take up slack on hoist to support weight of PS/PSM.

(5) Remove four quick-release pins (8), two at mounting brackets (3) attached to flange A, and two at mounting plates (5) attached to flange C.

(6) Raise PS/PSM in level attitude until clear of cradle (10).

(7) Remove nuts, washers, bolts and mounting plates (5) from flange C.

(8) Remove nuts, washers, bolts and two front mounting brackets (3) from flange A. Remove front brackets, and replace nuts, washers and bolts with standard nuts, washers and bolts supplied. Tighten nuts 32 to 36 lb.in.

(9) Loosely reassemble support brackets, together with mounting brackets and mounting plate, on cradle.

(10) Place associated hardware in a bag and secure to cradle. Retain cradle, skid base and associated hardware for possible reuse.

(11) Remove eight desiccant bags from engine and retain for reactivation (Ref. Para. 7.D.) and reuse.

(12) Remove envelopes containing shipping data, power section log book and other relevant documents from box glued to skid base.

(13) Shipping closures and five nuts, washers and bolts retaining transfer tube brackets to flange C should not be removed unless attachment to gas generator is imminent.

B. Installation

CAUTION: MAKE SURE OIL HAS BEEN COMPLETELY DRAINED FROM REDUCTION GEARBOX, PS/PSM CLASSIFIED VANE RING HAS BEEN REMOVED, AND RELEVANT DOCUMENTS COMPLETED.

(1) Make sure cradle and skid base are serviceable and a new or serviceable fiberboard sleeve and cover are available.

CAUTION: DO NOT USE STANDARD COMMERCIAL HARDWARE TO FASTEN SUPPORT BRACKETS TO THE PS/PSM OR CONTAINER. USE OF HARDWARE OF LOWER STRENGTH THAN SPECIFIED COULD CAUSE SERIOUS DAMAGE TO PS/PSM DURING SHIPPING.

(2) Make sure all shipping closures are attached (Ref. Fig. 308).

(3) Remove nuts, washers and bolts from each side of flange A. Locate each front mounting bracket (3, Fig. 307) and secure with bolts, washers and nuts supplied. Tighten nuts 32 to 36 lb.in. Place nuts, washers and bolts removed from flange A in polyethylene bag and fasten to cradle using pressure sensitive tape.

(4) Make sure interior of protective envelope (13) is free of dirt, oil, water and other contaminants. Note position of humidity indicator window.

(5) Install protective envelope (13) over PS/PSM, aligning gaskets with appropriate holes on flange C. Install mounting plates (5) to flange C, with offset holes aligned, with two sets of bolts, washers and nuts provided. Tighten nuts 32 to 36 lb.in.

(6) Align protective envelope flange A gaskets with appropriate hole on front mounting brackets (3), and install front support bracket (7) to mounting brackets (3) with bolts, washers and nuts provided. Tighten nuts 275 to 300 lb.in.

(7) Lower PS/PSM onto cradle (10); align front (7) and rear (3) mounting brackets with respective attaching points on cradle.

(8) Install four positive-lock quick-release pins (8).

(9) Remove sling (15) and hoist (1) from PS/PSM. Install propeller mounting flange cover (13, Fig. 308).

(10) Insert humidity indicator (9, Fig. 306) in protective envelope (8) and fasten, with indicator in correct position to be visible through window in fiberboard sleeve.

(11) Place PS/PSM log book, and other relevant papers to be shipped with PS/PSM in a weatherproof envelope and seal with pressure sensitive tape (10). Insert envelope in box fastened to skid base, and seal box.

CAUTION: REMOVE DESICCANT BAGS FROM PROTECTIVE BAG BEFORE INSTALLATION.

(12) Tie 8 (eight ounce) freshly activated desiccant bags (Ref. IPC) to PS/PSM, evenly disposed over its length, four bags on each side.

(13) Heat seal along top of envelope, using suitable hand sealing iron, leaving one corner open. Evacuate air, fold corner and heat seal.

(14) Install fiberboard sleeve (3, Fig. 306) over PS/PSM and fit in position on skid base (5).

(15) Fold protective envelope and align humidity indicator with window in sleeve. Fasten envelope folds with pressure sensitive tape (PWC05-070).

(16) Place cover (11) on sleeve, fold flaps down and seal at each corner with pressure sensitive tape.

(17) Install cover horizontally with 3/4-inch commercial strapping (2) and four reinforcing corners (1).

(18) Install cover and sleeve to skid base with two 3/4-inch commercial strapping (2) and eight metal reinforcing corners (1).

(19) Stencil PS/PSM number, serial number, oldest rubber assembly date, preservation and inspection dates on both ends of container.

11. Removal/Installation of Power Section/Power Section Module (PS/PSM) in Maintenance Stand

CAUTION: IF PS/PSM IS DROPPED, IN CONTAINER OR OTHERWISE, SEND ENGINE/PS/PSM TO AN OVERHAUL FACILITY FOR LIGHT OVERHAUL. INDICATE "DROPPED ENGINE".

A. Removal

(1) Locate sling mounting plate (10, Fig. 309) on propeller mounting flange (9). Align two dowels on flange with corresponding holes in plate, and install four screws from rear of mounting flange.

(2) Attach hoist (1) to lifting eye (2) on sling, and take up slack on hoist to support weight of PS.

(3) Remove nuts, washers and bolts fastening mounting ring (4) to flange C, and move power section (7) clear of mounting ring and stand (6).

(4) Reinstall bolts, washers and nuts on mounting ring.

(5) If a power section has to be converted into a power section module:

(a) Install propeller governor (Ref. 61-20-00, MAINTENANCE PRACTICES).

(b) Connect Py tube from FCU, to propeller governor (Ref. 73-10-08, MAINTENANCE PRACTICES).

(c) Connect propeller reversing linkage (Ref. 76-10-00, MAINTENANCE PRACTICES).

(d) Install oil pressure transfer elbow (Ref. 79-20-01, MAINTENANCE PRACTICES).

(e) Install external scavenge oil tubes (Ref. 79-20-01, MAINTENANCE PRACTICES).

B. Installation

(1) Remove Py tubing (Ref. 73-10-08, Removal/Installation) if applicable, pressure and scavenge oil tubing (Ref. 79-20-01, Removal/Installation), and propeller reversing linkage (Ref. 76-10-00, Removal/Installation), to allow attachment of mounting ring (4, Fig. 309).

(2) Install mounting ring on flange C with bolts, washers and nuts. Tighten nuts 75 to 85 lb.in.

(3) Install adapters (5, PWC30712) on stand (6) with bolts, washers and nuts at each adapter. Tighten bolts 600 to 650 lb.in.

(4) Position stand directly beneath suspended power section, aligning front face of mounting ring with rear face of adapters.

(5) Carefully lower power section (PS/PSM) (7) into stand (6) until adapters align with mounting ring holes. Fasten each adapter to mounting ring with bolts (14). Tighten bolts 250 to 270 lb.in.

(6) With PS/PSM (7) in a horizontal position, release bolts and sling (12) from propeller mounting flange (9) and remove sling assembly.

(7) Remove shipping covers and plugs (Ref. Fig. 308) immediately prior to installation of PS/PSM on gas generator assembly.

12. Removal/Installation of Gas Generator Module (GGM) from/in Container

CAUTION: IF GGM IS DROPPED, IN CONTAINER OR OTHERWISE, SEND ENGINE/GGM TO AN OVERHAUL FACILITY FOR LIGHT OVERHAUL. INDICATE "DROPPED ENGINE".

A. Removal

(1) Remove strapping (6, Fig. 302), cover (3), plywood supports (4 and 8), and inner sleeve from base (15). Retain reinforcing corners (5) and plywood supports.

(2) Cut protective envelope (12) to expose GGM.

(3) Install sling (1, Fig. 310) on hoist and adjust lifting eye for horizontal lift.

(4) Attach sling to lifting brackets (2 and 3) at flanges G and C respectively.

NOTE: Bracket (3) is part of sling.

CAUTION: DO NOT USE SLING AND LIFTING BRACKETS TO LIFT ENGINE/GGM ATTACHED TO SKID BASE

(5) Take up weight on sling, and remove mounting pins (9) fastening GGM to cradle (7).

(6) Maintain horizontal lift and raise GGM clear of cradle. Remove front mounting brackets (8) and rear mounting bracket (10).

(7) Replace front mounting brackets (8) and rear mounting bracket (10) on cradle with mounting pins (9). Retain all hardware in a suitable bag and attach to cradle for reuse.

(8) Remove ignition exciter (11) from cradle or skid base as applicable, and retain with GGM.

NOTE: Retain desiccant bag (Ref. IPC) in ignition exciter protective envelope until unit is required for use. Desiccant bag can be reactivated for reuse (Ref. Para. 7.D.).

(9) Remove desiccant bags from GGM and retain for reactivation and reuse.

(10) Remove envelopes containing shipping data, GGM log book and other relevant data from box fastened to skid base. Remove gasket for P2.5 adapter.

(11) Remove all shipping caps, covers and plugs (Ref. Fig. 311) from GGM.

(12) Retain protective wrapping around air inlet screen until engine is installed in airframe.

(12) Retain protective wrapping around air inlet screen until engine is installed in airframe.

(13) Retain caps, covers and plugs to prevent entry of foreign material and moisture accumulation until engine is installed (Ref. Fig. 311).

B. Installation

(1) With GGM in stand following preservation, fit all shipping caps, covers and plugs (Ref. Fig. 311).

(2) Install protective wrapping around air inlet screen and fasten with pressure sensitive tape (PWC05-070).

NOTE: Protective wrapping may be polyethylene sheet, aluminum foil, aluminized cotton backed material or waxed paper.

(3) Make sure cradle and skid base are serviceable and that a new or serviceable sleeve and lid are available.

(4) Remove GGM from stand.

(5) Remove ignition exciter and fasten ignition cables to GGM. Install protective caps (Ref. Fig. 311) and fasten with pressure sensitive tape (PWC05-070).

CAUTION: DO NOT USE STANDARD COMMERCIAL HARDWARE TO FASTEN ENGINE SUPPORT BRACKETS TO ENGINE OR CONTAINER. HARDWARE OF LOWER STRENGTH THAN SPECIFIED COULD CAUSE SERIOUS DAMAGE DURING SHIPPING.

(6) Check that interior of new protective envelope is free of dirt, oil, water or other contaminants.

(7) Lower GGM into protective envelope (4, Fig. 310) with gaskets aligned with engine lower mounting pads on each side of GGM and AGB.

(8) Attach front mounting brackets (8) and rear mounting bracket (10) to lower mounting pads and AGB respectively with bolts (6). Tighten front mounting bracket bolts 225 to 250 lb.in. and rear mounting bracket bolts 50 to 70 lb. in.

(9) Lower GGM into cradle and fasten front and rear mounting brackets (8 and 10) to cradle with mounting pins (9).

(10) Fasten humidity indicator to protective envelope in such a position as to be visible through sleeve window.

(11) Place GGM log book, log sheets, and other relevant documents in a protective envelope and seal with pressure sensitive tape (PWC05-070).

(12) Lower hoist so weight of GGM is supported by cradle, and remove sling and hoist.

CAUTION: REMOVE DESICCANT BAGS FROM PROTECTIVE ENVELOPES BEFORE INSTALLATION

(13) Fasten 12 freshly activated, eight unit desiccant bags (Ref. IPC) evenly over the length of GGM, six each side.

(14) Seal top of protective envelope (12, Fig. 302) with suitable sealing iron, leaving one corner open, evacuate air and finish sealing.

(15) Place ignition exciter (11), and one four unit desiccant bag in protective envelope, heat seal envelope leaving one corner open, evacuate air and finish sealing.

(16) Fasten exciter to cradle using bolts and washers or pressure sensitive tape (2).

(17) Place inner sleeve (9, Fig. 302) plywood support (8), and outer sleeve (7) over GGM in position on skid base (15).

(18) Make sure humidity indicator aligns with sleeve window, and fold protective envelope. Fasten envelope with pressure sensitive tape (2).

(19) Close sleeve, and fasten with pressure sensitive tape (2).

(20) Install plywood support (8) and cover (3) on sleeve, fold flaps down and seal at each corner with pressure sensitive tape (2).

(21) Install four reinforcing corners (5), and fasten corners and cover horizontally with strapping (6).

(22) Fasten cover and sleeve to skid base with sixteen reinforcing corners (5) and four lengths of strapping (6).

13. Removal/Installation of Gas Generator Module from/in Stand

CAUTION: IF GGM IS DROPPED, IN CONTAINER OR OTHERWISE, SEND ENGINE/GGM TO AN OVERHAUL FACILITY FOR LIGHT OVERHAUL. INDICATE "DROPPED ENGINE".

A. Removal

(1) For (PWC51140) or (PWC70907) engine stands:

WARNING: MAKE SURE FLOOR LOCK IS FULLY APPLIED IN LOCKED POSITION TO PREVENT ENGINE STAND FROM MOVING.

(a) Attach lifting bracket (2, Fig. 312, PWC50373) to lockplate (18) of mount ring at 12 o'clock location and secure with release pin (3).

(b) Attach sling (1, PWC51861-600) to lifting bracket (2) and take up weight of engine with hoist.

(c) Remove six bolts (19) and washers (20 and 21) attaching mount ring to engine stand (17).

(d) Remove GGM and lift clear of stand.

(e) Attach shackles (5) of engine sling to lifting brackets at GGM, Flanges C and G.

(f) Remove release pin (3) and remove lifting bracket (2, PWC50373) from mount ring.

(g) Remove bolts (16) securing mount ring halves (14 and 15) together.

(h) Remove cotterpins (13), nuts (12), washers (11 and 10) and bolts (9) securing mount ring halves to engine mount pads (6).

(i) Remove four bolts (7) and washers (8) securing engine mount pads (6) to GGM.

B. Installation

(1) For (PWC51140) or (PWC70907) engine stands:

(a) With GGM suspended from sling (1, Fig. 312, PWC51861-600), install four mount pads (6) at 2, 4, 8 and 10 o'clock positions on the GGM. Secure each pad with bolts (7) and washers (8). Lubricate bolts (7) with (PWC06-007). Torque 225 to 300 lb.in.

(b) Place mount ring halves (14 and 15) in position on gas generator case and secure mount ring together with lockplates (18) at 12 and 6 o'clock positions with bolts (16). Torque bolts securely.

(c) Attach engine left and right side mount ring halves (14 and 15, PWC70334) to respective mount pads (PWC32080) at 2, 4, 8 and 10 o'clock positions with bolts (9), washers (10 and 11) and nut (12). Torque bolt 500 to 600 lb.in. and secure with cotterpin (13).

(d) Install lifting bracket (2, PWC50373) on lockplate (18) of mount ring at 12 o'clock position and secure with release pin (3).

(e) Remove lifting sling shackles (5) from GGM lifting brackets at Flanges C and G allowing lifting bracket (2)(PWC50373) to take up the weight.

WARNING: MAKE SURE FLOOR LOCK IS FULLY APPLIED IN LOCKED POSITION TO PREVENT MOVEMENT OF ENGINE STAND.

(f) Position GGM into stand (17) and secure mount ring (PWC70334) to stand with bolts (19) and washers (20 and 21). Torque bolts securely.

(g) Remove release pin (3) and lifting bracket (2, PWC50373).

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304 Power Section/Power Section Module Shipping/Storage Container Stacking Limitations

72-00-00
ENGINE, TURBOPROP - REMOVAL/INSTALLATION

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire, unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC09-005	Compound, Universal Jointing

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC30269	Ring	
PWC34752	Adapter	
PWC51140	Engine Stand	Replaced by PWC70907
PWC51861-600	Sling Assy, Engine	
PWC70099	Sling, Power Section	Without Propeller
PWC70104	Sling, Power Section	With Propeller
PWC70907	Engine Stand	

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation of Engine

A. Removal of Engine from Airframe

CAUTION: IF ENGINE IS DROPPED, IN CONTAINER OR OTHERWISE, SEND THE ENGINE TO OVERHAUL FACILITY FOR LIGHT OVERHAUL. INDICATE "DROPPED ENGINE".

CAUTION: AIRFRAME MOUNTED IGNITION EXCITER AND ENGINE ELECTRONIC LIMITER MUST BE REMOVED WITH THE ENGINE AND NOT LEFT CONNECTED TO AIRFRAME INPUT LEADS.

CAUTION: BE VERY CAREFUL TO PREVENT IMPACT DAMAGE TO THE PROPELLER SHAFT AND ENGINE DURING REMOVAL FROM THE AIRFRAME.

(1) Remove engine from airframe (Ref. Aircraft Maintenance Manual) with sling (PWC51861) and suitable hoist.

NOTE: After you remove the engine from the airframe, install it correctly in the shipping/storage container if the engine is to be sent to an overhaul facility, or in engine stand if heavy maintenance is to be done (Ref. SERVICING).

(2) Examine the propeller shaft for impact damage that can possibly occur during propeller removal (Ref. 72-10-00, REDUCTION GEARBOX - MAINTENANCE PRACTICES).

B. Installation of Engine in Airframe

(1) Install engine-mounted airframe-supplied accessories (Ref. Aircraft Maintenance Manual).

> CAUTION: BE VERY CAREFUL TO PREVENT IMPACT DAMAGE TO THE PROPELLER SHAFT AND ENGINE WHEN YOU INSTALL THE ENGINE ON THE AIRFRAME.

(2) Install engine in airframe (Ref. Aircraft Maintenance Manual), with sling (PWC51861) and suitable hoist.

NOTE: Where ignition exciter is airframe mounted, install unit in accordance with Aircraft Maintenance Manual.

(3) Examine the propeller shaft for impact damage that can possibly occur during propeller installation (Ref. 72-10-00, REDUCTION GEARBOX - MAINTENANCE PRACTICES).

(4) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do checks associated with Installation/Replacement of Engine (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

6. Removal/Installation of Power Section/Power Section Module (PS/PSM)

CAUTION: IF PS/PSM IS DROPPED, IN CONTAINER OR OTHERWISE, SEND THE PS/PSM/ENGINE TO OVERHAUL FACILITY FOR LIGHT OVERHAUL. INDICATE DROPPED ENGINE.

A. Removal of Power Section/Power Section Module (PS/PSM) with Propeller Installed

CAUTION: PS/PSM MUST NOT BE LEFT IN SLING OVERNIGHT OR FOR LONGER PERIOD. REMOVE PROPELLER AND INSTALL PS/PSM IN STAND.

(1) Drain engine oil (Ref. SERVICING, Oil Servicing).

(2) Disconnect governor air tube (6, Fig. 401) from bulkhead coupling (8).

(3) Disconnect electrical connections to engine-mounted accessories on reduction gearbox, as necessary (Ref. Aircraft Maintenance Manual).

(4) Remove cotterpin, nut, washers, spacer and bolt fastening front clevis of push/pull terminal (3) to propeller reversing lever (15).

(5) Remove cotterpin, nut, washers, spacer and bolt fastening propeller governor interconnect rod (4) to reset arm on propeller governor (1).

(6) Release locknut fastening front swivel joint (5) of propeller reversing linkage to front lifting bracket.

(7) Remove inner nut and bolt and loosen outer nut and bolt fastening swivel joint retaining plate to front lifting bracket. Swing retaining plate and lift forward end of propeller reversing linkage clear of front lifting bracket. Suitably support linkage.

(8) Remove alumel and chromel nuts fastening T5 trim thermocouple wiring harness. Remove wiring harness, and fasten harness and airframe leads, fingertight only to terminal block.

(9) Attach sling (2) to front lifting bracket with split pin. Take up slack on hoist.

NOTE: Figure 401 shows sling attached to propeller flange for removal without propeller.

(10) Note position of components on flange C (7), and remove nuts, bolts, and components, and separate PS/PSM from gas generator module (GGM). Using sling, partially withdraw PS/PSM.

(11) Cap all tubes (11) and install plugs on couplings (12).

CAUTION: DO NOT ROTATE OR DISTURB INTERSTAGE SEALING RING ON COMPRESSOR TURBINE STATOR HOUSING UNLESS IT IS TO BE REMOVED FOR INSPECTION (REF. 72-50-01, MAINTENANCE PRACTICES).

(12) Withdraw PS/PSM from GGM and retain in sling.

(13) Install suitable protective cover over GGM and PSM openings.

B. Removal of Power Section/Power Section Module (PS/PSM) without Propeller Installed

(1) Drain oil (Ref. SERVICING, Oil Servicing).

(2) Disconnect coupling nut of governor air tube (6, Fig. 401) from bulkhead coupling (8).

(3) Disconnect electrical connections to engine-mounted accessories on reduction gearbox, as necessary (Ref. Aircraft Maintenance Manual).

(4) Remove cotterpin, nut, bolt and spacer fastening front clevis of push-pull terminal (3) to propeller reversing lever (15).

(5) Remove cotterpin, nut, washers, spacer and bolt fastening propeller governor interconnect rod (4) to reset arm on propeller governor (1).

(6) Release locknut fastening front swivel joint (5) of propeller reversing linkage to front lifting bracket.

(7) Remove inner nut and bolt and loosen outer nut and bolt fastening swivel joint retaining plate to front lifting bracket. Swing retaining plate and lift forward end of propeller reversing linkage clear of front lifting bracket. Suitably support linkage.

(8) Remove alumel and chromel nuts fastening T5 trim thermocouple wiring, T5 probe harness and airframe wiring to T5 terminal block at flange C.

(9) Note position of all components on flange C, and remove nuts, bolts, and components.

(10) Locate sling (2) on propeller mounting flange and engage four dowels in flange bolt holes. Attach sling to flange A to prevent PS/PSM rotation.

(11) Remove nuts and bolts from flange C (7) and using sling, partially withdraw PS/PSM from gas generator module (GGM).

(12) Cap all tubes (11) and install plugs on couplings (12).

CAUTION: DO NOT ROTATE OR DISTURB INTERSTAGE SEALING RINGS ON CT STATOR HOUSING UNLESS THEY ARE TO BE REMOVED FOR INSPECTION (REF. 72-50-01, MAINTENANCE PRACTICES).

(13) Withdraw PS/PSM from GGM and retain in sling.

NOTE: When removing PS/PSM from engine mounted in airframe, PS/PSM should be mounted in engine stand (PWC30800, (PWC34300), (PWC51140) or (PWC70907), Ref. SERVICING) using mount ring (PWC30269) and adapters (PWC30712) or (PWC34752).

(14) Install suitable protective cover over GGM and PSM openings.

C. Installation of Power Section/Power Section Module (PS/PSM)

CAUTION: WHEN INSTALLING A REPLACEMENT POWER SECTION MODULE (PSM) ONTO A GAS GENERATOR MODULE (GGM), MAKE SURE THE APPROPRIATE POWER TURBINE STATOR ASSEMBLY IS INSTALLED IN THE PSM TO MAINTAIN ORIGINAL MATCHING AND THE PROPER T5 IMMERSION THERMOCOUPLES ARE INSTALLED TO SUIT THE CONFIGURATION OF THE GGM COMBUSTION CHAMBER LINER.

(1) Install appropriate sling (2, Fig. 401) on PS/PSM; using hoist take weight of PS/PSM and remove from stand (10).

(2) Remove caps from pressure and scavenge oil tubes (11) and install new preformed packings on tubes.

(3) Remove plugs from couplings (12) at flange C on PS/PSM.

(4) Examine mating areas of GGM and PS/PSM for cleanliness and security of parts; remove any protective covers installed during maintenance period.

(5) Examine mating area flange C of GGM and power section exhaust duct are free from nicks, scratches, dents and other damages that affect sealing efficiency. Apply a thin layer of jointing compound (PWC09-005) on exhaust duct flange C before assembly.

NOTE: The jointing compound (PWC09-005) is to be applied only to flanges that are flat and is not required for flanges that incorporate a seal ring.

(6) Check and centralize interstage sealing ring on compressor turbine stator housing; this may be done by inserting a piece of beeswax of suitable size, in groove at 12 o'clock position in housing to prevent ring dropping to bottom of groove. Be sure ring is in same position noted at disassembly.

NOTE: Make sure pressure side of sealing ring (marked on ring) is facing mating flange of small exit duct to CT shroud housing.

CAUTION: CHECK FLANGE C OF GGM AND EXHAUST DUCT ARE PARALLEL AND AXIALLY ALIGNED. IF ASSEMBLIES DO NOT MATE FREELY, DO NOT USE FORCE. WITHDRAW PS/PSM AND CHECK FOR CAUSE OF INTERFERENCE.

(7) Using hoist, move PS/PSM carefully into position on GGM. Align pressure and scavenge oil tube couplings with respective tubes at rear of engine, and mate PS/PSM and GGM at flange C.

(8) Install bolts, through mating flanges with bolt heads rear, and components at previously marked positions, to flange C (Ref. Fig. 402 and IPC). Install clamps and bolts with self-locking nuts. Tighten nuts in diametric sequence 36 to 40 lb.in.

(9) Remove sling from propeller mounting flange or front lifting bracket, as applicable.

(10) Connect T5 probe harness, trim thermocouple harness and airframe leads to appropriate posts on T5 terminal block with nuts. Torque alumel nut 24 to 40 lbf.in. and chromel nut 15 to 20 lbf.in.

(11) Install Py air tube (6, Fig. 401) to bulkhead coupling (8) at center fireseal mount ring (9). Tighten coupling nut 90 to 100 lb.in., and lockwire.

(12) Install front swivel joint (5) of propeller reversing linkage in slot of front lifting bracket. Swing retaining plate over swivel joint and install inner bolt and nut. Tighten inner and outer nuts 36 to 40 lb.in. Tighten front swivel joint locknut 95 to 105 lb.in., and lockwire.

(13) Install spacer sleeve in propeller reversing lever (15) and locate clevis end of push-pull terminal (3) on propeller reversing lever with bolt and castellated nut. Tighten nut 12 to 18 lb.in., and install cotterpin.

(14) Locate governor interconnect rod (4) on reset arm of propeller governor (1) with bolt, washer and castellated nut. Tighten nut 12 to 18 lb.in., and install cotterpin.

(15) Install, tighten and lockwire airframe electrical connections as required (Ref. Aircraft Maintenance Manual).

(16) Install new preformed packing on chip detector housing (13) and install in reduction gearbox drain boss. Tighten 45 to 55 lb.in., and lockwire.

(17) Install engine in airframe (Ref. Para. 5.B.).

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Figure 401 Removal/Installation of Power Section/Power Section Module (PS/PSM)

Figure 402 Component Location on Engine Flanges

72-00-00
ENGINE, TURBOPROP - INSPECTION

1. General

A. The inspection criteria for the various sections of the engine are summarized in Table 601. Detailed inspection procedures are provided, where applicable, in the relevant Inspection/Check sections of subject chapters in this manual.

B. The inspection procedures detailed are considered a normal function of operating organizations and are intended as a guide for minimum inspection and maintenance requirements.

C. ROUTINE inspection coincides with the daily or preflight airframe inspection. MINOR inspection is coincidental with a typical airframe zone inspection. The intervals at which these inspections are performed may be altered by the aircraft manufacturer's maintenance program and approved by the operator's local airworthiness authority.

D. Engines maintained in compliance with the aircraft manufacturer's approved maintenance program must be inspected as required by Condition Monitoring in accordance with the Operator/Local Authority agreed plan. Engines operating in salt-laden or harsh atmospheres must be subjected to additional inspections for corrosion and compressor erosion.

E. Hot section inspection frequencies are outlined in the applicable service bulletin (Ref. Transport Canada Approved Service Bulletins) and will be updated periodically as dictated by service experience and time-between-overhauls (TBO). If, in the light of experience, it becomes necessary to modify procedures, these will be included in subsequent revisions to this manual.

F. Retaining rings (spirolox, etc.) used throughout the engine are to be inspected for distortion and general condition. Distorted rings are not acceptable and must be replaced (Ref. 70-00-00, MAINTENANCE PRACTICES, Locking Devices).

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC04-001	Grease, Synthetic
PWC15-011	Inhibitor, Rust
PWC15-015	Compound, Corrosion Preventative
PWC15-016	Compound, Corrosion Inhibitor
PWC15-017	DELETED

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC34910-101	Borescope Assembly
PWC34910-600	Guide Tube
PWC34913	Holding Fixture
PWC34941	Wrench
PWC73013	Borescope Kit, Fiberscope

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Corrosion

A. High Temperature Alloy Corrosion

High temperature alloy corrosion may be identified as metal loss or pitting, but more usually appears as local swelling or buildup due to greater volume occupied by nickel oxides. These corrosion products vary in color from black to green and in the advanced state there will be cracking and flaking, referred to as exfoliation.

Care should be taken to distinguish between corrosion buildup and possible light brown or rust colored deposits which are essentially harmless combustion by-products. The latter are usually more widespread over hot section components and while possibly affecting performance will not directly affect compressor turbine mechanical integrity.

B. Sulfidation

Sulfidation is a same name for a type of hot corrosion which can effect turbine area components of gas turbine engines.

Sulphates form at engine operation temperatures with sodium and sulphur present. Most aviation turbine fuels contain sulphur in sufficient quantities for sulfidation. Same sources of sodium are seawater, atmospheric pollutants and volcanic discharges.

Sulfidation attack most frequently effects the first-stage turbine blades, but sulfidation of shroud segments and other non-rotating components is not uncommon.

Degradation of the aluminide coating applied to CT blades will involve some loss of the base alloy. Post coating strip inspection may reveal that a majority of components should be rejected.

Stage 1 - Initial Coating Deterioration (Sulfidation): Small rough of the surface caused by some growth and localized breakdown of the oxide scale layer is found. Mechanical integrity is not effect.

Stage 2 - Initial Corrosion: Roughness of surface is more marked as oxide layer breakdown continues. Mechanical integrity is not affected.

Stage 3 - Advanced Corrosion: Oxidation of the base material has penetrated to significant depth, with obvious buildup scale. Integrity seriously affected. Progression to stage 4 will accelerate.

Stage 4 - Severe Corrosion: Deep penetration of attack with large "blister" of scale. Failure is likely due to loss of structural material.

All stages of attack may be encountered, although stages 3 and 4 will normally be limited to those engines which are directly

All stages of attack may be encountered, although stages 3 and 4 will normally be limited to those engines which are directly exposed to salt water.

Desalination wash using plain water with an antifreeze agent, if required, minimizes attack. During stages 1 and 2 the wash will dissolve and carry away sulfates on component surface.

Water used for washing must be free from contamination, in most cases drinking water is acceptable. Otherwise demineralized water should be used.

Wash frequency depends on the amount of contamination. Washing weekly is probably the minimum acceptable. Maritime areas may require washing daily or before each flight.

Recommended wash frequency is based on operator's estimate of corrosion environment or refer to Chapter 71-00-00 (Ref. POWER PLANT - CLEANING, Internal Washing).

An alternative method of establishing wash frequency is to monitor blade condition using a borescope. Wash schedule should be adjusted according to results.

If sulfidated blades continue in service, a borescope inspection program must be started. This program must continue until a reliable progression rate for the applicable circumstances can be established and a blade life limit determined. The recommended inspection interval is 200 hours. Blade lives established this way must be examined periodically to account for possible changes in the factors affecting sulfidation.

Two points are important to consider when analysis of sulfidated blades:

- Stage of corrosion attack.
- Estimate of progression rate to stage 3.

At stage 3 mechanical integrity is jeopardized and blades should be removed from service. When estimating progression beyond stage 1 or 2, exposure to contamination and improvements in wash programs should be taken into account.

6. Corrosion Inhibition

A. Corrosion Inhibition Procedure

NOTE: 1. For engines operating in corrosive environments, it may be necessary to do more frequent periodic preventative maintenance including the application of corrosion inhibitors to the Accessory Gearbox Housing, Reduction Gearbox Housing (Front and Rear) and the Compressor Inlet Case.

NOTE: 2. As the corrosion inhibitor starts to evaporate or is washed away in service, reapply as required to determine the optimum period between applications.

NOTE: 3. Discontinue the use of (PWC09-003) if using a corrosion inhibitor.

NOTE: 4. Continue to follow the recommended external and internal engine wash schedule (Ref. Chap. 71-00-00) after use of corrosion inhibitors.

(1) Do a compressor desalination wash followed by a compressor turbine desalination wash (Ref. 71-00-00, Cleaning).

(2) Do an external engine wash (Ref. 71-00-00, Cleaning).

(3) For components listed below, remove corrosion in accordance with the applicable Approved Repairs procedure:

- AGB Housing (Ref. 72-60-00, Approved Repairs)
- RGB Front and Rear Housings (Ref. 72-10-00, Approved Repairs)
- Compressor Inlet Case (Ref. 72-20-00, Approved Repairs)

WARNING: ALLOW THE ENGINE TO COOL COMPLETELY BEFORE APPLYING CORROSION INHIBITOR. IF CORROSION INHIBITOR IS SPRAYED ONTO A HOT SURFACE, THE CARRIER SOLVENT WILL RAPIDLY EVAPORATE AND WILL EASILY IGNITE IF AN IGNITION SOURCE IS PRESENT.

WARNING: DO NOT APPLY CORROSION INHIBITOR ON CONNECTORS, WIRING HARNESS, PROBES, RUBBER MATERIAL, ELECTRICAL EQUIPMENT OR ON HOT SECTION OF ENGINE.

WARNING: REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR INFORMATION SUCH AS HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(4) Apply rust inhibitor (PWC15-011) or corrosion preventative compound (PWC15-015) or corrosion inhibitor compound (PWC15-016) or equivalent onto the painted surfaces with a spray or brush per the manufacturer's instructions.

(5) Check to make sure that the surface is completely coated.

B. Air Inlet Case Corrosion Prevention (Ref. Fig. 601)

(1) Apply rust inhibitor (PWC15-011) or corrosion preventative compound (PWC15-015) or corrosion inhibitor compound (PWC15-016) or equivalent after every desalination wash.

NOTE: 1. Use of corrosion inhibitor will prevent the increase of corrosion without high maintenance work.

NOTE: 2. Use a larger diameter heat shrink tube when you apply corrosion inhibitor as drop and a smaller diameter heat shrink tube to apply a spray of corrosion inhibitor solution.

NOTE: 3. Identify the location and area of corrosion on the inlet case and apply the corrosion inhibitor as a drop or spray.

CAUTION: USE OF TOO MUCH CORROSION INHIBITOR CAN CAUSE CONTAMINATION OF THE COMPRESSOR.

(2) Apply small quantity of rust inhibitor (PWC15-011) or corrosion preventative compound (PWC15-015) or corrosion inhibitor compound (PWC15-016) or equivalent to all corroded areas on the air inlet case with a spray can or equivalent, with a heat shrink tube (0.13 in. or larger diameter) and 0.024 in. safety wire.

(3) Spray rust inhibitor (PWC15-011) or corrosion preventative compound (PWC15-015) or corrosion inhibitor compound (PWC15-016) or equivalent between the air inlet case and the compressor housing with spray can, 0.13 in. heat shrink tube and 0.024 in. safety wire.

(4) Apply rust inhibitor (PWC15-011) or corrosion preventative compound (PWC15-015) or corrosion inhibitor compound (PWC15-016) or equivalent as a drop between the air inlet case and the No. 1 bearing housing at 12 o'clock position with spray can, large diameter heat shrink tube and 0.024 in. safety wire.

(5) Examine the application of corrosion inhibitor on the air inlet case with a boroscope.

NOTE: 1. The corrosion inhibitor can also be applied on the air inlet case by connecting the heat shrink tube to the borescope with a clip.

NOTE: 2. It is possible to do this procedure through the air inlet plenum access cover and inlet screen.

(6) If there is too much corrosion on the air inlet case surface, do the steps that follow:

(6) If there is too much corrosion on the air inlet case surface, do the steps that follow:

(a) Remove the inlet case screen (Ref. 72-20-00, COMPRESSOR AIR INLET CASE - MAINTENANCE PRACTICES).

(b) Soak a lint free cloth in the rust inhibitor (PWC15-011) or corrosion preventative compound (PWC15-015) or corrosion inhibitor compound (PWC15-016) or equivalent and apply corrosion inhibitor on the air inlet case.

(c) Install the inlet case screen (Ref. 72-20-00, COMPRESSOR AIR INLET CASE - MAINTENANCE PRACTICES).

7. Control Linkage

Inspect all engine controls for correct operation. Make sure the linkages from the cockpit controls to the engine control levers are connected to permit full and free movement. Make sure controls are adjusted to permit over-travel of power control lever to ensure full operation of engine and that the linkage can be operated without interference. Also, investigate and eliminate any slack in the control system. Lubricate and adjust all controls (Ref. Aircraft Maintenance Manual).

8. Periodic Inspection

NOTE: The following tolerance is established for maintenance scheduling convenience.

Unless otherwise stated, the tolerance for periodic inspections is ten percent (10%), or up to a maximum of 100 hours operating time, whichever is less. The tolerance for scheduled inspections is ten percent (10%), or up to a maximum of 30 days calendar time, whichever is less.

Subsequent intervals will be adjusted to re-establish the original schedule. When an inspection is done more than 10% early, subsequent inspections will be advanced as required to not exceed the maximum tolerance.

For inspection items and intervals, refer to Table 601. Refer to Inspection/Check in the referenced CHAP/SEC/SUB for limits and disposition of items.

Table 601 Periodic Inspection

9. Borescope

NOTE: The borescope inspection is not intended to replace or diminish the importance of doing an HSI, but is intended to monitor the internal components of the engine to help reduce the cost of future repairs/refurbishments.

A. General

CAUTION: HEAT CAN DAMAGE THE BORESCOPE. ENGINE TEMPERATURE MUST BE LESS THAN 66°C (150°F) BEFORE YOU DO AN INSPECTION. THE SATISFACTORY COOLING PERIOD FOR STANDARD AMBIENT CONDITIONS IS 40 MINUTES (COLD SECTION) OR TWO HOURS (HOT SECTION) AFTER ENGINE SHUTDOWN, BUT CAN CHANGE WITH AMBIENT CONDITIONS. IF REQUIRED, DO DRY MOTORING RUNS TO ACCELERATE COOLING (REF. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

The borescope is a optical fibrescope or a digital devise which lets an operator to examine internal areas of the engine without removal or disassembly of the engine. Access is through ports or openings created by removal of engine components. Personnel doing inspection should be qualified to use borescope and analyze results. The borescope is a delicate device vulnerable to shocks, twisting and pinching. Use care and attention when handling tool. Examine the borescope assembly and its accessories (Ref. Fig. 603), and the following procedures.

B. Description

The borescope assembly comprises a pattern controlled rigid guide tube, a direct viewing flexible fiberscope, light source, side viewing adapter, and other accessories. If required, a camera may be used to record engine areas being inspected.

An operator can do on-wing inspections of the CT, CT stator assembly, combustion chamber liners, including cooling rings and dome, and AGB and RGB gears.

C. Removal /Installation of Side Viewing Adapter (Ref. Fig. 604)

(1) Installation

(a) Hold fiberscope as close as possible to distal end, and remove protective ring.

CAUTION: INSTALL SIDE-VIEWING ADAPTER CAREFULLY. IF NOT INSTALLED AND TIGHTENED CORRECTLY, ADAPTER COULD FALL INTO ENGINE. OVERTIGHTENING COULD DAMAGE DISTAL.

(b) Hold fiberscope as close as possible to distal end, and install adapter with indexing slot and lug aligned. Tighten adapter fingertight.

(2) Removal

(a) Hold fiberscope as close as possible to distal end, and remove side-viewing adapter.

CAUTION: INSTALL PROTECTIVE RING CAREFULLY. IF NOT INSTALLED AND TIGHTENED CORRECTLY, RING COULD FALL INTO ENGINE. OVERTIGHTENING COULD DAMAGE DISTAL.

(b) Hold fiberscope as close as possible to distal end, and install protective ring. Tighten ring fingertight.

(3) Light source

NOTE: Specify power requirement when purchasing borescope.

(a) A halogen lamp, with either 110V, 60 Hz, or a 220V, 50 Hz power supply.

(b) Remove top cover from light source to replace lamp.

(c) Set intensity knob at maximum for best results.

(d) Before installing light source, refer to manufacturer's instructions.

D. Removal/Installation of Camera

(1) A camera may be used to record internal engine components. It must be equipped with a 50 mm F1.8 lens.

(2) Install camera:

CAUTION: DO NOT USE COMPRESSED AIR TO CLEAN CAMERA, BORESCOPE, OR ASSOCIATED EQUIPMENT.

(a) Clean camera viewfinder, reflex mirror, focusing screen, and lens with lens cleaning tissue and lens cleaner.

(b) Install endoscopic focusing screen in camera.

(c) Install lens.

(d) Install adapter (CAII) on lens.

(e) Install film in camera (Ref. Camera Handbook).

(f) Set camera film speed to suit film, and set exposure to -2 (Ref. Camera Handbook).

(g) Align bayonet slots of adapter and install camera on borescope eyepiece pins.

NOTE: Make sure distal is not moved while taking photographs.

(3) Remove camera:

(a) Turn outer ring of camera adapter to disengage locking mechanism and remove camera.

(b) Remove camera adapter from lens.

(c) Remove film from camera and using a suitable label, add the following information:

Engine S/N.

Date and area photographed.

Engine TSN/TSO or cycles since last overhaul.

Reason for inspection.

E. Removal/Installation of Guide Tube (Ref. Fig. 605)

(1) Installation

(a) Remove appropriate fuel manifold adapter(s) (Ref. 73-11-05, Inspection/Check).

(b) Ease guide tube (PWC34910-600) through manifold adapter opening into combustion chamber and exit duct area turning guide tube three-quarters of a turn CCW.

NOTE: The rigid, pattern controlled guide tube must be inserted freely with NO force.

(c) The guide tube end locates between vanes of the CT stator, while the supporting flange is attached to the adapter boss.

(2) Removal

(a) Loosen knurled screw to release guide tube supporting flange.

(b) Withdraw guide tube, turning CW.

(c) Install fuel manifold adapter(s) (Ref. 73-11-05, Inspection/Check).

F. Inspection of Combustion Chamber Liner and Large Exit Duct

CAUTION: MAKE SURE ENGINE TEMPERATURE IS BELOW 60°C (140°F).

(1) Remove fuel manifold adapter as necessary (Ref. 73-11-05, Inspection/Check).

(2) Fasten holding fixture (PWC34913) to flange C with nuts and bolts, insert fiberscope into opening, fasten eyepiece to fixture, and attach light source.

(3) Examine combustion chamber liner (Ref. Para. 10.C. and Fig. 606, Area 1 and Area 2).

(4) Remove fiberscope, light source, and fixture.

(5) Install fuel manifold adapter (Ref. 73-11-05, Inspection/Check).

G. Inspection of CT Stator Assembly

(1) Install guide tube (Ref. Para. E.).

(2) Fasten holding fixture (PWC34913) to flange C, install borescope, and attach light source (Ref. Fig. 603).

CAUTION: MAKE SURE ENGINE TEMPERATURE IS BELOW 60°C (140°F).

(3) Insert fiberscope into guide tube.

NOTE: The side-viewing adapter will add to inspection capability (Ref. Para. C.).

(4) Examine CT stator assembly (Ref. Para. 10.D.).

(5) Remove light source, borescope and holding fixture.

(6) Remove guide tube (Ref. Para. E.).

H. Inspection of CT Blades and Shroud Segments

(1) Install guide tube (Ref. Para. E.).

(2) Fasten holding fixture (PWC34913) to flange C (Ref. Fig. 603).

CAUTION: MAKE SURE ENGINE TEMPERATURE IS BELOW 60°C (140°F).

(3) Insert fiberscope into guide tube while looking through eyepiece. Stop inserting when distal reaches end of guide tube.

NOTE: Make sure distal actuating lever is in neutral position when installing/removing fiberscope.

(4) Remove starter-generator (Ref. Aircraft Maintenance Manual).

NOTE: The inspection of the CT disk and shroud segments can be done without removal of the starter-generator. Install the wrench (PWC34941) in the AGB drive pad No. 5 or 6 and turn the compressor.

(5) Install wrench (PWC34941) in AGB splined gearshaft.

(6) Loosen knurled knob on holding fixture.

CAUTION: MAKE SURE DISTAL TIP IS NOT BETWEEN CT BLADES BEFORE TURNING COMPRESSOR.

(7) Examine CT blades, and shroud segments (Ref. Para. 10.E. and F.) while turning compressor.

(8) Retract fiberscope into guide tube.

(9) Remove wrench from splined gearshaft, and install starter-generator (Ref. Aircraft Maintenance Manual).

(10) Remove fiberscope from guide tube.

(11) Remove borescope and holding fixture.

(12) Remove guide tube (Ref. Para. E.).

I. Inspection of PT Disk Face (Ref. Fig. 607)

NOTE: Based on the operator experience, examine the PT blades for sulphidation.

(1) Remove one of the airframe exhaust ducts for access (Ref. Aircraft Maintenance Manual).

(2) Insert fiberscope into exhaust stub with micro borescope (PWC73013).

CAUTION: MAKE SURE THE PROPELLER IS NOT ROTATING AS IT CAN DAMAGE THE BORESCOPE TIP.

(3) Examine the power turbine disk face for any fretting wear identified between power turbine stator seal and power turbine disk.

(4) If there is fretting wear on power turbine disk face, send the engine or the power section to an approved P&WC overhaul facility.

J. Inspection of First-Stage Compressor Rotor and Air Inlet Surfaces

CAUTION: KEEP COMPRESSOR INLET AREA CLEAR OF ALL FOREIGN OBJECTS. FOREIGN OBJECTS CAN MOVE TO DOWN STREAM ENGINE COMPONENTS AND CAUSE DAMAGE DURING SUBSEQUENT OPERATION.

(1) Install the holding fixture (PWC34913) to the engine rear lifting bracket, and attach the eyepiece to the holding fixture, and connect light source.

CAUTION: DO NOT TRY TO PUSH THE BORESCOPE MORE THAN THE FIRST-STAGE COMPRESSOR STATOR.

(2) Put the fiberscope into the compressor inlet, and adjust to correct position for the inspection of the first-stage compressor rotor and the air inlet case surfaces.

(3) Examine the first-stage compressor rotor (Ref. 72-30-05, COMPRESSOR ROTOR - MAINTENANCE PRACTICES).

(4) Examine the compressor air inlet surfaces for corrosion (Ref. 72-20-00, COMPRESSOR AIR INLET - MAINTENANCE PRACTICES).

(5) Remove the fiberscope, light source, eyepiece and the holding fixture (PWC34913).

K. Inspection of Accessory Gearbox Gears

(1) Remove oil filler cap/ gage assembly and filler tube from accessory gearbox housing (Ref. 72-60-00, Removal/Installation).

(2) Remove starter-generator (Ref. Aircraft Maintenance Manual).

NOTE: When the AGB inspection is done at the same time as the first-stage compressor rotor, the AGB gears can be turned by the first-stage rotor. Do not use bare hands.

(3) Insert wrench (PWC34941) into splined gearshaft.

(4) Clamp holding fixture (PWC34913) to engine rear lifting bracket, fasten eyepiece to holding fixture, and connect light source.

CAUTION: MAKE SURE THAT THE END OF THE FIBERSCOPE DOES NOT TOUCH THE GEARS.

(5) Put the fiberscope into the oil filler hole and examine gear teeth, while second operator rotates geartrain with the wrench (PWC34941). Examine the gears (Ref. Para. 10.I.).

(6) Remove wrench, light source, fiberscope, eyepiece and holding fixture.

(7) Install starter-generator (Ref. Aircraft Maintenance Manual).

(8) Install oil filler tube, filler cap and gage assembly (Ref. 72-60-00, Removal/Installation).

L. Inspection of Reduction Gearbox Gears

(1) Remove scavenge oil strainer (Ref. 72-10-00, Removal/Installation).

(2) Fasten holding fixture (PWC34913) to flange A, attach eyepiece to fixture, and connect light source (Ref. Fig. 603).

CAUTION: MAKE SURE THAT THE END OF THE FIBERSCOPE DOES NOT TOUCH THE GEARS.

(3) Put the fiberscope into the oil strainer access along the lower passage until the first-stage planet gears can be seen. To view the second-stage gears, put the fiberscope in an upward direction. Examine the gears (Ref. Para. 10.I.).

(4) Manipulate fiberscope while second person rotates geartrain by turning the propeller by hand.

(5) Remove wrench, light source, fiberscope, eyepiece and holding fixture.

(6) Install scavenge oil strainer (Ref. 72-10-00, Removal/Installation).

M. Fault Isolation

(1) The possible sources of, and remedies for problems encountered when using borescope are shown in Table 602.

Table 602 Fault Isolation

10. In-service Inspection

A. Hot Section Components

In-service inspection is used to determine performance deterioration. Parts can be inspected using a borescope (Ref. Para. 9.) or by removing the power section (Ref. Subpara. B.). Refer to FAULT ISOLATION for areas to be inspected.

Using a borescope is more practical for this inspection. Removal and installation of the power section, components/assemblies may result in damage to parts and/or distortion of sealing surfaces causing gas leaks and performance loss.

Acceptable damage must be documented and progression monitored. Record engine/module TSN/TSO and cycles, fuel nozzle ports used, if found by borescope, component, description, location and estimation of damage/crack length.

If rotating components are found with unacceptable damage during inspection, an HSI must be done before next flight. If damaged non-rotating components are found, except when holes are burnt through the combustion chamber or the CT stator airfoil trailing edge defects are beyond limits, the HSI may be delayed, providing an engine performance/ground power check is done.

An additional engine performance/ground power check and inspection of the affected area must be done after 50 hours. Again inspect the affected area in 100 flight hours. If you do not find any progression, get back to normal inspection intervals as given in applicable EMM section. If you find progression, subsequent inspections and engine performance/ground power check intervals will depend on the progression rate and level of deterioration. Contact field support representative or customer help desk for more information. Keeping an engine in service after components have deteriorated can substantially increase the cost of future repairs/refurbishments.

Gas path components downstream of components having material missing must be inspected for secondary damage. Pay special attention to rotating components. CT stator vanes burned through at trailing edge (pressure and suction sides) may mean replacement of the complete set of CT blades, depending on the area of the surface burned through.

The ability of an engine to produce the TO power required by the flight manual for the actual Tam/PA is the only engine airworthiness requirement. However, on some installations the aircraft maintenance manual provides an engine ground power test. This test may be used to confirm TO power is produced within operating limits over the complete range of Tam and PA for which the engine/aircraft is certified. If, at an anticipated high ambient temperature and/or altitude, T5 and Ng will approach or exceed the maximum limits, an HSI is recommended before the actual conditions occur. When T5 and Ng approach, or are anticipated to approach or exceed the maximum limits, troubleshoot the engine/installation before doing an HSI.

Carbon accumulation inside fuel nozzle passages is the principle cause of spray pattern degradation resulting in non-uniform combustion and local high temperature peaks. Exposure to these peaks contributes to premature hot section deterioration. Carbon accumulation is progressive and can affect all nozzles. Therefore, inspect all nozzles (Ref. 73-11-05, Inspection/Check), to minimize premature deterioration occurring at other locations.

If component deterioration exceeds limits, either replace the individual component or do an HSI, depending on the general condition of the hot section and engine performance.

The inspections are recommended concurrent with scheduled engine maintenance checks applicable to individual aircraft installations.

B. Removal/Installation of Power Section Module (Heavy Maintenance Only)

NOTE: This is an alternative to using borescope.

(1) Removal

(a) Remove power section (Ref. 72-00-00, REMOVAL/INSTALLATION).

(b) Remove CT disk assembly (Ref. 72-50-02, Removal/Installation).

(c) Remove combustion chamber inner liner (Ref. 72-40-01, Removal/Installation).

(d) Remove CT stator assembly, shroud housing and small exit duct (Ref. 72-50-01, Removal/Installation).

NOTE: Do not separate parts unless CT stator damage exceeds limits.

(e) Inspect hot section components (Ref. Para. C., D., E., F., G. and H. following).

(2) Installation

(a) Install CT stator assembly, shroud housing and small exit duct (Ref. 72-50-01, Removal/Installation).

(b) Install CT disk assembly (Ref. 72-50-02, Removal/Installation).

(c) Install combustion chamber inner liner (Ref. 72-40-01, Removal/Installation).

(d) Install power section (Ref. 72-00-00, REMOVAL/INSTALLATION).

C. Inspection of Combustion Chamber

NOTE: 1. Combustion chamber includes small exit duct, large exit duct, inner and outer combustion chamber liner assemblies.

NOTE: 2. The Large Exit Duct (LED) is an integral part of the combustion chamber liner. Combustion chamber liners inspection criteria are applicable to LED portion (Ref. 606, Area 1).

(1) Combustion chamber liner cracks may be repairable, and an HSI is recommended before component replacement is required. Converging cracks in the inner and outer combustion chamber liner walls which do not meet are acceptable.

(a) Inspect affected area at 100 hours. Subsequent inspections must not exceed 400 hours.

(2) Plasma top coating (ceramic) loss revealing undercoat (diffused aluminide) on outer and inner liners is acceptable, providing base metal is not burnt or eroded.

(3) Small areas (approximately 1 sq.in.) bulging and/or hot spots on inner or outer liner walls may be repairable, and an HSI is recommended.

NOTE: Engine may remain in service, providing the associated fuel nozzle(s) is/are inspected (Ref. 73-11-05, Inspection/Check) and replaced if not within limits.

(a) Subsequent inspections are at operator's discretion, but must not exceed 400 hours.

(4) Holes in the inner and outer liner walls are unacceptable. An HSI must be done to replace or repair the affected component, and the associated fuel nozzle(s) inspected (Ref. 73-11-05, Inspection/Check) and replaced if not within limits.

(5) Cracked or distorted cooling rings on liners may be repairable. An HSI is recommended before cooling rings are burned through and pieces enter the gas stream.

NOTE: Engine may remain in service if it is understood that cooling air flow is changed, and the rate at which the combustion chamber deteriorates may increase. Therefore, if an HSI is not done, combustion chamber liner with distorted cooling rings or converging cracks must have the associated fuel nozzle(s) inspected (Ref. 73-11-05, Inspection/Check) and replaced if not within limits.

(a) Inspect damage at 100 hours. Subsequent inspections are at operator's discretion, but must not exceed 400 hours.

(6) Excessive carbon deposits inside combustion chamber could be result of poor fuel atomization by the fuel nozzles (indicated by deposits around fuel nozzle bosses). Distortion of combustion chamber liner cooling rings may produce carbon deposits in the dome area downstream of the affected cooling ring. If excessive carbon deposits are found, flow check fuel nozzles (Ref. 73-11-05, Inspection/Check). If CT blades are eroded, refer to Inspection of CT Blades.

(a) If the nozzles are serviceable, the combustion chamber liner is the probable cause of the deposits. Inspect the CT blades, as erosion by carbon particles (some carbon particles remain in the gas stream and are not deposited in the combustion area) may damage and cause CT blade replacement.

(b) If CT blades are not eroded, engine may remain in service and the CT blades and combustion chamber liners inspected within 100 hours. Subsequent inspections are at operator's discretion, but must not exceed 400 hours.

(7) As the structural integrity of the small exit duct is not affected, cracks and open radial cracks extending from the inner to the outer diameter are acceptable (length not limited), and an unlimited amount of coating loss is acceptable.

(a) Holes less than 0.500 in. in diameter in the outer wall are acceptable.

(b) If holes or open cracks are found, an HSI is recommended.

NOTE: The engine may remain in service, and HSI delayed, providing it is understood that the CT stator cooling air flow is affected, increasing the rate of deterioration.

(c) When damage is found, inspect the CT stator (Ref. 72-50-01, Inspection/Check) and associated fuel nozzle (Ref. 73-11-05, Inspection/Check).

(d) Inspect damage at 100 hours. Subsequent inspections are at the discretion of the operator, but must not exceed 400 hours. If deterioration exceeds the above limits, an HSI is recommended.

(8) Outer liner inner wrapper edge (vane contact area) warping and delamination is permitted (Ref. 72-40-01 COMBUSTION CHAMBER LINER ASSY - MAINT. PRACTICES).

D. Inspection of CT Stator Assembly

CAUTION: IF ANY CT STATOR VANE HAS TRAILING EDGE BURN THROUGH EXCEEDING THE FOLLOWING LIMITS, THEN DISCARD THE CT BLADES.

(1) Measure trailing edge burn through (Ref. Fig. 608 and Table).

NOTE: Burned areas on vanes increase flow area which accelerates downstream component deterioration, decreases Ng and increases T5.

(2) If the cracks are in the limits, you can repair the cracks (Ref. Fig. 609 or 610). Keep the engine in service and monitor deterioration. Do an HSI before damage progress to such a limit where you cannot repair the CT stator. This will increase the cost of the subsequent HSI. Do an inspection of the damaged stator in less than 100 hours (Ref. Fig. 609 or 610). If the cracks not progressed, do the subsequent inspection in less than 400 hours of the last inspection with the same tolerance given in the periodic inspection section (Ref. Para. 8.).

(3) If damage have progressed beyond repair limits (Ref. Fig. 609), engine may remain in service, and a ground power check (Ref. Aircraft Maintenance Manual) is done, and the airfoil trailing edge damage must not more than limits shown (Ref. Fig. 608). An HSI is recommended if the vane trailing edge damage are more than the limits shown or downstream components are affected by the CT vane distress or engine performance is unacceptable.

NOTE: Refer to Subpara. A. for additional recommendations.

E. Inspection of CT Blades Airfoil

(1) Coating loss and sulfidation

- Coating loss show as a small color change (can be dark gray or rust coloured) is permitted (Ref. Fig. 611).
- Initial stages of sulfidation show like a small coating increase that can be associated with blisters is permitted, given blisters are not break and a do borescope inspection of the effect area every 200 hours (Ref. Fig. 611).
- Forward sulfidation showed as burst blisters is not permitted and the engine must be removed for HSI.
- When a compressor turbine blade airfoil is inspected, operators can notice surface anomalies that could be mistaken for sulfidation. These surface anomalies are a result of the blade manufacturing process and do not effect turbine performance. The blades are serviceable if the geometrical deviations 0.005 inch deep or 0.005 inch high and are not associated with corrosion or sulfidation. There is no width limitation (Ref. Fig. 613).

(2) Nicks, dents and pits (Ref. Fig. 612)

- Isolated pitting up to 0.008 inch deep not exceeding 30% of the total area.
- Area A (pressure and suction surface), max. six local surface nicks or dents up to 0.015 inch deep and spaced 0.100 inch apart.
- Area B (fillet radius) max. four nicks or dents up to 0.010 inch deep and spaced 0.100 inch apart.
- Area C (LE) max. four nicks or dents up to 0.020 inch deep and spaced 0.100 inch apart.
- Area C (TE) max. four nicks or dents up to 0.010 inch deep and spaced 0.100 inch apart.

(3) Cracks

- Airfoil tip hairline cracks not more than 0.050 in. (1.27 mm) are permitted (Ref. Fig. 611).
- Blades with cracks 0.050 in. long in the upper 1/3 of the trailing edge may remain in service for 100 hours.
- Cracks in any other area are not acceptable.

(4) Tip rubs and erosion

(a) The condition of blades and tips is critical to obtain rated power. Most significant blade tip damage (rubs and oxidation) increase interturbine temperature (T5). Even if T5 is below maximum, an HSI may be recommended if damage is more than the limits shown (Ref. Fig. 611).

NOTE: Refer to Subpara. A. for additional HSI recommendations.

1 Damages are acceptable, provided their condition is monitored by further inspections and engine performance/ground power checks.

2 Subsequent inspections are at the discretion of the operator, but must not exceed 400 hours.

3 HSI is recommended, if damage are more than the limits shown (Ref. Fig. 614).

F. Inspection of CT Shroud Segments

(1) Heavy rubbing and oxidation are acceptable, providing T5 is within limits. Operating the engine with the shroud segments burned may cause damage to the CT shroud housing (cracking and burning of the attachment rim), and an HSI is recommended. A damaged shroud housing must be replaced at the next HSI or refurbishment.

NOTE: Refer to Subpara. A. for additional HSI recommendation.

G. Inspection of PT Stator

NOTE: Inspection of the PT stator is recommended when upstream component damage does not explain performance loss or when secondary damage is suspected.

(1) Damage on the vanes may produce an increase in flow area which will increase Ng and T5.

(2) Cracks on the inner and outer rings and vanes are repairable. Keeping the engine in service, the defects will progress until the stator becomes unrepairable. This will increase the cost of the subsequent HSI. Inspect the damaged area within 100 hours. Subsequent inspections must not exceed 400 hours.

(3) An HSI is recommended when the defects are still repairable.

(4) If the defects are not repairable, replace PT stator at the next power section repair. Providing Ng and T5 are within limits, there is no need for power section repair and PT stator change, regardless of the amount of damage, unless structural integrity of the vanes are affected (e.g. wide open cracks, excessive foreign object damage (FOD) and missing or burnt material are unacceptable).

H. Inspection of PT Blades

(1) Increased tip clearance of PT first and second-stage blades increases T5. If T5 is within limits, there is no need to change the PT assembly, regardless of the amount of damage, providing structural integrity of the components is not affected.

(2) Rotate propeller by hand and inspect second stage power turbine blades through exhaust duct:

(a) Check for cracking or for loss of material in the blade tip shroud area.

(b) Check blade airfoil for evidence of cracking.

NOTE: If there is any evidence of cracking or loss of material, remove power section and ship to an approved overhaul facility.

I. Inspection of AGB and RGB Gears

(1) The following inspection criteria should be used when inspecting the accessory and the reduction gearboxes with a borescope.

(2) This inspection may be done at operator's discretion if gearbox distress is suspected or as a troubleshooting aid as required.

(3) Acceptable Damage on Tooth Contact Faces

(a) Small clusters of spalling at one extremity of the tooth width or in a narrow band on less than 1/2 tooth length.

(b) Light shallow scoring where the scratches cannot be detected with a 0.040 in. radius scriber. Scoring usually indicates poor lubrication and the associated oil nozzle is recommended to be overhauled.

(c) Heat discoloration usually indicates poor lubrication which may lead to scoring, then spalling. The associated oil nozzle is recommended to be overhauled.

(d) Ideal tooth contact is a centrally-located strip on face of tooth. Any deviation indicates incorrect tooth contact.

(e) Wear pattern starting at the end of the tooth denotes end loading. A minor amount of end loading is not considered detrimental.

(f) Incorrect tooth contact may result in spalling because the torque transmitted by the gear is transmitted by a smaller tooth surface resulting in increased contact pressure and local overloading.

(g) Components having acceptable damage may remain in service providing an inspection of the affected area is carried out at an interval not exceeding 400 hours. Subsequent inspections should be done at intervals depending upon the rate of progression and level of deterioration seen. In addition, special attention must be paid to the scheduled oil filter and chip detector inspections required by the regular maintenance program.

(4) Non-acceptable Damage

NOTE: Replace affected module or component if any of the following non-acceptable conditions are evident.

(a) Spalling in a narrow band along whole width of tooth or dispersed throughout contact area.

(b) Deep scoring (root/tip direction) across tooth contact surface.

NOTE: Deep scoring is defined as scoring where the scratches can be felt with 0.040 in. radius scriber.

(c) Rough tooth contact surface due to excessive wear, with raised material at tooth extremities.

11. Hot Section Inspection

A. General

For HSI frequency, refer to Service Bulletin SB14603.

Engine performance check (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Performance Check) before and after inspection is recommended and is important in determining status of hot section parts, and ascertain performance recovery.

Hot section parts can be inspected using a borescope (Ref. Para. 9.)

The following information is offered as a guide to improved engine performance/handling.

B. Inspection of Gas Generator Module

(1) Maintain CT blade radial tip clearance within prescribed limits (Ref. 72-50-01, Inspection/Check).

(2) Improve compressor turbine blade tip clearance by maintaining lug and slot joint geometry (Ref. 72-50-01, Inspection/Check) and minimizing side clearance of lugs.

(3) When required, replace classified PT stator with one of same class ± 0.1 variation as the original, the CT stator with one within ± 0.03 classes of original, and compressor bleed valve seat with one within ± 2 classes of original.

(4) Interstage sealing rings must be in satisfactory condition.

(5) Compressor bleed valve must be functioning correctly.

(6) No air leaks are permitted in gas generator assembly area (e.g. cabin bleed air adapter, fuel nozzle adapter, igniter plug, P3 filter cover and adjoining lines including ecology system if fitted).

(7) Cracks in the compressor turbine vane ring are acceptable provided they do not exceed acceptable limits (Ref. 72-50-01, Inspection/Check) or destroy lug and slot joint free movement and flat surface sealing.

(8) The following affected parts condition, sealing faces and interference fits may be maintained by rework.

1. Sealing faces: CT stator to small exit duct; shroud housing and lock plate (Ref. 72-50-01, Repair).

2. Lugs/slot Fit: CT stator to shroud housing and No. 2 bearing flange (Ref. 72-50-01, Repair).

C. Inspection of Power Section Module

(1) Maintain same power turbine first-stage vane ring class as installed in last engine build.

(2) Inspect power turbine stator housing for cracks. Remove and ship cracked housing to approved overhaul facility for repair.

(3) Cracks in power turbine first-stage vane ring are acceptable provided they do not exceed limits (Ref. 72-50-03, Inspection/Check) or destroy lug and slot joints free movement and flat surface sealing.

(4) Free sliding fit should exist between power turbine lugs of first-stage vane ring and slots of stator housing. Stone lugs or deburr slots as necessary (Ref. 72-50-03, Inspection/Check).

(5) The following affected parts condition, sealing surfaces and interference fits may be maintained by rework.

1. Sealing Surface: PT stator to interstage stator (Ref. 72-50-03, Repair).
2. Lugs/Slot Fits: PT stator to stator housing (Ref. 72-50-03, Repair).
3. Sliding Fit: PT stator to stator housing (Ref. 72-50-03, Repair).

D. Criteria

(1) Inspection criteria is found in Table 603.

Table 603 Hot Section Inspection

E. Hot Section Inspection (HSI) (Ref. Fig. 615)

(1) For a normally scheduled HSI, do a ground performance run (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(2) Remove the RGB strainer, the main oil filter and the chip detector(s). Inspect the debris (Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES).

(3) Inspect the compressor for foreign object damage (FOD) (Ref. 72-30-05, COMPRESSOR ROTOR - MAINTENANCE PRACTICES).

(4) Remove power section/power section module (Ref. Para. 10. B.).

(5) Measure radial CT blade tip clearance and remove compressor turbine disk and blade assembly (Ref. 72-50-02, COMPRESSOR TURBINE - MAINTENANCE PRACTICES).

(6) Remove combustion chamber liner (Ref. 72-40-01, Inspection/Check).

NOTE: If it is necessary, during HSI, to make a more detailed inspection of components which remain installed, those components should be removed as detailed in 72-50-01, Inspection/Check.

(7) Inspect components per Table 603.

(8) If HSI is done due to overtemperature, remove PT stator housing (Ref. 72-50-03, Inspection/Check).

(9) If necessary, calibrate and verify aircraft instrumentation after engine assembly (Ref. AMM).

(10) Do a ground performance run (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(11) If a significant T5 increase is noted after ground performance run, borescope hot section for CT blade shroud rub.

12. Unscheduled Inspection

NOTE: 1. P&WC recommends the operator to contact the overhaul facility when an engine module is to be shipped for light overhaul or repair to conform the engine testing requirements.

NOTE: 2. The light overhaul workscopes do not apply if the engine has gone through abnormal conditions, such as but not limited to, excessive "G" forces, abnormal temperatures that cause major material distress, exposure to chemical agents or thermal shock. This can possibly include events such as aircraft contact with the ground outside of the intended landing site, engine separation from the airframe, rotor burst, external fire or any other situation in which the aircraft receives damage that affects the structural strength, performance or flight characteristics and major repairs are necessary or replacement/repair of a major component or combination of components. In such cases, an assessment of the circumstances and the product condition is necessary to establish (if any) additional inspection, test or repairs that are necessary to make sure continued airworthiness.

NOTE: 3. The operator may be requested to provide additional information, per SIL GEN-135, in order to determine the appropriate maintenance recommendations (workscope) and/or supplement existing Instructions for Continued Airworthiness. For this purpose an additional fee may apply.

A. General

(1) Unscheduled inspection is done when the engine is subjected to unusual stress or operating conditions, or exceeds operating limitations or gives unsatisfactory performance/handling.

(2) If as a result of the inspection, engine removal is required, a written report stating cause of removal in detail (e.g., overspeed, overtemperature, etc.) must be sent with the engine to an approved overhaul facility.

(3) Refer to the applicable accessories manual for disposition of external components or, if applicable, send component along with the removed engine or module to an approved overhaul facility.

(4) Several types of events call for rotating the propeller by hand as part of the inspection of the power section. On some engines, the power turbine may rub immediately after shutdown. This is not an indication of distress providing the rubbing/noise disappears after engine cools down.

B. Performance Deterioration

(1) Refer to FAULT ISOLATION.

C. Overspeed

(1) Check engine/aircraft indicating system. If satisfactory, do the following:

(a) If Ng exceeded 104%, find and correct the cause of overspeed (Ref. Chap. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(b) If Np exceeded 110%, find and correct the cause of overspeed. Send the power section to an approved overhaul facility for Light Overhaul, Engine Overspeed, indicating Np observed.

(c) If Np exceeded 100% for more than 20 seconds, but does not exceed 110%:

1 Inspect PT blades and check for rubs.

2 Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00 and 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

3 Turn the propeller by hand and listen for unusual noises coming from the reduction gearbox or PT bearings (Ref. Para. A.(4)). For unusual noises, slow propeller acceleration on start or abrupt deceleration on shutdown, send power section to an approved overhaul facility for Light Overhaul. Indicate the maximum speed attained, the duration, and any inspection discrepancy.

4 Run at 80% TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00and 79-20-02). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25 hours minimum).

5 Inspect main oil filter after one week (25 hours minimum, 65 hours maximum) (Ref. 79-20-02). If no metallic debris is found, return to standard inspection intervals.

D. Inadvertent Cut-off and Relight During Taxi

NOTE: An inadvertent cut-off and relight happens when the operator moves the fuel condition lever from Low Idle to Cut-off and immediately back to Low Idle. This may result in a short-term sub-idle overtemperature.

(1) For operators WITH an engine monitor and have obtained a detailed recording of the overtemperature event: Refer to Chap. 71-00-00, ADJUSTMENT/TEST, Inadvertent Cut-off and Relight During Taxi figure.

(2) For operators WITHOUT an engine monitor: Return the compressor turbine blade and disk assembly to an overhaul shop facility for stretch check, fluorescent penetrant inspection and a metallurgical analysis (cut-up) of two blades.

E. Overtemperature

(1) Check engine/aircraft indicating system. If satisfactory, refer to Chapter 71-00-00, ADJUSTMENT/TEST for required action.

(2) When an overtemperature has occurred, and the maximum temperature reached and/or its duration cannot be established, or whenever an overtemperature is suspected to have occurred, send the engine to an overhaul facility for Light Overhaul. Indicate "Unknown Overtemperature".

NOTE: Two compressor turbine blades must be sent for metallurgical analysis (cut-up) to determine the extent of any damage to the engine.

(3) If engine was subject to an inadvertent cut-off and relight during taxi, refer to Para. D.

F. Overtorque

(1) Check engine/aircraft indicating system. If satisfactory, refer to Chapter 71-00-00, ADJUSTMENT/TEST and do the following:

(2) If the overtorque is in Area B:

(a) Remove and inspect RGB chip detector, oil strainer and main oil filter (Ref. 72-10-0079-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(b) Turn the propeller by hand and listen for unusual noises coming from the reduction gearbox or PT bearings (Ref. Para. A.(4)). For unusual noises, slow propeller acceleration on start or abrupt deceleration on shutdown, send power section to an approved overhaul facility for Light Overhaul. Indicate torque observed and duration.

(c) Run at 80 % TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-0079-20-02). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25

(c) Run at 80 % TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-0079-20-02). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25 hours minimum).

(d) Do an inspection of the main oil filter after 25 hours minimum, but not more than 65 hours maximum (Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES). If no metallic debris is found, return to standard inspection intervals.

(3) If the overtorque is in Area C, send PSM to an approved overhaul facility for Light Overhaul. Indicate torque observed and duration.

(4) Refer to Aircraft Maintenance Manual for related aircraft checks.

G. Immersion in Water

(1) Send engine to an approved overhaul facility for Light Overhaul. Indicate immersion in water.

H. Dropped Engine or Component

(1) Send engine or component to an approved overhaul facility for Light Overhaul. Indicate dropped engine or component; the type of surface the engine struck and from what height.

I. Material Ingestion (e.g., ice, stones, etc.)

(1) Check compressor first-stage blades for damage (Ref. 72-30-05, Inspection/Check).

(2) Do an engine performance (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Performance Check) or ground power check (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Power Check) as applicable.

J. Bird Strike/Soft Material Ingestion (e.g., rags, plastic bags, etc.)

(1) Remains on compressor first stage blades confirm if bird or soft material has passed through the engine and possibly contaminated the gas path and CT vane cooling passages. If contamination occurred, remove the power section and inspect hot section components (Ref. Para. 10.). Evidence of possible contamination of the compressor turbine vane cooling passages necessitates an approved overhaul level inspection of the vane.

(2) If the engine remains in service, do a performance recovery wash (Ref. 71-00-00, POWER PLANT - CLEANING, Internal Washing) and a performance (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Performance Check) or ground power check as applicable (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Power Check).

K. Chip Detector Circuit Completion and/or Debris in Oil Filter

(1) Refer to FAULT ISOLATION.

L. Propeller Sudden Stoppage or Strike

NOTE: 1. Propeller sudden stoppage occurs when propeller rotation stops due to contact (propeller strike) with a hard object (e.g. ground, ground service equipment, etc.).

NOTE: 2. The term propeller strike is used when either a rotating propeller hits an object which causes a speed variation (no stoppage) and blade damage, or a stationary propeller is hit by a moving object which causes blade damage.

(1) Propeller sudden stoppage

(a) Remove the power section from service and send it to an approved overhaul facility for the inspection required after propeller sudden stoppage. The inspection is to be carried out in accordance with Overhaul Manual instructions (Ref. Light Overhaul).

(b) Inspect remainder of engine:

1 Remove and inspect the main oil filter (Ref. 79-20-02, OIL FILTER, HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES). If metallic debris found, refer to FAULT ISOLATION.

2 Inspect for cracks or distortion at all engine casings and housings, especially at or near the flanges. Remove the starter-generator and check all AGB pads and AGB mounted engine and airframe components (Ref. 72-60-00, ACCESSORY GEARBOX ASSEMBLY - MAINTENANCE PRACTICES). Look for shearing, cracks, distortion or mis-alignment, and loose/pulled fasteners. Similarly, inspect all engine mounts (Ref. 72-30-04, GAS GENERATOR CASE - MAINTENANCE PRACTICES).

3 Inspect fireseals for warping or buckling (Ref. 72-30-01, CENTER FIRESEAL MOUNT RING - MAINTENANCE PRACTICE and 72-30-02, REAR FIRESEAL MOUNT RING - MAINTENANCE PRACTICES), and all external tubes for damage and/or fluid leaks. Refer to repair section or replace as necessary.

4 Check all airframe/engine connections, including fuel inlet and oil cooler lines, air system, electrical, ignition and indicating systems, control linkages, and drains (Ref. AMM).

5 Rotate the compressor by hand and listen for rubbing, scraping, interference of rotating components with stationary parts, or rapid/abrupt deceleration. Check for rear accessory case mounted accessory drag. Check for compressor turbine tip rub (Ref. 72-50-02, COMPRESSOR TURBINE - MAINTENANCE PRACTICES).

6 As described above, for casing or accessories damage, evidence of electrical discharge, unusual noises that could indicate damage to the gears, bearings, seals or rotors, slow compressor acceleration on start or abrupt deceleration on shutdown, remove the complete engine from service and send it to an approved overhaul facility for light overhaul. Indicate propeller sudden stoppage and extent of damage.

7 After installation of a repaired/replacement power section on the serviceable gas generator, run at 80% TO power for ten minutes. Remove and inspect the main oil filter (Ref. 79-20-02, OIL FILTER, HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES). If no metallic debris is found, return the engine to service.

8 Inspect main oil filter after one week (25 hours minimum, 65 hours maximum). If no metallic debris is found, return to standard inspection schedule.

(2) Propeller strike causing blade structural/major damage (Ref. Propeller Maintenance Manual to assess blade condition), or propeller strike on a power line, or propeller strike at power above FLIGHT-IDLE (Ng above 82 %), or propeller strike causing vibration during operation that was not present before the event (Ref. AMM).

(a) Remove the power section from service and send it to an approved overhaul facility for the inspection required after a propeller strike. The inspection is to be carried out in accordance with Overhaul Manual instructions (Ref. Light Overhaul).

(b) Inspect remainder of engine:

1 Remove and inspect the main oil filter (Ref. 79-20-02, OIL FILTER, HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES). If metallic debris found, refer to FAULT ISOLATION.

2 Inspect for cracks or distortion at all engine casings and housings, especially at or near the flanges. Remove the starter-generator and check all AGB pads and AGB mounted engine and airframe components (Ref. 72-60-00, ACCESSORY GEARBOX ASSEMBLY - MAINTENANCE PRACTICES). Look for shearing, cracks, distortion or mis-alignment, and loose/pulled fasteners. Similarly, inspect all engine mounts (Ref. 72-30-04, GAS GENERATOR CASE - MAINTENANCE PRACTICES).

4 Check all airframe/engine connections, including fuel inlet and oil cooler lines, air system, electrical, ignition and indicating systems, control linkages, and drains (Ref. AMM).

5 For propeller strike on a power line (power utility line - does not include guide/support wires, telephone or telecommunications lines), check for evidence of electrical discharge (localized burn marks) at the C-flange or at the compressor turbine.

6 Rotate the compressor by hand and listen for rubbing, scraping, interference of rotating components with stationary parts, or rapid/abrupt deceleration. Check for rear accessory case mounted accessory drag. Check for compressor turbine tip rub (Ref. 72-50-02, COMPRESSOR TURBINE - MAINTENANCE PRACTICES).

7 As described above, for casing or accessories damage, evidence of electrical discharge, unusual noises that could indicate damage to the gears, bearings, seals or rotors, slow compressor acceleration on start or abrupt deceleration on shutdown, remove the complete engine from service and send it to an approved overhaul facility for light overhaul. Indicate propeller strike and extent of damage.

8 After installation of a repaired/replacement power section on the serviceable gas generator, run at 80% TO power for ten minutes. Remove and inspect the main oil filter (Ref. 79-20-02, OIL FILTER, HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES). If no metallic debris is found, return the engine to service.

9 Inspect main oil filter after one week (25 hours minimum, 65 hours maximum). If no metallic debris is found, return to standard inspection schedule.

(3) Propeller strike causing minor blade damage (not structural) (Ref. Propeller Maintenance Manual to assess blade condition), or propeller strike with engine at or below FLIGHT-IDLE power (Ng at or below 82 %) or while engine was shut down.

(a) Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, REDUCTION GEARBOX - MAINTENANCE PRACTICES and Ref. 79-20-02, OIL FILTER HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES). If metallic debris is found, refer to FAULT ISOLATION.

(b) Turn the propeller by hand and listen for unusual noises coming from the reduction gearbox or PT bearings (Ref. Para. A. (4)). For unusual noises, slow propeller acceleration on start or abrupt deceleration on shutdown, remove the power section from service and send it to an approved overhaul facility for Light Overhaul. Indicate propeller strike and extent of damage.

(c) Run engine at 80% TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, REDUCTION GEARBOX - MAINTENANCE PRACTICES and Ref. 79-20-02, OIL FILTER HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25 hours minimum).

(d) Inspect main oil filter after one week (25 hours minimum, 65 hours maximum) (Ref. 79-20-02, OIL FILTER HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES). If no metallic debris is found, return to standard inspection intervals.

M. Propeller Lightning Strike

(1) If signs of arcing are found on the propeller blades, the propeller shaft and flange must be checked for magnetism. Check for magnetism using one of the following methods:

(a) Check propeller shaft, especially flange, using a magnetometer to make sure residual magnetism is within ± 3 gauss or 3 oersted of 2.38 A/cm. If reading is above limits, replace power section.

(2) If propeller shaft or flange is magnetized:

(a) Ship power section to an approved overhaul facility for Light Overhaul. Indicate Lightning Strike.

(b) On the gas generator, check for evidence of electrical discharge (localized burn marks) at the C-flange or at the compressor turbine. Evidence of discharge requires sending the complete engine to an approved overhaul facility.

(c) Inspect the main oil filter (Ref. 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(3) If the propeller shaft or flange is not magnetized:

(a) Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, and 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(b) Turn the propeller by hand and listen for unusual noises from the reduction gearbox or PT bearings (Ref. Para. A.(4)). For unusual noises, slow propeller acceleration on start or abrupt deceleration on shutdown, send power section to an approved overhaul facility for Light Overhaul and indicate lightning strike.

(c) Run engine at 80% TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, and 79-20-02). If no metallic debris is found, return the engine to service and check RGB chip detector daily for one week (25 hours minimum).

(d) Inspect main oil filter after one week (25 hours minimum, 65 hours maximum) (Ref. 79-20-02). If no metallic debris is found, return to standard inspection intervals.

N. Propeller Electrical Leads Shorting

(1) If signs of arcing between de-icer leads and the propeller spinner, bulkhead or hub assembly have been found, check propeller de-icing system (Ref. Aircraft Maintenance Manual) and rectify.

(2) Inspect engine:

(a) Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00 and 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(b) Turn the propeller by hand and listen for unusual noises coming from the reduction gearbox or PT bearings (Ref. Para. A.(4)). For unusual noises, slow propeller acceleration on start or abrupt deceleration on shutdown, send power section to an approved overhaul facility for Light Overhaul. Indicate propeller electrical leads short and any discrepancy noted. Otherwise, run engine at 80% TO power for ten minutes.

(c) Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, and 79-20-02). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25 hours minimum).

(d) Inspect main oil filter after one week (25 hours minimum, 65 hours maximum) (Ref. 79-20-02). If no metallic debris is found, return to standard inspection intervals.

O. Heavy/Hard Landing

NOTE: 1. Do the following checks in the event of a suspected heavy or hard landing. A landing must be considered hard if the aircraft incurred any airframe or landing gear damage.

NOTE: 2. If the heavy/hard landing involved a windmilling (inoperative) engine, send the complete engine to an approved overhaul facility for Light Overhaul. Indicate heavy/hard landing of inoperative engine. Otherwise, proceed as follows:

(1) Inspect for cracks or distortion at all engine casings and housings, especially at or near the flanges.

(2) Remove the starter-generator and check all AGB pads and AGB mounted engine and airframe components. Look for shearing, cracks, distortion or mis-alignment, and loose/pulled fasteners. Similarly, inspect all other accessories and engine mounts.

(3) Inspect fireseals for warping or buckling, and all external tubes for damage and/or fluid leaks.

(4) Check all airframe/engine connections, including fuel inlet and oil cooler lines, air system, electrical, ignition and indicating systems, control linkages, and drains.

(5) Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, and 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(6) Turn the compressor by hand and listen for rubbing, scraping, interference of rotating components with stationary parts, or rapid/abrupt deceleration. Examine for rear accessory case mounted accessory drag. Examine for compressor turbine tip rub (Ref. Para. 10.E.). Turn the propeller by hand and listen for any interference of rotating components with stationary parts or any other unusual noises coming from the gearbox or turbines (Ref. Para. A.(4)). Examine PT disk assembly and exhaust area through exhaust ports for the indication of distress. If damage is found, inspect (Ref. 72-50-04, Inspection/Check).

(7) For casing or accessories damage, unusual noises that could indicate damage to the gears, bearings, seals or rotors, slow propeller acceleration on start or abrupt deceleration of compressor or power section on shutdown, send the complete engine to an approved overhaul facility for Light Overhaul. Indicate heavy landing and discrepancies observed.

(8) Run engine at 80% TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, and 79-20-02). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25 hours minimum).

(9) Inspect main oil filter after one week (25 hours minimum, 65 hours maximum). If no metallic debris is found, return to standard inspection schedule.

P. Aircraft Flown Through Volcanic Ash or Smoke

(1) Wash compressor and turbine (Ref. 71-00-00, POWER PLANT - CLEANING, Internal Washing).

(2) Drain and refill oil system with new oil (Ref. SERVICING, Lubricating Oil System).

(3) Clean or change main oil filter (Ref. 79-20-02, Cleaning).

(4) Examine compressor (Ref. INSPECTION/CHECK, Borescope).

(5) Return engine to service if no defects are found.

(6) Drain and refill oil system with new oil (Ref. SERVICING, Lubricating Oil System) 50 ± 10 flight hours after original oil change done in step (2) .

Q. Sustained Running at Oil Temperature Outside Limits

(1) Check aircraft/engine indicating system and correct cause of high oil temperature (Ref. FAULT ISOLATION).

(2) Rotate the compressor rotor and check for indications of AGB or bearing distress.

(3) Turn the propeller by hand and listen for unusual noises coming from the reduction gearbox or PT bearings (Ref. Para. A.(4)).

(4) For any presence of unusual noise, send the complete engine to an approved overhaul facility for Light Overhaul. Indicate the oil temperature that the engine was operated at, the engine power and the duration.

(5) Drain and discard oil (Ref. SERVICING, Lubricating Oil System).

(6) Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, and 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(7) Fill oil system (Ref. SERVICING, Lubricating Oil System).

(8) Run engine at 80% TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, and 79-20-02). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25 hours minimum).

(9) Inspect main oil filter after one week (25 hours minimum, 65 hours maximum)(Ref. 79-20-02). If no metallic debris is found, return to standard inspection intervals.

R. Loss of Oil/Oil Pressure or Low Oil Pressure

NOTE: Low oil pressure is defined as oil pressure below limits (Ref. 71-00-00, ADJUSTMENT/TEST, Pre-Operational Check). If oil pressure was fluctuating (such as a result of loss of oil) or transient, refer to the transient limits.

(1) If the engine oil pressure dropped below 60 psi, or, if the engine oil pressure dropped between 60 to 90 psi with engine power above , or if the transient low oil pressure limits were exceeded:

(a) Check oil pressure indicating system. If correct, ship the engine to an approved overhaul facility for Light Overhaul. Indicate oil pressure the engine was run at, the engine power, and duration.

(2) If the engine lost 6 qt. or more oil and the oil pressure fluctuated without exceeding transient limits or if the engine ran at an oil pressure of 60 to 90 psi, at power less than torque for a period longer than the transient limit:

(a) Check oil pressure indicating system. If correct, remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(b) Rotate the compressor rotor and check for indications of AGB or bearing distress.

(c) Turn the propeller by hand and listen for unusual noises coming from the reduction gearbox or PT bearings (Ref. Para. A. (4)). For unusual noises, slow starts or abrupt deceleration on shutdown, send the engine to an approved overhaul facility for Light Overhaul. Indicate oil pressure the engine was run at, the engine power, and duration.

(d) Run the engine at 80% TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, 79-20-02). If no metallic debris is found, return the engine to service and check RGB chip detector daily for one week (25 hours minimum).

(e) Inspect main oil filter after one week (25 hours minimum, 65 hours maximum (Ref. 79-20-02). If no metallic debris is found, return to standard inspection intervals.

S. High Oil Pressure

NOTE: High oil pressure is defined as oil pressure above limits (Ref. 71-00-00, ADJUSTMENT/TEST, Pre-Operational Check). If oil pressure was fluctuating (such as a result of loss of oil) or transient, refer to the transient limits.

(1) If the engine oil pressure raised above 135 psi or if the engine oil pressure raised above 200 psi during starting, or if the transient high oil pressure limits were exceeded:

(a) Check oil pressure indicating system. If correct, check engine and aircraft oil system for possible external oil leak.

(b) Check the RGB/AGB chip detectors. If metallic debris is found, refer to FAULT ISOLATION, Fig. 105.

(c) Perform oil filter patch test (Ref. 79-20-02).

(d) Inspect pressure relief valve for possible malfunction. Remove, clean and inspect valve and replace as necessary.

T. Contamination by Fire Extinguishing Agents

(1) Foam, powder or other chemical extinguishers:

(a) If only engine externals are exposed, then wash (Ref. 71-00-00, CLEANING, Engine External Wash) using drinkable quality water only and monitor for corrosion.

(b) In the event of internal contamination, return engine to an approved overhaul facility for Light Overhaul. Indicate the agent ingested by the engine. Depending on the agent, and at the option of the operator, an attempt may be made at cleaning the contaminating agent prior to shipping:

1 Do a dry motoring run (Ref. 71-00-00, ADJUSTMENT/TEST, Dry Motoring Run) to blow out any residual deposits.

2 Wash engine externally (Ref. 71-00-00, CLEANING) using drinkable quality water only.

3 Do an engine performance recovery wash (Ref. 71-00-00, CLEANING) followed by two dry motoring runs.

(2) Halon:

(a) No engine maintenance required.

U. Audible Rubbing, Binding or Scraping

NOTE: Any unusual engine noise requires immediate investigation.

(1) Rotate compressor rotor and listen for any interference of rotating components with stationary parts and/or check for rapid deceleration on shutdown.

(a) Do a visual inspection of the first-stage compressor rotor with a borescope or with the air inlet screen removed (Ref. 72-30-05, COMPRESSOR ROTOR - MAINTENANCE PRACTICES).

(b) Check for rear accessory case mounted accessory drag.

(c) Check for compressor turbine tip rub (Ref. 72-50-02, Inspection/Check).

(d) Check for the indications of compressor rub or bearing or AGB distress or unusual deposits seen on CT blade airfoil. Send engine to an approved overhaul facility for light overhaul.

NOTE: If you find deposits, look for the presence of debris at the bottom of the gas generator case. If you see one of these conditions, contact P&WC Customer Engineering for recommendations.

(e) If no damage is found and condition is still present for one hour after shutdown, ship the engine to an approved overhaul facility.

(2) Rotate the propeller and listen for any interference of rotating components with stationary parts (Ref. Para. A.(4)). If power turbine rotor rattles, or if there is rubbing or scraping, slow propeller acceleration on start or abrupt deceleration on shutdown:

(a) Examine PT disk assembly and exhaust area through exhaust ports for evidence of distress.

(b) If damage is found, inspect (Ref. 72-50-04, Inspection/Check).

(c) If no damage is found and condition is still present one hour after shutdown, ship engine to an approved overhaul facility.

(3) Slow or stiff propeller rotation. Send power section to an approved overhaul facility for Light Overhaul. Indicate rubbing.

(4) If the suspected problem cannot be repeated or confirmed:

(a) Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

(b) Run engine at 80% TO power for ten minutes. Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, 79-20-02). If no metallic debris is found, return engine to service and check RGB chip detector daily for one week (25 hours minimum).

(c) Inspect main oil filter after one week (25 hours minimum, 65 hours maximum) (Ref. 79-20-02). If no metallic debris is found, return to standard inspection intervals.

V. Propeller Windmilling after In-flight Shutdown

(1) Investigate cause of shutdown. If suspected of being attributed to an engine or accessory problem, send engine or accessory to an approved overhaul facility for Light Overhaul. Indicate engine shutdown and the events and conditions at the time.

(2) With shutdown not related to an engine problem (serviceable engine):

NOTE: Windmilling can result in engine oil accumulation inside engine, and possible oil leakage.

(a) With stabilized windmilling Np not more than 20 rpm and less than 6 qt. of oil required to bring oil level to MAX on dipstick, no further action is necessary.

(b) With an unknown (not recorded) Np or stabilized windmilling Np greater than 20 rpm or if 6 qt. or more of oil is required to bring oil level to MAX on dipstick:

1 Remove and inspect RGB chip detector, oil strainer, and main oil filter (Ref. 72-10-00, 79-20-02). If metallic debris is found, refer to FAULT ISOLATION.

2 Rotate the compressor rotor and check for indications of AGB or bearing distress.

W. Contamination of Oil with Non-metallic Foreign Material

NOTE: 1. AGB/RGB internal protective coatings may be released within the engine and appear as flakes 1/64 inch to 3/8 inch in diameter, usually shiny, yellow, brown or green in color, and may or may not be transparent.

NOTE: 2. Inspect chip detector, main oil filter and AGB scavenge pump screen after approximately 10 hours. If no debris is found, inspect at 50 hours.

NOTE: 3. If no debris is found at 50 hours, refer to the standard periodic inspection interval for oil filter and chip detector (Ref. Table 601).

NOTE: 4. If these flakes are found, immediately contact your local P&WC customer support representative. Send engine to an approved overhaul facility for Light Overhaul. Indicate oil contamination from released AGB/RGB internal protective coatings.

(1) Remove chip detector from reduction gearbox front housing (Ref. SERVICING, Oil Servicing) and scrub scavenge oil strainer sleeve with a brush to remove any foreign material blocking the screen.

(2) Remove accessory gearbox drain plug(s).

(3) Flush oil system (Ref. SERVICING, Oil System Flushing).

(4) Reinstall chip detector and plug(s) and tighten. Refill engine oil tank.

NOTE: Do not lockwire chip detector and drain plug(s) at this time.

(5) Remove chip detector and inspect scavenge oil strainer sleeve for residual foreign material accumulated after system flush (Ref. NOTE).

(6) Repeat steps (2) thru (5), if required.

(7) Reinstall chip detector. Tighten all plugs and chip detector and lockwire.

X. Contamination of Oil with Carbon Debris

(1) Remove the main oil filter and clean (Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES) according to type. Install the oil filter again.

(2) Remove the chip detector from the reduction gearbox front housing (Ref. 72-00-00, ENGINE, TURBOPROP - SERVICING) and scrub the scavenge oil strainer sleeve with a brush to remove any foreign material blocking the screen.

(3) Remove the oil drain plug(s) from accessory gearbox housing and oil-to-fuel heater.

(4) Put suitable containers under the engine.

CAUTION: LIMIT ENGINE ROTATION TO MINIMUM TIME REQUIRED TO DRAIN OIL. ALSO OBSERVE STARTER OPERATING LIMITATIONS.

(5) With drains open, put fuel condition lever to CUT-OFF and ignition switch OFF. Motor engine with starter only and allow scavenge pumps to clear all lubricating oil.

(6) Install the chip detector and drain plugs.

(7) Fill the engine oil tank (Ref. 72-00-00, ENGINE, TURBOPROP - SERVICING)

(8) Start the engine and run at ground-idle for a minimum of five minutes (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(9) Feather propeller.

(10) Shutdown the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(11) Put suitable containers under the engine.

(12) Remove chip detector from reduction gearbox front housing, and oil drain plug(s) from accessory gearbox housing and oil-to-fuel heater.

CAUTION: LIMIT ENGINE ROTATION TO MINIMUM TIME REQUIRED TO DRAIN OIL. ALSO OBSERVE STARTER OPERATING LIMITATIONS.

(13) With the drains open, put fuel condition lever to CUT-OFF and ignition switch OFF. Motor engine with starter only and allow scavenge pumps to clear all lubricating oil.

(14) Remove the reduction gearbox oil strainer and clean (Ref. 72-10-00, REDUCTION GEARBOX - MAINTENANCE PRACTICES). Install the strainer again.

(15) Install the chip detector and plug(s) again, and tighten.

NOTE: Do not lockwire chip detector and drain plug(s) at this time.

(16) Inspect the main oil filter and clean, (Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES) according to type. Install the oil filter again.

NOTE: At this point oil color must be identical to new oil and oil filter in clean condition. If not, repeat Steps (7) thru (16) preceding.

(17) Remove the main oil filter and replace with new one (Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES) according to type. Install the oil filter again.

(18) Tighten all plugs, chip detector and lockwire.

(19) Fill the engine oil tank (Ref. 72-00-00, ENGINE, TURBOPROP - SERVICING).

(20) Start the engine and run at ground-idle (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST) for a minimum of five minutes.

(21) Feather propeller.

(22) Shutdown the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(23) Do a check of oil level within 15 to 20 minutes after engine shutdown and replenish, as necessary (Ref. 72-00-00, ENGINE, TURBOPROP - SERVICING).

(24) Return the engine to service. Inspect the main oil filter and clean after 50 hours (Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES). If no carbon debris is found, inspect main oil filter and clean every 100 hours and replace the filter element at 200 hours interval. After 400 hours if no further carbon debris is found in filter reinstate normal periodic inspection intervals (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

(25) If debris is found, repeat Steps (1) thru (24) preceding.

Y. Tear or Opening found on Main Oil Filter Secondary Screen (Coarse hat-type screen attached to the inner end of the filter) (Ref. Fig. 616)

(1) Do a main oil filter patch check (Ref. 79-20-02, OIL FILTER HOUSING - MAINTENANCE PRACTICES).

(2) If you find contamination, send the engine to P&WC approved overhaul facility for light overhaul. Mention the type of contamination as applicable (example: carbon, metallic, non-metallic, etc).

Z. Starter-Generator Replacement

(1) If there is an engine starting fault or an electrical generation defect, do the following inspections:

(a) Inspect the starter-generator drive splines:

1 Inspect per Aircraft Maintenance Manual (AMM).

2 If there is no inspection procedure in the AMM, clean the starter-generator splines and inspect for evidence of electrical arcing damage (in the form of pitting) using a 10X magnifying glass.

NOTE: 1. If there is any evidence of electrical arching, return engine to an approved overhaul facility for Electrical Discharge Damage (EDD) repair.

NOTE: 2. If there is NO evidence of electrical arching, inspect the main oil filter (Ref. Step (b)).

3 If cause of pitting can not be determined, metallurgical analysis may be required. Contact the Aircraft OEM.

(b) Inspect the main oil filter:

1 Do a main oil filter patch check (Ref. 79-20-02). The results of the filter patch analysis should be reviewed within the next 25 flight hours. If non allowable debris is found, follow the recommended maintenance actions (Ref. 79-20-02).

2 Regardless of the results of the patch analysis, repeat step 1 every 100 hours, for the next 700 flight hours.

3 If bearing material (AMS 6440/6444 or AMS 6490/6491, (Ref. 79-20-02) is found, remove the engine/gas generator module and send to an approved overhaul facility for repair.

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72-01-00
POWER SECTION - DESCRIPTION AND OPERATION

1. Description and Operation

The power section comprises a power turbine stator housing and stator assembly with interturbine temperature sensing system, a power turbine rotor assembly, exhaust duct and insulation blanket, and reduction gearbox and shaft assembly.

72-10-00
REDUCTION GEARBOX - DESCRIPTION AND OPERATION

1. Description and Operation

A. General (Ref. Fig. 1)

The reduction gearbox is located at the front of the engine and consists of two alloy housings, front and rear, bolted together at Flange A of the exhaust duct.

The reduction gearbox contains a two-stage planetary geartrain, accessory drives, torquemeter, Para. B. following, and propeller shaft. The first-stage reduction gear and torquemeter are contained in the rear housing, while the second-stage reduction gear, accessory drives and propeller shaft are in the front housing. Torque from the power turbine section is transmitted through the power turbine shaft and turbine coupling to the first-stage sun gear.

The first-stage reduction geartrain is driven by the sun gear which consists of a short hollow steel shaft with an integral spur gear at the front and external splines on the rear. The external splines engage with the internal splines of the turbine coupling on the power turbine shaft. Axial float between the sun gear and turbine coupling is controlled by a thrust washer retained within the coupling by a retaining ring. A spigot installed at the rear of the sun gear centerbore locates the power turbine shaft and serves to centralize the gear relative to the shaft. Lubrication to the coupling is provided through radial holes in the spigot . An oil dam is located in the sun gear at the front to make sure adequate oil is available for lubrication of the No. 4 bearing and the sun gear splines.

The first-stage of the reduction geartrain consists of three planet gear assemblies in a rotating carrier balancing assembly and a non rotating ring gear. The ring gear is located in helical splines in the rear housing. The torque developed by the power turbine is transmitted through the sun gear and planet gears to the ring gear which is opposed by the helical splines. This opposition causes the planet gear carrier to rotate. The ring gear, although held radially by the helical splines, is allowed to move axially between the housing and retaining plates fastened to the housing. The axial movement is used in the torquemeter application.

The second-stage of reduction is housed in the front housing of the reduction gearbox. The first-stage planet carrier is attached to the second-stage sun gear by a flexible coupling which also acts to dampen any vibrations between the two rotating masses.

The second-stage sun gear drives five planet gears mounted in the second-stage carrier. A second-stage ring gear is located by splines in the front housing of the reduction gearbox by retaining plates. The second-stage carrier is in turn splined to the propeller shaft and held by a keywasher and nut. A flanged roller bearing supports the second-stage carrier and the rear of the propeller shaft. The inner race of the bearing is located on the machined circumference of the second-stage carrier extension, while the flanged outer race is bolted to a web in the front case. An oil transfer tube and nozzle assembly is located in the propeller shaft to provide lubrication to the No. 4 bearing. Oil is applied to the oil transfer tube via an oil transfer sleeve installed on the propeller shaft. The sleeve housing is supplied by two independent oil sources via two transfer tubes. Engine oil pressure is applied to the rear section of the housing to provide lubrication to the No. 4 bearing and second-stage carrier bearings while propeller governor oil pressure is applied to the front section of the housing to provide hydraulic power for the propeller pitch servo system.

The accessories located on the front housing are driven by a bevel drive gear mounted at the rear of the propeller shaft thrust bearing assembly. Drive shafts from the bevel drive gear transmit rotational power to the three pads on the front of the reduction gearbox. The pads are located at the 12, 3, and 9 o'clock positions.

Propeller thrust loads are absorbed by the ball bearing assembly, located on the front section of the propeller shaft. The bevel drive gear adjusting spacer, thrust bearing and seal runner are stacked and secured to the propeller shaft by a keywasher and spanner nut. A thrust bearing cover assembly is bolted at the front flange of the reduction gearbox front housing. The cover assembly incorporates an oil seal retaining ring plate which facilitates replacement of the oil seal. Two oil transfer tubes allow pressure oil in the reduction gearbox to be applied to the front face of the thrust bearing and scavenge oil to return to the reduction gearbox via cored passages in the cover assembly.

Pressure lubricating oil is supplied to an external connection on the front housing and is distributed within the reduction gearbox via an oil transfer sleeve on the propeller shaft. Oil supplied to the rear section of the sleeve is distributed via a transfer tube/nozzle assembly and cored passages. within the propeller shaft to the first and second-stage carriers, torquemeter, No. 4 and No. 5 bearings, and to the No. 3 bearing transfer tube in the rear housing. Lubrication to the power turbine coupling is provided through radial holes in the first-stage sun gear spigot. An oil dam is fastened in the centerbore of the sun gear at the front to make sure that enough oil is available for lubrication of the No. 4 bearing and the sun gear splines. Oil supplied to the front section of the oil transfer sleeve is distributed to the accessory drive gears, and No. 6 bearing, and to the propeller governor to provide hydraulic power for the propeller pitch system.

B. Torquemeter (Ref. Fig. 2)

The torquemeter is a hydro-mechanical torque-measuring device, installed at the rear of the first-stage reduction gear in the rear housing of the reduction gearbox. The torquemeter provides an accurate indication of engine power output and consists of a cylinder, piston, seal rings, valve plunger and spring.

Rotation of the ring gear is resisted by the helical splines, which impart an axial movement to the ring gear and to the torquemeter piston. Movement of the piston moves a valve plunger against the spring, opening a metering orifice and allowing an increased flow of pressure oil into the torquemeter chamber. Piston movement continues until oil pressure in the torquemeter chamber is proportional to torque being absorbed by the ring gear. Any change in engine power recycles the sequence until a state of equilibrium is again reached.

Hydraulic locks are prevented by allowing oil to bleed continuously from the torquemeter chamber into the reduction gear sump through a small bleed orifice at the top of the torquemeter cylinder.

Because the external ambient pressure and the pressure within the reduction gearbox may vary and affect the total pressure on the torquemeter piston, internal pressure is measured. The difference between the torquemeter pressure and reduction gear internal pressure accurately indicates the torque being produced. The two pressures are internally routed to bosses at the top of the reduction gearbox front housing where connections can be made to suit individual airframe instrumentation requirements.

C. Magnetic Chip Detector (Ref. Fig. 3)

A magnetic chip detector is installed in the base of the front housing to provide an indication of metal particle contamination of the engine oil system. The detector takes the form of a double-ended, threaded adapter. One end houses the magnetic detector poles, and screws into the front housing, and the other end is an electrical connector that houses the detector output terminals and mates with an airframe cable connector.

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Figure 1 Reduction Gearbox Assembly Cross-Section

Figure 2 Torquemeter - Schematic (Typical)

Figure 3 Magnetic Chip Detector - Cross-Section (Typical)

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire, unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch in diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-037	Enamel, Epoxy
PWC05-061	Cloth, Abrasive Coated Crocus
PWC05-101	Cloth, Abrasive
PWC05-166	Solution, Anodizing
PWC07-023	Coating, Aluminum and Zinc
PWC08-002	Adhesive, Fluorosilicone
PWC09-001	Sealant, Silicone Rubber (RTV)
PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC13-001	Primer, Epoxy

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC32072	Puller

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Propeller Shaft Oil Seal

(1) Remove propeller (Ref. Aircraft Maintenance Manual).

(2) Note split line location, identify top and bottom halves, and remove bolts (6, Fig. 201), washers (7) and oil seal from propeller shaft thrust bearing cover assembly (3).

(3) Remove gasket (2) and discard.

(4) Work out seal element (4) from cavity, be careful not to damage bore of thrust bearing cover assembly or surface of oil seal runner (5).

(5) Remove garter spring from inside diameter rear face of seal (Ref. Fig. 203). Unwind spring and remove from propeller shaft. Remove seal by stretching over propeller shaft flange.

NOTE: Seal may be cut in order to remove it. When cutting, protect surface of propeller shaft from possibility of damage by cutting instrument.

(6) Clean off gasket mating surfaces using suitable non-metallic scraper.

B. Removal of Scavenge Oil Strainer

(1) Place suitable container under RGB, and remove bolt (2, Fig. 202), lug (3), and plug (4) with puller (PWC32072).

(2) Remove and discard preformed packing (5).

(3) Remove scavenge oil strainer assembly (6) from reduction gearbox.

C. Removal of Chip Detector

CAUTION: AVOID FORCING OR CONTACT WITH THE OIL PRESSURE TRANSFER ELBOW WHEN YOU REMOVE THE CHIP DETECTOR. DAMAGE TO THE ELBOW MOUNTING LUGS CAN OCCUR RESULTING IN LOSS OF ELBOW RETENTION AND OIL LEAKAGE.

(1) Remove airframe cable connector, (Ref. Aircraft Maintenance Manual) or cover (9, Fig. 202) as applicable from chip detector at 6 o'clock position on RGB front case.

(2) Place drip pan/suitable container under RGB

(3) Remove lockwire, and chip detector (8) from RGB.

(4) Remove and discard preformed packing (7)

D. Installation of Propeller Shaft Oil Seal

CAUTION: HANDLE SEAL CAREFULLY TO PREVENT DAMAGE. AVOID APPLYING LOADS LOCALLY TO LIP OF SEAL AS SEAL IS SOFT AND HAS LOW TEAR RESISTANCE.

(1) Tape a strip of plastic material (polyethylene sheet) over flange of propeller shaft and apply liberal layer of engine oil (PWC03-001). This will let seal slip over flange without undue stress.

(2) For the new seal (4, Fig. 201), remove the garter spring from the seal.

(3) Heat seal to approximately 93°C (200°F) maximum for 20 minutes.

(4) Moisten seal (4, Fig. 201) in engine oil (PWC03-001) and install over propeller mounting flange onto propeller shaft. Vee side of seal is to face thrust bearing cover assembly (3).

(5) Install garter spring in rear of seal (Ref. Fig. 203).

CAUTION: GASKET IS BRITTLE AND SHOULD NOT BE OVERSTRESSED DURING INSTALLATION. CLEAN REAR FACE OF RETAINING PLATE.

(6) Gently press assembled seal (4) and garter spring into cavity formed by bore of thrust bearing cover (3) and oil seal runner (5). Work seal into cavity with thumbs until seal is correctly seated in cavity.

(7) Moisten the felt inserts (8) with engine oil (PWC03-001).

(8) Remove the plastic material. Align the groove in retaining ring halves (1) with the corresponding cutout in gasket (2) and drain spigot in the thrust bearing cover assembly (3). If applicable, make sure the felt inserts (8) in ring halves engage lip of oil seal runner (5).

CAUTION: BOLTS MUST BE SAFETY WIRED WITH FINISHING PIG TAIL POINTING INBOARD OR TOWARDS PROPELLER SHAFT TO PREVENT DAMAGE TO BETA FEEDBACK RING.

(9) Install bolts (6) and washers (7). Tighten the bolts (6) in diametric sequence, torque 24 to 36 lb.in., and lockwire in pairs.

NOTE: Lockwire bolts as to obtain correct direction of twist which will force the loop tail down and around bolt heads (Ref. Fig. 204).

(10) Install propeller (Ref. Aircraft Maintenance Manual).

E. Installation of Oil Strainer

(1) Install strainer assembly (6, Fig. 202) into cored passage in RGB. Make sure strainer is pressed fully home.

(2) Install new lubricated preformed packing (5) in recess on boss of strainer plug (4).

(3) Install plug on RGB with bolt (2) and lug (3). Tighten bolt 36 to 40 lb.in. and lockwire.

(4) Replenish oil as necessary (Ref. 72-00-00, SERVICING, Lubricating Oil System).

NOTE: Make sure the chip detector is installed before you replenish the oil.

F. Installation of Chip Detector

(1) Install packing (7, Fig. 202) on chip detector (8).

CAUTION: IN VIEW OF SIZE OF WRENCH THAT WOULD NORMALLY BE USED FOR CHIP DETECTOR BODY, OVERTIGHTENING CAN EASILY OCCUR. THEREFORE, USE OF TORQUE WRENCH TO AVOID OVERTIGHTENING IS RECOMMENDED TO PREVENT FRACTURE OF CHIP DETECTOR BODY.

CAUTION: AVOID FORCING OR CONTACT WITH THE OIL PRESSURE TRANSFER ELBOW WHEN YOU INSTALL THE CHIP DETECTOR. DAMAGE TO THE ELBOW MOUNTING LUGS CAN OCCUR RESULTING IN LOSS OF ELBOW RETENTION AND OIL LEAKAGE.

(2) Coat thread of chip detector with engine oil (PWC03-001) and install assembly in RGB (1). Tighten detector 45 to 55 lb.in. and lockwire.

(3) Install electrical connector or cover (9) as applicable (Ref. Aircraft Maintenance Manual).

(4) Replenish oil as necessary (Ref. 72-00-00, SERVICING, Lubricating Oil System).

NOTE: Make sure the oil strainer is installed before you replenish the oil.

6. Cleaning/Painting

A. Cleaning of Scavenge Oil Strainer

(1) Soak scavenge oil strainer in clean solvent (PWC11-027) or (PWC11-031). Remove oil sludge and examine for evidence of metallic particles. Open up blocked holes using non-metallic scraper.

(2) Wipe clean with lint-free cloth and dry with clean, dry compressed air.

B. Cleaning of Magnetic Chip Detector

CAUTION: DO NOT SOAK DETECTOR IN SOLVENT.

(1) Seal electrical receptacle.

(2) Clean with solvent (PWC11-027) or (PWC11-031) and a medium-stiff bristle brush or spray.

(3) Make sure magnets are free of metal particles, and store detector in sealable container until ready for use.

7. Inspection/Check

A. Inspection of Propeller Thrust Bearing Cover Assembly

(1) Examine thrust bearing cover seal cavity for burrs, nicks, corrosion and other surface damage. Light stoning of damaged surfaces is acceptable. Corrosion may be removed (Ref. Para. 8.).

(2) Make sure plug, or airframe-supplied adapter fitting, at seal overboard drain cavity is tight and lockwired.

B. Inspection of Oil Seal Retaining Ring or Ring Halves

(1) Examine for nicks, burrs and similar surface damage. Light stoning of damaged surfaces is acceptable.

(2) Check integrity of felt inserts. If worn or damaged, replace insert (Ref. Para. 8.).

C. Inspection of Oil Seal Runner

(1) Examine visible area of seal runner for nicks, burrs and other surface damage caused by tools during removal of seal. No repair is acceptable. Send power output section of engine to an approved overhaul facility for replacement of defective seal runner.

NOTE: If applicable, check sealant (PWC09-001) between oil seal runner and propeller shaft. Replace if necessary.

D. Inspection of Scavenge Oil Strainer

(1) Examine for blocked passages. Clean as necessary (Ref. Para. 6.).

(2) Examine seating surfaces for nicks, burrs and other surface damage caused during removal and installation. Light stoning of damaged surfaces is acceptable.

(3) Examine threads of nut and, if plug is removed, internal threads for deformation. Chase threads using suitable die or tap as appropriate. Remove all metal chips.

E. Inspection of Magnetic Chip Detector

NOTE: For detailed debris analysis refer to Chapter 70-00-00, MAINTENANCE PRACTICES, Debris Analysis and Material Specifications.

(1) Examine threads for damage. Chase threads as required. Replace detector if threads are badly damaged or crossed.

NOTE: Rejection of one part is cause for rejection of the other since the two parts of the chip detector are not individually procurable. Component parts of chip detectors should remain in sets and not mixed.

(2) Connect ohmmeter across detector output terminals and place suitable steel bar across magnet poles. Circuit continuity must exist.

(3) Check output terminal pins and condition of potting compound. If pins are loose or if compound is cracked, reject complete detector.

F. Inspection of Propeller Shaft Oil Seal

(1) Examine visible area of oil seal contact area for damage and wear. If oil leakage at the OD of the seal is suspected, replace oil seal as follows:

(a) Remove old seal element (Ref. Para. 5.).

(b) Clean seal cavity of thrust bearing cover using solvent (PWC11-027) or (PWC11-031).

(c) Apply adhesive (PWC08-002) or (PWC09-001) in seal cavity.

(d) Install new seal element (Ref. Para. 5.). Remove excess adhesive and cure per manufacturer's instructions.

G. Inspection of Propeller Shaft (Ref. Fig. 205)

(1) Inspect Area B of the propeller shaft for damage as follows:

(a) Isolated surface damage up to 0.003 in. deep and minimum 0.010 in. apart is acceptable.

NOTE: The anti-corrosion coating can be up to 0.004 in. thick. For propeller shaft with such coating, you can remove the coating locally in order to have a better view of the damage. Refer to the anti-corrosion coating repair per Para. 8.E.

(2) Inspect other surfaces as follows:

(a) Local surface damage on flange and pins up to 0.005 in. is acceptable.

(b) Local surface damage on remaining surfaces up to 0.002 in. deep is acceptable.

(3) If the propeller shaft has an anti-corrosion coating, perform local paint touch-up on exposed surfaces per Para. 8.E. as required.

8. Approved Repairs

A. Repair of Corrosion - Front RGB Housing and Rear RGB Housing Visible Flange

NOTE: Corrosion must not be deeper than 0.010 in. and must not cover an area greater than 30 percent of the total surface of the front RGB housing and rear RGB housing visible flange.

(1) Apply a suitable covering material over the compressor section.

(2) Clean the surface of the area to be repaired with a swab soaked in isopropyl alcohol (PWC11-014) and crocus cloth (PWC05-061).

(3) Remove all traces of corrosion (magnesium oxide) using a suitable steel brush, crocus cloth (PWC05-061), abrasive cloth (PWC05-101), file or grit paper. Remove all traces of debris using a vacuum cleaner.

(4) Flush the area with clean water at room temperature.

(5) Dry the area with clean compressed air at 29 psig.

WARNING: REFER TO THE MATERIAL SAFETY DATA SHEETS BEFORE YOU USE THESE MATERIALS FOR INFORMATION SUCH AS HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES. SOME OF THESE MATERIALS CAN BE DANGEROUS. YOU CAN GET THE DATA SHEETS FROM THE MANUFACTURERS OR THE SUPPLIERS OF THESE MATERIALS.

(6) Prepare a chrome pickle solution (Ref. Chap. 70-00-00, MAINTENANCE PRACTICES, Touch-Up Solution).

(7) Using a swab or brush, apply the chrome pickle solution, at a temperature of 17° to 29°C (55° to 85°F), to the prepared surface for 30 to 45 seconds.

NOTE: Repeat the application frequently to make sure that the affected surface is continually wet with the solution.

(8) Swab the area with clean water until successive swabs are no longer stained yellow.

(9) Dry the area with local heating (air dry or a heat gun at a low setting).

(10) Clean the affected area with a rag soaked in clean water.

(11) Dry the area with clean, compressed air at 29 psig.

(12) Apply two coats of primer (PWC13-001).

(13) Allow the primer to air dry for eight hours before applying enamel paint. Use compressed air at 29 psig to accelerate the drying time.

(14) Apply three to four coats of enamel (PWC05-037) to the primed surface. Allow the surface of the enamel to become tacky (approximately 15 minutes) between each coat. The final coat of enamel must dry for 24 hours before returning the engine to service.

NOTE: Drying time for the primer and paint can be reduced with the use of a heat gun at a low setting. Refer to the manufacturers instructions.

B. Replacement of Accessory Drive Seal

(1) The procedures for Nf tachometer-generator drive shaft seal replacement are the same as for Ng tachometer-generator (Ref. 72-60-00, MAINTENANCE PRACTICES, Approved Repairs) using same tooling.

C. Replacement of Felt Strip Inserts

(1) Remove worn or damaged insert from ring half by carefully scraping slot area with a suitable scraper.

(2) Clean slot area with solvent (PWC11-023) or (PWC11-025).

(3) If anodizing has been damaged, apply solution (PWC05-166).

(4) Cut portions of felt strip insert to suit slot in retaining ring half. Make sure insert protrudes 0.020 to 0.040 inch at each end of ring half.

(5) Apply adhesive (PWC08-002) following manufacturer's instructions, and cure at temperature not to exceed 93°C (200°F) for 30 minutes min.

D. Repair of Thrust Bearing Cover (Corroded Seal Cavity)

NOTE: Mask bearing and propeller shaft, to prevent ingress of debris.

(1) Remove corrosion from seal cavity contact surface using abrasive cloth (PWC05-061).

(2) Clean area with solvent (PWC11-027) or (PWC11-031).

(3) Apply adhesive (PWC08-002) at corroded surface following manufacturer's instructions. Remove excess adhesive.

(4) Install new seal element (Ref. Para. 5.D.).

(5) Allow adhesive to cure following manufacturer's instructions.

E. Propeller Shaft Anti-corrosion Coating (Ref. Fig. 206)

(1) Mask the propeller shaft bore, the runner, seal area and all the surrounding surface.

(2) Install heat insulation blanket over the propeller thrust bearing cover area.

(3) Use abrasive cloth (PWC05-061) to remove any corrosion and/or stains on the propeller shaft. If required, use a abrasive paper 600-800 grit (PWC05-270) to locally remove the coating.

WARNING: REFER TO MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(4) Clean the area surface to touch-up with isopropyl alcohol (PWC11-014B) commercial grade.

(5) Use a fine brush, apply a thin and even coat of paint 0.0015 to 0.002 in. thick as per one of the following options:

WARNING: REFER TO MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(a) SermeTel 984 coating (PWC07-062A): Mix the aluminium coating base with the aluminium coating catalyst in the following proportion: 100 parts base to 17 parts catalyst by volume.

(or)

(b) Alseal 500 coating (PWC07-062B) or Alseal 519 coating (PWC07-062C): Mix the aluminium coating base with the aluminium coating catalyst in the following proportion: 100 parts base to 1.6 parts catalyst by volume.

(6) Air dry for 10 to 15 minutes. Cure the coating with heat lamp set at 190°C (375°F) minimum for 90 to 120 minutes.

(7) Use a soft cloth and manually burnish the coated surface.

(8) Use a strip of masking tape (PWC05-283) and check the coating for adhesion.

WARNING: REFER TO MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(9) Use a fine brush to apply a thin, even coat of epoxy enamel paint (PWC07-015). Use color required to match existing coating.

(a) The mix ratio is one part of catalyst to one part of base.

(10) Air dry for 15 to 20 minutes. Cure the top coat with heat lamp set at 80°C (175°F) minimum for 4 hours.

(11) Use a strip of masking tape (PWC05-283) and check the coating for adhesion.

(12) Remove all masking and heat insulation blankets.

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Figure 201 Removal/Installation of Propeller Shaft Oil Seal

Figure 202 Removal/Installation of Scavenge Oil Strainer Assembly and Magnetic Chip Detector

Figure 203 Propeller Shaft Oil Seal Garter Spring

Figure 204 Lockwiring of Thrust Bearing Cover Bolts

Figure 205 Inspection of Propeller Shaft

Figure 206 Propeller Shaft Anti-corrosion Coating - Local Restoration

72-20-00
COMPRESSOR AIR INLET - DESCRIPTION AND OPERATION

1. General

A. The compressor inlet case is a component of the engine gas generator assembly and directs incoming air to the compressor rotor assembly. An air inlet screen prevents debris entering the compressor inlet.

2. Description and Operation (Ref. Fig. 1)

A. Compressor Inlet Case

The compressor inlet case is a circular casting that forms an annular plenum chamber for the passage of air to the compressor rotor. Two mounting flanges are incorporated; Flange F at the front provides mounting for the gas generator case while Flange G at the rear, provides mounting for the accessory gearbox. The inlet case also forms a compartment for, and the forward face of the integral oil tank. An oil level sight gage is located on the side of the inlet case at the 10 o'clock position. The oil tank pressurizing valve and oil cooler return adapter are located at the 11 and 12 o'clock positions respectively.

Housed in the inlet case is the No. 1 bearing assembly with its associated rotor and stator seals and the No. 1 bearing oil jet. The guide vanes in the inlet case plenum chamber are hollow and direct P2.5 interstage air, released by the compressor bleed valve, into the incoming air via a series of openings cut in the guide vanes. This tangential air flow creates a swirl effect known as "jet flap function", to reduce compressor stall during starting and low power conditions.

B. Air Inlet Screen

The air inlet screen is an open mesh screen wrapped around the periphery of the inlet case to prevent entry of large objects that may bypass the airframe cowling inertial separator vanes.

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Figure 1 Compressor Inlet Case and Air Inlet Screen Installation

COMPRESSOR AIR INLET - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC04-004	Grease, High Temperature
PWC04-005	Grease, Extreme Pressure
PWC05-019	Compound, Lapping
PWC05-037	Enamel, Aluminized
PWC05-061	Cloth, Coated Abrasive
PWC05-101	Cloth, Abrasive
PWC05-145	Use PWC05-019
PWC06-002	Petrolatum, White
PWC08-002	Adhesive, Fluorosilicone
PWC11-014	Alcohol, Isopropyl

PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC13-001	Primer, Epoxy

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

A. Removal of Air Inlet Screen

CAUTION: KEEP COMPRESSOR INLET AREA CLEAR OF ALL FOREIGN OBJECTS THAT COULD BE INGESTED BY ENGINE DURING SUBSEQUENT OPERATION.

(1) Pre-SB14472: Remove the self-locking nuts (2, Fig. 201) and the bolts (1) that attach the air inlet screen (3) flanges at 4 o'clock position or at the position where it is installed for easy access.

(2) Post-SB14472: Remove the self-locking nuts (2, Fig. 201) and the bolts (1) that attach the air inlet screen (3) flanges at 6 o'clock position or at the position where it is installed for easy access.

(3) Carefully open the air inlet screen (3) and remove it from the compressor inlet case.

CAUTION: IF ANY OBJECT FALLS INTO ENGINE COMPRESSOR INLET AREA, STOP ALL WORK UNTIL YOU REMOVE THE OBJECT FROM THE COMPRESSOR INLET AREA.

(4) To protect compressor inlet area from foreign object ingress, cover entire inlet area with suitable polyethylene or similar sheeting.

B. Removal of Oil Level Sight Gage

(1) Drain engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove bolts (4, Fig. 202) and washers (3) fastening oil level sight gage (2) and gasket (1) to compressor inlet case.

(3) Remove sight gage and gasket. Discard gasket.

C. Removal of Oil Tank Pressurizing Valve

(1) Remove nuts (1, Fig. 203) and bolts (3) fastening bracket (14) to rear mount ring.

(2) Remove bolts (2) and washer fastening bracket (14), cover (4) and gasket (5) to compressor inlet case.

(3) Withdraw valve assembly (11) from inlet case and internal breather tube.

(4) Install suitable protective cover to compressor inlet case.

(5) Install valve (Ref. Para. F.) or repair (Ref. Para. 8.) as required.

D. Installation of Air Inlet Screen

CAUTION: IF ANY OBJECT FALLS INTO ENGINE COMPRESSOR INLET AREA, STOP ALL WORK UNTIL YOU REMOVE THE OBJECT FROM THE COMPRESSOR INLET AREA.

(1) Remove protective covering from compressor inlet area, and make sure area is free of foreign material or loose components.

(2) Pre-SB14472 install the air inlet screen as follows:

(a) Apply grease (PWC04-004) or (PWC04-005) to inner circumference of rubber rims of the air inlet screen (3).

CAUTION: EXTRA CARE MUST BE TAKEN TO MAKE SURE THAT NO HARDWARE FALLS IN THE AIR INLET DURING THE INSTALLATION OF THE AIR INLET SCREEN.

(b) Carefully install the air inlet screen (3, Fig. 201) over the compressor inlet case, inserting the screen between the case and the external fittings and lines. Locate the mating flange faces at 4 o'clock position. However, for easy access, the flange can be installed at any position as long as it is aligned with an inlet case strut.

(3) Post-SB14472 install the air inlet screen as follows:

(a) Apply a thin layer of white petrolatum (PWC06-002) to the inner circumference of rubber rims of the air inlet screen (3).

CAUTION: EXTRA CARE MUST BE TAKEN TO MAKE SURE THAT NO HARDWARE FALLS IN THE AIR INLET DURING THE INSTALLATION OF THE AIR INLET SCREEN.

(b) Carefully install the air inlet screen (3, Fig. 201) over the compressor inlet case, inserting the screen between the case and the external fittings and lines. Locate the mating flange faces at 6 o'clock position. However, for easy access, the flange can be installed at any position as long as it is aligned with an inlet case strut.

(4) Attach the flanges of the air inlet screen (3) with the bolts (1) and self-locking nuts (2). Torque the self-locking nuts (2) to 12 to 15 lbf.in.

E. Installation of Oil Level Sight Gage

(1) Make sure mating face on compressor inlet case is smooth and clean.

(2) Install new gasket (1, Fig. 202) and sight gage (2) to compressor inlet case with washers (3) and bolts (4). Tighten bolts in diametric sequence 24 to 36 lb.in. and lockwire.

(3) Refill engine oil system (Ref. 72-00-00, SERVICING, Lubricating Oil System) and test run engine (Ref. 71-00-00, ADJUSTMENT/TEST, General). Check for oil leaks.

F. Installation of Oil Tank Pressurizing Valve

(1) Install new lubricated preformed packing (10, Fig. 203) on valve assembly (11) and insert through compressor inlet case into internal breather tube.

(2) Install new gasket (5), cover (4) and support bracket (14), to compressor inlet case with bolts (2) and washer (13). Tighten bolts 36 to 40 lb.in. and lockwire.

(3) Install support bracket (14) to rear mount ring using bolts (3) and self-locking nuts (1). Tighten nuts 36 to 40 lb.in.

6. Cleaning/Painting

A. Cleaning of Air Inlet Screen

(1) Clean wire mesh using solvent (PWC11-027) or (PWC11-031). Dry with clean, dry compressed air.

B. Cleaning of Pressurizing Valve

(1) Clean components by flushing or spraying with solvent (PWC11-027) or (PWC11-031). Make sure bores are clean and free of obstructions. Dry components using clean, dry compressed air.

7. Inspection/Check

A. Inspection of Air Inlet Screen

(1) Examine air inlet screen wire mesh for cleanliness and/or damage. Clean as necessary.

(2) Examine rubber sealing rims and flanges for proper attachment and/or damage.

B. Inspection of Air Inlet Case

(1) Examine struts for cracks. None are allowed. If cracks are found send case to an approved overhaul facility.

(2) Examine inlet case expansion plugs as follows (Ref. Fig. 204):

(a) Drain oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(b) Remove oil filter and filter housing (Ref. 79-20-02).

(c) Insert suitable mirror through oil filter housing bore and with a strong light source, locate upper and lower expansion plugs on front face of inlet case. Check for looseness of plugs.

(d) If plug(s) is/are loose, send engine to an approved overhaul facility for repair/replacement of plug(s).

(3) Inspect the compressor air inlet surfaces as follows:

(a) Procedure A

1 Remove the inlet screen (Ref. Para. 5.A.).

2 Use a mirror and a light source to examine the inlet throat area, struts, radii and mating surfaces for corrosion.

3 If you find corrosion, then repair the damaged area (Ref. Para. 8.A.).

a If the corrosion is in the repairable limits, then the engine can return to service for 20 hours or one month, whichever occurs first, for scheduling the repair in accordance with Para. 8.A. Corrosion progression in salt laden area must be considered. Alternatively apply corrosion inhibitor and examine at every MINOR inspection or three months, whichever occurs first.

4 If you find coating loss with no corrosion, then the engine can return to service. It is recommended to apply new coating in accordance with Para. 8.A. or apply corrosion inhibitor and examine at every MINOR inspection or three months, whichever occurs first.

5 Apply corrosion inhibitor (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

(b) Procedure B (Alternate)

1 Examine with a borescope.

2 Examine the inlet throat area, struts, radii and mating surfaces for corrosion.

3 If you find corrosion, then repair the damaged area (Ref. Para. 8.A.).

a If the corrosion is in the repairable limits, then the engine can return to service for 20 hours or one month, whichever occurs first, for scheduling the repair in accordance with Para. 8.A. Corrosion progression in salt laden area must be considered. Alternatively apply corrosion inhibitor and examine at every MINOR inspection or three months, whichever occurs first.

4 If you find coating loss with no corrosion, then the engine can return to service. It is recommended to apply new coating in accordance with Para. 8.A. or apply corrosion inhibitor and examine at every MINOR inspection or three months, whichever occurs first.

5 Apply corrosion inhibitor (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

NOTE: Typically done with a long tube attached to the borescope to reach the required area, in particular No. 1 bearing area.

C. Inspection of Oil Level Sight Gage

(1) Examine the sealing and mating surfaces for scratches, scoring and other surface damage.

(2) Check the sealing of lens within the sight gage for possible leakage. Replace the sight gage as required.

D. Inspection of Oil Tank Pressurizing Valve

(1) Examine for wear or corrosion. Valve seats must be free of scoring and/or pitting. Repair as required (Ref. Para. 8.).

8. Approved Repairs

A. Repair of Corrosion - Compressor Inlet Case

(1) Remove surface corrosion on the compressor inlet case, with corrosion equal or below 0.060 in. depth in Zone A and equal or below 0.035 in. depth in Zone B and corrosion area less than 30% of the total surface in Zone A and less than 30% area of any one strut in Zone B, as follows (Ref. Fig. 205):

NOTE: Corrosion must not be deeper than 0.060 in. in Zone A and 0.035 in. in Zone B other than the specific areas (Ref. Fig. 205). Corrosion must not cover an area more than 30% of the total surface in Zone A and must not cover an area greater than 30% of the surface of any one strut in Zone B. Repair in-situ within 20 flight hours or one month, whichever occurs first, or alternatively apply corrosion inhibitor and examine at every MINOR inspection or three months, whichever occurs first (Ref. Table 201).

(a) Apply a suitable covering material over the compressor section.

(b) Clean the surface of the area to be repaired with a swab soaked in isopropyl alcohol (PWC11-014) and crocus cloth (PWC05-061).

(c) Remove all traces of corrosion (magnesium oxide) using a suitable steel brush, crocus cloth (PWC05-061), abrasive cloth (PWC05-101), file or grit paper. Remove all traces of debris using a vacuum cleaner.

(d) Flush the area with clean water at room temperature.

(e) Dry the area with clean compressed air at 29 psig (200 kPa).

(f) Surface treatment

1 Method A - Chrome pickle solution (PWC05-161)

a Prepare a Chrome pickle solution (PWC05-161) (Ref. 70-00-00, STANDARD PRACTICES - REPAIR).

b Apply the chrome pickle solution (PWC05-161) with brush or swab on the prepared surface at the temperature of 17° to 29°C (55° - 85°F) for 30 to 45 seconds.

NOTE: Apply the solution frequently to make sure that the affected surface is continually wet.

c Clean the area with water until successive swabs are no longer stained yellow.

d Dry the area with local heating (Air dry or a heat gun at a low setting).

d Dry the area with local heating (Air dry or a heat gun at a low setting).

e Clean the affected area with a rag soaked in clean water.

f Dry the area with clean compressed air at 29 psig (200 kPa).

2 Method B - Surface treatment with conversion coating touch-up (PWC05-419) as per manufacturer's recommended application process.

NOTE: Conversion coating touch-up (PWC05-419) can be used on both aluminum and magnesium inlet cases.

3 Method C - Surface treatment with conversion coating touch-up (PWC05-418) as per manufacturer's recommended application process.

NOTE: Conversion coating touch-up (PWC05-418) can be used on both aluminum and magnesium inlet cases.

(g) Apply two coats of primer (PWC13-001).

NOTE: The primer can be diluted with 10% solvent.

(h) Allow the primer to air dry for eight hours before you apply enamel paint. Use compressed air at 29 psig (200 kPa) to accelerate the drying time.

(i) Apply three to four coats of enamel (PWC05-037) to the primed surface. Allow the surface of the enamel to become tacky (approximately 15 minutes) between each coat. The final coat of enamel must dry for 24 hours before returning the engine to service.

NOTE: Drying time for the primer and paint can be reduced with the use of a heat gun at low setting (Ref. Manufacturers Instructions).

(j) Apply corrosion inhibitor (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

(2) DELETED.

(3) If corrosion is more than 0.060 in. depth in Zone A or 0.035 in. depth in Zone B or if corrosion covers an area greater than 30 percent in Zone A or covers an area greater than 30 percent of the surface of any one strut in Zone B, the engine must be sent for repair to an approved overhaul facility before next flight (Ref. Table 201).

NOTE: The repair limits in the specific areas described continues to be same and do not change (Ref. Fig. 205).

Instructions).

(j) Apply corrosion inhibitor (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

(2) DELETED.

(3) If corrosion is more than 0.060 in. depth in Zone A or 0.035 in. depth in Zone B or if corrosion covers an area greater than 30 percent in Zone A or covers an area greater than 30 percent of the surface of any one strut in Zone B, the engine must be sent for repair to an approved overhaul facility before next flight (Ref. Table 201).

NOTE: The repair limits in the specific areas described continues to be same and do not change (Ref. Fig. 205).

Table 201 Compressor Inlet Case Repair Limits.

B. Repair of Air Inlet Screen Edge

(1) Clean area (Ref. Para. 6.), and apply adhesive (PWC08-002) to mating surfaces of loose rims or flanges.

(2) Allow to dry for two hours at room temperature. Full bond strength will be obtained after 72 hours.

C. Repair of Oil Tank Pressurizing Valve (Heavy Maintenance Only)

(1) Remove roll pin (12, Fig. 203) fastening valve seat (6), piston (7) and spring (8) in valve housing (9).

(2) Clean valve components (Ref. Para. 6.).

(3) Lap valve seat (6) to give 360 degree surface contact using compound (PWC05-019) or (PWC05-145).

(4) After lapping, thoroughly clean the valve seat (Ref. Cleaning/Painting) to remove all traces of the compound.

(5) Insert spring (8) and piston (7) into housing (9). Screw valve seat (6) in until travel stops, to compress spring to minimum height.

(6) Back off valve seat (6) 2.5 turns (0.104 in.).

(7) Fasten the valve components in housing (9) with spring pin (12).

(8) Install the valve assembly in the compressor inlet case (Ref. Para. 5.).

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Figure 201 Removal/Installation of Air Inlet Screen

Figure 202 Removal/Installation of Oil Level Sight Gage

Figure 203 Removal/Installation of Oil Tank Pressurizing Valve

Figure 204 Compressor Inlet Case Expansion Plugs

Figure 205 Repair of Corrosion - Compressor Inlet Case

List of Tables

201 Compressor Inlet Case Repair Limits.

72-30-00
COMPRESSOR SECTION - DESCRIPTION AND OPERATION

1. Description and Operation

The gas generator assembly comprises a compressor inlet case and screen, gas generator case, compressor rotor assembly, combustion chamber liner, and compressor turbine.

The exterior of the gas generator case has provision for the fireseal mount rings, flow divider and dump valve, fuel manifold and nozzles, fuel drain valves, spark igniters, compressor bleed valve, P3 and P2.5 airframe airbleed adapters. Also, on the rear flange of the compressor inlet case is attached the accessory gearbox.

72-30-01
CENTER FIRESEAL MOUNT RING - DESCRIPTION AND OPERATION

1. Description and Operation

The center fireseal mount ring, which forms a bulkhead between the compressor air inlet zone and the front of the engine, consists of upper and lower halves with bolting flanges. Each half is manufactured from stainless steel sheet with the outer circumference contoured to suit airframe nacelle requirements. Holes for external piping and attaching parts are provided at appropriate locations in the upper and lower halves. An insulating strip is bonded to the inner circumference to provide a seal between the fireseal and the gas generator case. The upper and lower halves are bolted together to form a complete ring which is fastened to the gas generator case by mounting brackets attached to the assembly.

CENTER FIRESEAL MOUNT RING - MAINTENANCE PRACTICES

1. General

A. It is not a necessary practice to remove the mount ring during maintenance of the engine. Removal should be dictated by the extent of repair necessary as determined during inspection. Refer to the relevant chapters in this manual for the removal/installation of lines/tubes and components passing through the rings.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC08-002	Adhesive, Fluorosilicone
PWC09-001	Sealant, Silicone Rubber
PWC11-027	Solvent, Petroleum
PWC11-029	Solvent, Removing
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

Refer to the relevant chapters in this manual for the removal/installation of lines/tubes and components passing through the mount ring.

5. Removal/Installation

Refer to the relevant chapters in this manual for the removal/installation of lines/tubes and components passing through the mount ring.

A. Removal of Center Fireseal Mount Ring (Ref. Fig. 201)

(1) Remove self-locking nuts (3) and bolts (1) securing top center fireseal mount ring (2) to bottom center fireseal mount ring (8).

(2) Support bottom center fireseal mount ring (8), remove nuts (3) and bolts (18) securing ring to support brackets (5) located on gas generator case, and lower mount ring from engine.

(3) Remove nuts (7), washers (6) and bolts (4) securing top center fireseal mount ring (2) to fireseal support brackets (5) located on the gas generator case. Lift mount ring from engine.

B. Installation of Center Fireseal Mount Ring (Ref. Fig. 201)

(1) Install the lower center fireseal mount ring (8) on fireseal support brackets (5) with the nuts (7), washers (6) and bolts (4) securing. Tighten nuts 36 to 40 lb.in.

(2) Install the top center fireseal mount ring (2) on fireseal support brackets (5) with the nuts (7), washers (6) and bolts (4) securing. Tighten nuts 36 to 40 lb.in.

(3) Attach upper and lower mount rings (2) and (8) with the nuts (3) and bolts (1). Tighten nuts 36 to 40 lb.in.

6. Cleaning/Painting

A. Cleaning of Center Fireseal Mount Ring

(1) Clean with solvent (PWC11-027) or (PWC11-031). Dry with clean, dry, compressed air.

7. Inspection/Check

A. Inspection of Center Fireseal Mount Ring

(1) Examine mount ring halves for attachment, damage and condition.

NOTE: For external tubes/lines passing through mount rings, refer to relevant chapters in this manual.

(2) Examine circumferential insulating strips for attachment. Loosened strip may be rebonded (Ref. Approved Repairs).

8. Approved Repairs

A. Repair of Mount Ring Insulating Strips (Ref. Fig. 202)

(1) Remove old adhesive from mount ring and insulating strip with solvent (PWC11-029).

(2) Clean surfaces (Ref. Para. 7.).

(3) Bond insulating strip to mount ring halves with adhesive sealant (PWC09-001), or if alternate configuration mount ring halves with adhesive sealant (PWC08-002).

(4) Allow sealant to cure at room temperature for approximately 72 hours.

(5) Trim insulating strip to dimensions shown.

NOTE: Seventy two hours is normal curing time of bond. Ring half may be returned to service after two to four hours, but avoid exerting pressure that would cause sealant to exude and weaken bond.

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Figure 201 Center Fireseal Mount RIng - Removal/Installation

Figure 202 Center Fireseal Mount Ring - Insulating Strip Replacement

72-30-02
REAR FIRESEAL MOUNT RING - DESCRIPTION AND OPERATION

1. Description and Operation

The rear fireseal mount ring, which forms a bulkhead between the compressor air inlet zone and the accessory gearbox, consists of upper and lower halves with bolting flanges. Construction is similar to the center fireseal mount ring except for the outer circumference contours. The upper and lower halves are bolted together and secured to the compressor inlet case by mounting brackets attached to the assembly. The rear fireseal mount ring includes provisions for installation of a compressor wash ring around the air inlet screen.

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1. General

   A. It is not a necessary practice to remove the rear fireseal mount ring during maintenance of the engine. Removal should be dictated by the extent of repair necessary as determined during inspection.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-014	Cloth, Abrasive
PWC05-070	Tape, Pressure Sensitive Adhesive
PWC08-002	Adhesive, Fluorosilicone
PWC09-001	Sealant, Silicone Rubber
PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-029	Solvent, Removing
PWC11-031	Cleaner, Engine
PWC11-032	Solvent, Degreaser

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

Refer to the relevant chapters in this manual for the removal/installation of lines/tubes and components passing through the mount rings.

A. Removal of Compressor Wash Ring

> CAUTION: COVER AIR INLET SCREEN TO PREVENT OBJECTS FROM FALLING INTO INLET. IF ANY OBJECT PASSES THROUGH SCREEN, ALL WORK MUST CEASE UNTIL OBJECT IS RECOVERED.

(1) Note position of elbow (4, Fig. 201), and remove cap (5) and elbow from tee (16).

(2) Disconnect upper and lower tube assemblies (1 and 9) from inlet tee (16).

(3) Remove bolts (3), washers (2), and upper tube assembly (1) from tee (16). Cap open end.

(4) Remove bolts (7), washers (8), and lower tube assembly (9) from tee (16). Cap open end.

(5) Remove jam nut (6) and tee (16) from upper half of mount ring. Cap all openings.

(6) If tube assemblies are to be cleaned, remove rivets (13 and 12) and plugs (14 and 11). Remove and discard preformed packings (10 and 15).

(7) Clean and inspect tubes and fittings (Ref. Paras. 6. and 7.).

B. Removal of Rear Fireseal Mount Ring (Ref. Fig. 202)

(1) Remove the compressor wash ring (Ref. Removal of the Compressor Wash Ring).

(2) Remove self-locking nuts (2) and bolts (3) that attach the support bracket (4) to the top rear fireseal mount ring (1).

(3) Remove the self-locking nuts (8), washers (7) and bolts (6) that attach the top rear fireseal mount ring (1) to the lower rear fireseal mount ring (9).

(4) Remove the top rear fireseal mount ring (1) and the lower rear fireseal mount ring (9) from the generator case.

C. Installation of Rear Fireseal Mount Ring (Ref. Fig. 202)

(1) Install the top rear fireseal mount ring (1) and the lower rear fireseal mount ring (9) on the generator case with the self-locking nuts (8), washers (7) and bolts (6). Torque nuts 32 to 36 lb.in.

(2) Install the self-locking nuts (2) and bolts (3) that attach the support bracket (4) to the top rear fireseal mount ring (1). Torque

(3) Install the compressor wash ring (Ref. Installation of the Compressor Wash Ring).

D. Installation of Compressor Wash Ring

> CAUTION: COVER AIR INLET SCREEN TO PREVENT OBJECTS FALLING INTO INLET. IF ANY OBJECT PASSES THROUGH SCREEN, ALL WORK MUST CEASE UNTIL OBJECT IS RECOVERED.

(1) If previously removed, reinstall plugs as follows:

(a) Install new preformed packings (15 and 10, Fig. 201) on plugs (14 and 11).

(b) Install each plug into open end of tube assemblies (1 and 9).

(c) Align plug and tube holes, and install rivets (13 and 12).

(d) Flare rivets with suitable tools.

(2) Install tee (16) on upper half of mount ring with jam nut (6). DO NOT tighten.

(3) Position lower tube assembly (9) on front face of lower half of mount ring, install two washers (8) between ring and tube assembly mounting bracket, and install bolt (7). DO NOT tighten.

(4) Connect lower tube assembly (9) to tee (16). DO NOT tighten.

(5) Position upper tube assembly (1) on front face of upper half of mount ring, install two washers (2) between ring and tube assembly mounting bracket, and install bolt (3). DO NOT tighten.

(6) Connect upper tube assembly (1) to tee (16). DO NOT tighten.

(7) Tighten jam nut (6) 70 to 80 lb.in.

(8) Tighten tube assembly coupling nuts 270 to 300 lb.in.

(9) Tighten bolts (3 and 7) 36 to 40 lb.in.

(10) Install elbow (4) on tee (16) at position noted at disassembly, and tighten 110 to 120 lb.in.

(11) Install cap (5) on elbow (4). Tighten cap 110 to 120 lb.in., and lockwire.

6. Cleaning/Painting

A. Cleaning of Rear Fireseal Mount Ring

(1) Clean with solvent (PWC11-027) or (PWC11-031). Dry with clean, dry, compressed air.

B. Cleaning of Wash Ring

(1) Clean tee, elbow, and plugs with solvent (PWC11-027) or (PWC11-031). Dry with clean, dry, compressed air.

NOTE: If necessary, pressure flush tee to make sure all ports are clear.

(2) Clean exterior of spray tubes with soft cloth moistened in solvent(PWC11-027) or (PWC11-031).

(3) Pressure flush each spray tube as follows:

(a) With a suitable flexible, coiled, non-metallic brush, and lots of solvent (PWC11-027) or (PWC11-031) thoroughly scrub interior of each tube.

(b) Temporarily cover all tube spray holes with pressure sensitive tape (PWC05-070).

(c) Fit suitable tubing over plug end of tube and provide a suitable container for spillage.

(d) Pressure flush tubes from coupling nut end with solvent (PWC11-027) or (PWC11-031), and remove tubing.

(e) Remove tape from each tube, and remove adhesive residue with solvent (PWC11-027) or (PWC11-031).

(f) Install suitable slave plugs in plug ends of tubes.

(g) Pressure flush tubes with solvent (PWC11-027) or (PWC11-031). Make sure all spray holes are clear.

(h) Remove slave plugs and dry each tube with clean dry compressed air.

7. Inspection/Check

A. Inspection of Rear Fireseal Mount Ring

(1) Examine rear fireseal mount ring halves for attachment, damage and condition.

NOTE: For external tubes/lines passing through mount rings, refer to relevant chapters in this manual.

(2) Examine circumferential insulating strips for attachment. Loosened strip may be rebonded (Ref. Approved Repairs).

B. Inspection of Compressor Wash Ring

(1) Examine tee, elbow and cap for condition/damage. Repair damaged threads with suitable chaser/die.

(2) Examine plugs for condition/damage. Replace plugs as required.

(3) Check spray holes in each tube. Clear holes of any foreign matter with a 0.052 to 0.057 in. drill bit. DO NOT break sharp edges.

(4) Examine brazed joints in area of coupling nuts and plugs. Cracks are not acceptable.

(5) Examine locating brackets and support clips for proper attachment. Cracks are not acceptable.

(6) Examine tubes as follows:

(a) Scratches with no appreciable depth are acceptable. Scratches to 0.005 in. deep should be smoothed out (Ref. 70-00-00, REPAIR, Blend Repairs). Replace tube(s) if scratch(es) exceed 0.005 in.

(b) Nicks 0.0625 in. long, by 0.010 in. wide and 0.003 in. deep are acceptable. Nicks to 0.005 in. should be smoothed out to remove sharp edges (Ref. 70-00-00, REPAIR, Blend Repairs).

(c) Dents are acceptable provided they are round bottomed and length or depth does not exceed 10 percent of tube OD.

(d) Minor isolated pitting to 0.003 in. deep is acceptable. Clusters should be removed and smoothed to 0.005 in. max. deep.

(e) Corrosion, rust or stains are acceptable if they can be removed by light polishing with abrasive cloth (PWC05-014) and oil (PWC03-001).

8. Approved Repairs

A. Repair Mount Ring Insulating Strips (Ref. Fig. 203)

(1) Remove old adhesive from mount ring and insulating strip with solvent (PWC11-029).

(2) Clean surfaces with solvent (PWC11-014) or (PWC11-032).

(3) Bond insulating strip to mount ring halves with adhesive (PWC09-001), or with alternate configuration mount ring halves using adhesive sealant (PWC08-002).

(4) Allow sealant to cure at room temperature for approximately 72 hours.

(5) Trim insulating strip to dimensions shown.

NOTE: Seventy-two hours is the normal curing time of bond. Ring half may be returned to service after two to four hours, but avoid exerting pressure that would cause sealant to exude and weaken bond.

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Figure 201 Removal/Installation of Compressor Wash Ring

Figure 202 Rear Fireseal Mount RIng - Removal/Installation

Figure 203 Rear Fireseal Mount Ring - Insulating Strip Replacement

72-30-04
GAS GENERATOR CASE - DESCRIPTION AND OPERATION

1. General

The gas generator case comprises the components necessary for the compression of the incoming air, and the mixing and combustion of fuel and air. It also provides the main attachment points for mounting the engine in the airframe.

2. Description and Operation (Ref. Fig. 1)

The gas generator case is of sheet metal construction and comprises an inner and outer case formed by webs. The inner rear case provides the housing for the compressor rotor assembly and its associated No. 1 and No. 2 bearings. The outer case provides the mountings for the compressor inlet case (flange F), exhaust duct (flange C), and the main engine mount pads. The interior of the outer case provides the support for diffuser tubes carrying air from the compressor centrifugal impeller to the combustion chamber, which is also enclosed by the gas generator case. Pressure and scavenge oil, P3, and P2.5 air distribution is provided for. Fuel drains are located at the 6 o'clock position. Externally, the gas generator outer case supports the fuel manifold and adapters, igniter plugs and, toward the rear, a compressor bleed valve at the 3 o'clock position. A bleed air adapter, located at the 12 o'clock position on the case, provides P2.5 air for airframe services. P3 airframe air is provided by an adapter located at the 9 o'clock position between the main engine mounts.

The front section of the gas generator case forms the outer housing for the combustion chamber liner. The case is circular in section, with mounting bosses for the 14 fuel manifold adapters, the front and rear drain valves and the two spark igniters. The drain valves are located at the 6 o'clock position, while the spark igniter bosses are at the 4 and 9 o'clock positions.

The spark igniters and the fuel nozzles and sheaths of the manifold adapters pass through the case and outer liner of the combustion chamber to protrude into the combustion area. The fuel nozzle sheaths are utilized to support the front of the combustion chamber outer liner. Six pads are provided on the gas generator case at the 2, 4, 6, 8, 10 and 12 o'clock positions for engine mounting in the airframe.

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Figure 1 Gas Generator Case Installation - Cross-section

GAS GENERATOR CASE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire shall, unless otherwise specified, comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-003	Cloth, Abrasive
PWC05-014	Cloth, Abrasive
PWC05-040	Insert, Helical Coil
PWC05-101	Cloth, Abrasive
PWC05-118	Insert, Keensert
PWC07-012	Coating, Aluminum
PWC07-023	Coating, Aluminum and Zinc (Serme Tel 249)
PWC07-024	Catalyst Coating, Aluminum and Zinc (Serme Tel 273)
PWC11-005+	Envirosolv 655

PWC11-012	Acetone
PWC11-014	Alcohol, Isopropyl
PWC11-023+	Ardrox Leeder 1064K
PWC11-025+	Desoclean 45
PWC15-013	Inhibitor, Rust

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31771	Spreader, Shanknut

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Locking Tool (Keensert)	P/N TD1032L

5. Removal/Installation

A. Removal of P2.5 Adapter (Transfer Tube)

(1) Remove bolts (1, Fig. 201) and cover (2).

(2) Remove screws (4), adapter (5) and gasket (3). Discard gasket (3).

(3) Remove and discard preformed packing (6) and gasket (7).

B. Removal of P3 Adapter

(1) Remove bolts (8, Fig. 201) fastening cover (9) and gasket (10) to adapter (12), or remove airframe ducting, as applicable (Ref. Airframe Maintenance Manual).

(2) Remove screws (11) fastening adapter (12) and gasket (13) to gas generator case. Discard gasket.

(3) Install suitable protective cover over opening.

C. Removal of Gas Generator Assembly (Heavy Maintenance)

(1) Remove engine from airframe and install in stand (Ref. 72-00-00, REMOVAL/INSTALLATION).

(2) Remove power section/power section module (PS/PSM) from gas generator assembly and install in stand (Ref. 72-00-00, REMOVAL/INSTALLATION).

(3) Remove CT disk and blade assembly (Ref. 72-50-02, Removal/Installation).

(4) Remove combustion chamber inner liner (Ref. 72-40-01, Removal/Installation).

(5) Remove CT stator assembly, stator housing assembly and small exit duct (Ref. 72-50-01, Removal/Installation).

D. Installation of P2.5 Adapter (Transfer Tube)

(1) Install preformed packing (6, Fig. 201) on adapter (5).

(2) Install new gasket (7) and adapter (5) in gas generator case.

(3) Fasten adapter temporarily with slave bolts, tighten initially 35 to 40 lb.in., and then 75 to 85 lb.in.

(4) Install screws (4) and tighten 32 to 36 lb.in., and remove slave bolts.

(5) Install cover (2) with new gasket (3) and install bolts (1).

(7) Install airframe ducting (Ref. Aircraft Maintenance Manual).

E. Installation of P3 Adapter

(1) Install gasket (13, Fig. 201) and adapter (12) on gas generator case with slave bolts. Tighten bolts initially 35 to 40 lb.in., then increase to 75 to 85 lb.in.

(2) Install screws (11), tighten 32 to 36 lb.in. and remove slave bolts.

(3) Position cover (9) and new gasket (10) on adapter (12), and install bolts (8). Tighten initially 35 to 40 lb.in., then increase to 75 to 85 lb.in. and lockwire.

(4) Install airframe ducting (Ref. Aircraft Maintenance Manual).

NOTE: Remove cover (9) and gasket (10) if you install the airframe duct.

F. Installation of Gas Generator Assembly

(1) Install small exit duct, stator housing assembly and CT stator assembly (Ref. 72-50-01, Removal/Installation).

(2) Install combustion chamber inner liner (Ref. 72-40-01, Removal/Installation).

(3) Install CT disk and blade assembly (Ref. 72-50-02, Removal/Installation).

(4) Remove PS/PSM from stand, and install on gas generator assembly (Ref. 72-00-00, REMOVAL/INSTALLATION).

(5) Install engine in airframe (Ref. 72-00-00, REMOVAL/INSTALLATION).

6. Cleaning/Painting

A. Cleaning of Gas Generator Case

(1) Wash salt and smog deposits from gas generator case with clean water. Dry with clean, dry compressed air.

(2) Clean corrosion buildup with non-metallic brush.

7. Inspection/Check

A. Inspection of Gas Generator Case

(1) External:

(a) Examine for general condition, including cracks, distortion, corrosion and evidence of overheating.

(b) Examine protective coating for loss or deterioration. Repair as necessary (Ref. Approved Repairs).

(c) Minor corrosion on exposed surface of gas generator case may be removed (Ref. Approved Repairs).

NOTE: If condition of gas generator case indicates further inspection is required, remove fuel manifold adapters or (Ref. 73-11-05, Removal/Installation) and spark igniters (Ref. 74-20-00, Removal/Installation).

1 Machined surfaces (bosses and pads) with corrosion pitting less than 0.010 inch deep and less than 75 percent of the surface is acceptable without repair.

(d) Examine fuel nozzle pads for broken studs. Repair as necessary.

(e) On engines INSTALLED in airframe, inspect engine mounts for attachment and condition (Ref. Aircraft Maintenance Manual).

(f) On engines NOT INSTALLED in airframe, inspect condition of mounting pads and threaded holes. Damage to threaded holes may be repaired (Ref. Approved Repairs).

(g) Examine mount ring mounting brackets for damage to the following limits (Ref. Fig. 202):

1 Cracks in legs must be stop drilled with a 0.0625 (1/16) inch drill bit.

2 Crack through one leg is acceptable. Remove sharp edges.

3 Cracks through both legs is acceptable on two brackets provided brackets are 180° apart. Remove sharp edges.

NOTE: Cracks may be an indication of vibration, or misalignment. Check for sources of vibration (propeller, starter, etc.) and fit of airframe firewall(s) and cowling(s).

4 Replace damaged brackets at next overhaul.

(2) Internal (Heavy Maintenance Only):

(a) Examine shanknuts (2 and 3, Fig. 202) on flanges in area of No. 2 bearing. Loose or damaged nuts may be replaced (Ref. Approved Repairs).

(b) Examine straightening vanes for cracks and missing material. A maximum of seven vanes with one side broken off is acceptable provided no more than two are adjacent and sharp edges are removed to prevent detachment of material.

(c) Examine diffuser exit ducts (Ref. Fig. 203):

1 Cracks of any length on inner surface of any number of ducts are acceptable provided cracks will not converge and allow metal to become detached (Ref. Details A, B and C). Cracks must be stop drilled (Ref. Approved Repairs).

2 Cracks ending in weld are acceptable and require no repair.

3 Loss of material is acceptable on a maximum of four ducts, provided detached material is removed from engine and hole size is within the limits shown (Ref. Details A and B). Remove sharp edges (Ref. Approved Repairs).

4 Cracks in duct outer face are acceptable. Cracks must be stop drilled (Ref. Approved Repairs).

5 Fretting wear on outer face and edge adjacent to next duct is acceptable provided such wear is repaired (Ref. Approved Repairs).

6 Cracks in fretted areas are acceptable provided such cracks are stop drilled (Ref. Approved Repairs).

7 Examine for 0.020 inch minimum clearance at the following locations:

a Between adjacent ducts.

b Between ducts and adjacent straightening vanes.

c Between ducts and inner wall of gas generator case.

8 If any of the above limits are exceeded the duct(s) must be replaced (Ref. Approved Repairs).

(d) Reject engine if two adjacent ducts are missing, or if more than two non-adjacent ducts are missing.

(e) An engine with two non-adjacent ducts missing may remain in service until removal for repair or overhaul provided all other ducts are within allowable limits, allowable repairs have been done, and engine performance is acceptable and surge free. Remove debris, and sharp edges

NOTE: If engine is kept in service, do a borescope inspection of hot section and combustion chamber 250 hours after discovery of loss, and subsequently at a 400 hour interval.

(f) Cracking of ducts may be associated with vibration. The source of vibration should be identified, and corrective action taken to reduce it.

8. Approved Repairs

A. Installation of Helical Insert at Engine Mount Pad threaded holes (Ref. Fig. 204)

(1) Measure depth of damaged hole.

(2) Position gas generator case. Drill and tap for 3/8-24 inch insert.

(a) Minor diameter depth (actual value recorded at step (1)) maximum.

(b) Minimum full thread depth of 0.430 inch.

(3) Install helical insert (PWC05-040) per SPOP 415.

(4) Do a pressure flush.

B. Corrosion Removal

(1) Remove all visible corrosion with coarse abrasive cloth (PWC05-003) exposing bare metal. Use pad (PWC05-014) or a soft bristle brush to provide a clean surface.

NOTE: Do not use power tools for corrosion removal.

(2) Restore protective coating (Ref. Para.C.).

(3) Mask all areas that are to remain free of corrosion inhibitor (PWC15-013).

(4) Apply inhibitor in accordance with manufacturer's instructions

C. Repair of Protective Coating

WARNING: SOLVENTS ARE FLAMMABLE AND TOXIC. OBSERVE SAFETY PRECAUTIONS.

(1) Clean area to be touched up with acetone (PWC11-012) or alcohol (PWC11-014) or ardrox leeder 1064K (PWC11-023+) or desoclean 45 (PWC11-025+) or envirosolv 655 (PWC11-005+).

C. Repair of Protective Coating

WARNING: SOLVENTS ARE FLAMMABLE AND TOXIC. OBSERVE SAFETY PRECAUTIONS.

(1) Clean area to be touched up with acetone (PWC11-012) or alcohol (PWC11-014) or ardrox leeder 1064K (PWC11-023+) or desoclean 45 (PWC11-025+) or envirosolv 655 (PWC11-005+).

(2) Touch-up area with abrasive cloth (PWC05-101).

(3) Clean with dry, clean, compressed air, and wipe with clean, dry cloth.

NOTE: Do not use solvent on, or touch bare metal.

(4) Use any of the below procedure and apply paint coating:

(a) Option A:

1 Apply SermeTel 249 (PWC07-023) and air dry 15 to 30 minutes or until dry to touch.

2 Use a spray, brush or swab to coat the touch-up surface with SermeTel 273 catalyst (PWC07-024). Allow to stand one hour. Wash with water and dry with shop air.

(b) Option B:

1 Apply a coat of paint (PWC07-012).

2 Do a ground run for five minutes to dry the coating (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

3 Apply second coat of paint (PWC07-012).

4 Do a ground run for another five minutes to dry the coating (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

D. Repair of Igniter Boss Threads

(1) Dress damaged threads using a 0.5625-18 UNJF-3B tap.

E. Replacement of Shanknut (Heavy Maintenance Only)

(1) Using a suitable drill, partially remove the flared end of shanknut (Ref. Fig. 205).

NOTE: Do not drill through to contact flange.

E. Replacement of Shanknut (Heavy Maintenance Only)

(1) Using a suitable drill, partially remove the flared end of shanknut (Ref. Fig. 205).

NOTE: Do not drill through to contact flange.

(2) Remove shanknut using a parallel pin punch at drilled end to shear weakened flare, and retrieve from case.

(3) Install new shanknut and hold against flange (Ref. Fig. 205).

(4) Apply oil (PWC03-001) to tapered portion of shanknut spreader (PWC31771) and screw into shanknut until shank end is flared against flange.

(5) Remove spreader and examine flared end of shanknut for correct forming with no evidence of deformation or cracks.

F. Repair of Diffuser Exit Ducts (Heavy Maintenance Only) (Ref. Fig. 206)

(1) Stop drill cracks with a 0.0625 (1/16) inch drill (Ref. Details A, B and C).

(2) Smooth out areas where material has become detached (Ref. Details A and B).

(3) Cracks on edges of duct, which may join and cause sections to become detached, must be smoothed (Ref. Detail C).

(4) Cracks in outer wall of ducts may be reached by drilling access holes in inner walls with a 0.250 (1/4) inch drill, then stop drill crack in outer wall with a 0.0625 (1/16) inch drill. Access holes are acceptable without repair (Ref. Detail D).

(5) Fretting wear at exit of duct should be carefully smoothed.

(6) Cracks in fretted areas should be stop drilled with a $^{1}/_{16}$ (0.0625) inch drill.

G. Repair of Bleed Valve Pad and/or Fuel Nozzle Pad Rear Threaded Holes

(1) Mask gas generator openings to prevent ingress of debris.

(2) Open up damaged hole(s) with a 0.272 inch (letter I) drill bit. Chamfer 0.323 to 0.333 inch x 90 ± 5 degrees included angle.

(3) Tap hole using 0.3125-18 UNC-2B tap.

(4) Install threaded insert (PWC05-118) fingertight as follows:

(a) Fuel nozzle inserts 0.010 to 0.015 inch above surface with keys aligned.

(b) Bleed valve inserts 0.010 to 0.015 inch below surface.

(c) Drive keys down with locking tool and hammer.

(5) Remove all masking material.

H. Replacement of Fuel Nozzle and/or Bleed Valve Damaged Threaded Inserts

(1) Remove insert material between keys and thread to 0.157 (5/32) inch deep maximum with a 0.219 (7/32) inch drill.

(2) Deflect keys inward, break off using suitable pin punch.

(3) Remove insert with suitable extraction tool.

(4) Install new insert (Ref. Para. G.).

I. Repair of Fuel Nozzle Pad Front Threaded Hole

NOTE: This is a temporary (field level) repair. Holes repaired using these instructions will require removal of the threaded insert at overhaul.

(1) Remove power section (Ref. 72-00-00, REMOVAL/INSTALLATION).

(2) Remove fuel manifold adapter(s).

(3) Remove combustion chamber liner (Ref. 72-40-01, Removal/Installation).

(4) Mask gas generator openings to prevent ingress of debris.

(5) Open up damaged front hole with a 0.203 (13/64) inch drill bit.

(6) Chamfer hole 0.220 - 0.250 inch diameter X 120 degrees ± 5 degrees.

(7) Tap hole and install helical insert (MS124655 or equivalent).

NOTE: The insert must be installed $^{3}/_{4}$ to one thread pitch below surface.

(8) Break and remove driving tangs.

(9) Remove all masking material.

(10) Clean inside gas generator case with suitable suction cleaner.

(11) Install combustion chamber liner (Ref. 72-40-01, Removal/Installation).

(11) Install combustion chamber liner (Ref. 72-40-01, Removal/Installation).

(12) Install fuel manifold adapter(s) (Ref. 73-11-05, Removal/Installation).

(13) Install power section (Ref. 72-00-00, REMOVAL/INSTALLATION).

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Figure 201 Removal/Installation of P2.5 and P3 Adapters

Figure 202 Repair of Gas Generator Case

Figure 203 Inspection of Diffuser Exit Ducts

Figure 204 Installation and Replacement of Helical Inserts

Figure 205 Shanknut Replacement

Figure 206 Repair of Diffuser Exit Duct

72-30-05
COMPRESSOR ROTOR - DESCRIPTION AND OPERATION

1. General

The compressor rotor is housed in the gas generator case and is driven by the compressor turbine. It compresses incoming air for delivery to the combustion chamber.

2. Description and Operation (Ref. Fig. 1)

The compressor rotor comprises a four-stage axial compressor and a single-stage centrifugal impeller held together by tie rods. The axial stages comprise an assembly of balanced rotors and stator vanes. Air from one rotor is directed to the next by a row of stator vanes. The last stator vane stage directs air to the centrifugal impeller. The centrifugal impeller delivers air to the combustion chamber via diffuser exit ducts. The assembly is supported on a No. 1 ball bearing and a No. 2 roller bearing assembly. The stator vane assemblies form the outer casing. The outer casing diameter and the outer diameter of the rotors decrease from entry to exit and blade root diameter increases from entry to exit creating the compression effect on the air flow. Air pressure in the assembly is regulated at starting and lower rotational speeds by a compressor bleed valve.

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Figure 1 Compressor Rotor Cross-section

COMPRESSOR ROTOR - MAINTENANCE PRACTICES

1. General

A. Maintenance of the compressor rotor is restricted to inspection and repair of the first-stage rotor.

2. Consumable Materials

Not Applicable

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Inspection/Check - (First-Stage Compressor Rotor)

A. General

> CAUTION: KEEP COMPRESSOR INLET AREA CLEAR OF ALL FOREIGN OBJECTS THAT COULD BE INGESTED BY ENGINE AND CAUSE DAMAGE DURING SUBSEQUENT OPERATION.

NOTE: The following inspection should be done whenever the air inlet screen is removed (Ref. 72-20-00, Removal/Installation). Due to limited access, the use of a mirror is recommended.

(1) The limits stated under 'Acceptable Damage Limits' and 'Acceptable Erosion Limits' are considered acceptable without repair. The actual damage must be documented and additional inspections scheduled to assess the rate of defect progression.

NOTE: If acceptable limits are exceeded, the blades may still be repaired (Ref. Para. 6.).

(2) Continued operation of a compressor with FOD, either accepted as-is or blended is dependent on satisfactory engine performance.

NOTE: When assessing damage, it should be understood that continued operation with a large number of blades damaged

NOTE: When assessing damage, it should be understood that continued operation with a large number of blades damaged or eroded at or near maximum acceptable limits may result in reduction of compressor efficiency and engine performance.

(3) Acceptable damage limits are based primarily on structural integrity considerations. Rotors with damage exceeding 'Acceptable Damage Limits' cannot remain in service unless damage can be removed by blending (Ref. Para. 6.):

Table 201 Example of FOD (Ref. Fig. 202, Sheet 1)

NOTE: Remove the minimum material required to remove the damage. Document the damage (Ref. Subpara. B.).

(4) If damaged blade is within acceptable limits and is not reworked, inspect area at 100 hours. Subsequent inspections are at the discretion of the operator but must not exceed 400 hours.

(5) If damage to the blades is acceptable, and/or after blending, engine performance is within acceptable limits, inspection of the subsequent stages, (rotors, stators and impeller) is not required. Under these conditions, the engine is considered acceptable for service.

(6) If damage exceeds limits and cannot be removed by blending or engine performance is unsatisfactory after repair, the engine or gas generator must be removed from service.

B. Documenting Damage

(1) Defects/damage should be documented (i.e., engine module TSN/TSO, cycles, component description, location and dimensions, if obtainable).

(2) If the blade is repaired document the amount of material removed, (i.e. if the blade was cut back, the amount of cutback should be documented).

C. Acceptable Damage Limits (Ref. Fig. 201)

CAUTION: NICKS IN LEADING AND TRAILING EDGES BECOME INCREASINGLY CRITICAL TOWARD ROOT. DAMAGE IS NOT PERMITTED WITHIN 0.050 IN. OF BLADE ROOT FILLET RADIUS. THE ENGINE MAY REMAIN IN SERVICE PROVIDED THE DAMAGE IS COMPLETELY REMOVED BY LEADING EDGE CUTBACK.

NOTE: For multiple leading edge defects closer than 0.200 in., the entire leading edge may be blended.

(1) Leading or trailing edge nicks 0.100 in. deep maximum. Two per blade on any number of blades.

NOTE: A nick is considered to be a sharp surface indentation caused by impact resulting in loss of parent material.

(2) Leading or trailing edge dents 0.100 in. deep by 0.100 in. long. Two per blade on any number of blades.

(3) Leading or trailing edge tip curl, without tearing, maximum is 0.100 in. deformation on one edge, up to four blades.

(4) Leading edge nicks 0.030 to 0.050 in. deep by 0.080 in. wide, more than 0.200 in. apart, and more than 0.250 in. from blade tip, on any number of blades, are acceptable provided there are no tears and/or cracks.

(5) Trailing edge dents and nicks, maximum of four (4) per blade, 0.030 to 0.050 in. deep by 0.080 in. wide, more than 0.200 in. apart, and more than 0.250 in. from blade tip, on any number of blades, are acceptable provided there are no tears or cracks.

(6) Blade tip rub is acceptable providing there is no rolled over material and an engine performance/ground power check is acceptable.

(7) Area a and c:

(a) Corrosion pitting, nicks and dents 0.005 in. deep are acceptable.

(8) Area b:

(a) Corrosion pitting, nicks and dents 0.010 in. deep are acceptable.

(9) Area d:

(a) Corrosion pitting 0.002 in. deep is acceptable.

D. Acceptable Erosion Limits

(1) Erosion at the root is acceptable providing the chord is not reduced by more than 0.250 in. and there is no feathered, (i.e., sharp) edge(s).

NOTE: The chord of an airfoil section is the shortest distance between the leading and trailing edges.

(2) Feathered edges must be removed (Ref. Para. 6.) or the engine or gas generator module removed from service. The original airfoil chord of the repaired section must not be reduced by more than 0.250 in. and the original leading edge profile must be restored.

E. Unacceptable Damage (Ref. Fig. 202)

(1) Tears and cracks due to deformation of leading or trailing edges and cracks on any blade surface are not acceptable. The blade must be repaired if the defect is within repairable limits (Ref. Para. 6.), or the engine or gas generator module removed from service.

(2) Tip curl more than 0.100 in. is unacceptable. Rework corner 0.250 in. maximum along tip and 0.250 in. maximum down leading edge (Ref. Para. 6.).

(3) Sharp corners must be smoothed to 0.100 in. radius minimum, and 0.050 in. deep and maximum width. Tip corner radius must not exceed 0.100 in. Maintain trailing edge profile.

6. Approved Repairs - (First-Stage Compressor Rotor)

CAUTION: BLENDING OF THE FIRST-STAGE COMPRESSOR ROTOR BLADES PRIMARILY AFFECTS ENGINE PERFORMANCE AT ALTITUDE. AFTER BLENDING VERIFY ENGINE PERFORMANCE ON THE GROUND.

NOTE: Access to airfoils is limited and makes blend repair difficult and labor intensive. As the limits for blending take into consideration the structural integrity of the component, it is possible, the performance after blending may be unacceptable and will require engine removal.

A. General

(1) Blend repair limits are provided to possibly prevent unnecessary engine removal due to FOD. Should the damage be extensive, an evaluation should be made to proceed with the repair or remove the engine and send to a facility capable of performing the repair.

(2) Any blend repair performed should be documented (Ref. Subpara. 5.B.)

(3) Blend repair limits provide the maximum permissible amount of material that can be removed from any one blade. Remove the minimum amount of material necessary to remove the defect (Ref. Fig. 203) i.e. should the damage be 0.020 in. deep and the maximum blend repair limit is 0.050 in. blend only to a depth of 0.020 in.

(4) Blending to maximum permissible depth may result in compressor unbalance. If the amount of material removed exceeds 50% of the recommended limit, the diametrically opposite blade should be blended to the same dimension.

(5) Unless otherwise noted an unlimited number of blades can be blended to the specified limits, provided the engine performance remains satisfactory. However the affected components may have to be replaced at the next overhaul.

(6) Maintain leading edge profile and fillet radius as close as possible to original.

B. Repair of Leading Edge (Ref. Fig. 203)

CAUTION: KEEP COMPRESSOR INLET AREA CLEAR OF ALL FOREIGN MATERIAL AND OBJECTS WHICH COULD BE INGESTED BY ENGINE AND CAUSE DAMAGE DURING OPERATION.

(1) Repair the first-stage blade leading edge within the following limits using fine hand files and stones.

WARNING: AN ACCUMULATION OF TITANIUM DUST IS A FIRE HAZARD. CLEAN UP TITANIUM DUST ON COMPLETION OF REPAIR AND DO NOT ALLOW DUST TO ACCUMULATE ON CLOTHING.

(2) Suitably mask entire first-stage compressor area to prevent contamination of compressor with filing residue.

(3) In case of multiple leading edge defects situated closer than 0.200 in., the entire leading edge of an unlimited number of blades may be cut back 0.050 in. maximum (Detail A). If blade has been previously cut back, reduce repair limit by previous cut back. Maintain leading edge profile and fillet radius as close as possible to original.

NOTE: Cutting back the leading edge by 0.050 in. maximum is acceptable providing engine performance is within limits. This to permit the engine to remain in service. However, the affected components may have to be replaced at the next overhaul.

(4) Nicks and tears may be smoothed to 0.300 in. wide maximum by 0.165 in. deep maximum, provided repaired area is 0.220 in. minimum from blade tip (Detail C).

NOTE: If repairing within the above limits does not eliminate the defects or make them acceptable, individual defects may be smoothed to 0.500 in. wide maximum and 0.250 in. deep maximum, providing repair area is 0.350 in. minimum from blade tip, and engine performance is within limits. However, the affected components may have to be replaced at next overhaul.

(5) Bent or torn leading edge tips may be repaired to 0.280 in. deep maximum by 0.375 in. wide maximum (Detail D).

NOTE: If repairing the airfoil within the above limits does not eliminate the defects or make them acceptable, individual defects may be smoothed to 0.750 in. wide maximum and 0.400 in. deep maximum, providing engine performance is within limits. However, the affected components may have to be replaced at next overhaul.

(6) Remove sharp edge at leading edge root eroded area. Restore as near as possible the original radius and smoothness (Detail E). After repair, make sure the original airfoil chord at the repair area was not reduced by more than 0.250 in.

(7) Clean inlet area with a suitable suction cleaner. Remove all masking material and repeat cleaning. Make sure all residue is removed from inlet area and first-stage blades.

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Figure 201 Compressor First-Stage Blades Inspection

Figure 202 Example of Damage Removal

Figure 203 Compressor First-Stage Blades Repair Limits

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201 Example of FOD (Ref. Fig. 202, Sheet 1)

72-40-00
COMBUSTION SECTION - DESCRIPTION AND OPERATION

1. Description and Operation

The combustion section of the engine is contained in the front part of the gas generator case, and consists of the inner and outer combustion chamber liners and the small exit duct. Compressor delivery air from the diffuser section discharges into the combustion section. The air enters the liner through straight and plunged holes, mixes with the fuel from the manifold, and is ignited. The expanding gases flow to the rear and into the exit duct zone, where the gas flow is turned 180 degrees inward to flow forward through the compressor turbine stator to the compressor turbine.

72-40-01
COMBUSTION CHAMBER LINER ASSEMBLY - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

The combustion chamber assembly is made up of two heat-resistant steel liners bolted together at the front (domed) end to create an annular space open to the rear. The outer liner extends rearward to form the large exit duct, incorporates a bolting flange by which it is fastened to the gas generator case at the compressor stator assembly mounting flange. The inner liner has a sliding joint at the rear to engage the outer diameter of the small exit duct.

Igniter sleeves and fuel manifold adapter ports and support collars are located in the front of the outer liner. A series of straight and shielded holes let P3 air to enter the combustion zone of the liner assembly. The shape, size and locations of the holes and shields, as well as the locations of the igniter sleeves, provide the best fuel/air ratios for starting and sustaining combustion, and form efficient primary and secondary zones within the combustion zone. Primary air introduced near the fuel manifold adapter ports, supports combustion. Secondary air provides a layer of cooling air over the inner walls of the liners, which also prevents the flame from touching the liner walls, cools the gases leaving the combustion zone to a temperature the compressor turbine can tolerate, and provides air for combustion.

The domed end of the combustion chamber liner assembly is supported inside the front section of the gas generator case by the fuel manifold adapter sheaths and is located by the spark igniter. The rear of the assembly is supported at the small exit duct and compressor turbine stator assembly interface.

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Figure 1 Combustion Chamber Liner Assemblies

COMBUSTION CHAMBER LINER ASSY - MAINT. PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-151	Wire, Filler
PWC11-014	Alcohol, Isopropyl

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC34414	Puller

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Combustion Chamber Liner

(1) Remove power section/power section module (Ref. 72-00-00, REMOVAL/INSTALLATION).

(2) Mark index line at 12 o'clock position on inner liner, with an approved marker (Ref. 70-00-00, MAINTENANCE PRACTICES, Marking of Parts).

(3) Remove bolts (1, Fig. 201).

CAUTION: DO NOT ATTEMPT TO PRY LINER LOOSE WITH SHARP EDGED OR POINTED TOOLS.

(4) Withdraw the combustion chamber inner liner (2) from the combustion chamber outer liner (3) using puller (PWC34414).

NOTE: If it is difficult separating inner and outer liner, strike inside wall of inner liner with palm of hand to dislodge it from small exit duct joint.

(5) If applicable, remove the combustion chamber outer liner (3) from the gas generator case (4) (Ref. 72-50-01, Removal/Installation).

B. Installation of Combustion Chamber Liners

(1) Install combustion chamber outer liner (3, Fig. 201) in gas generator case (4), if removed (Ref. 72-50-01, Removal/Installation).

(2) Install combustion chamber inner liner (2) in combustion chamber outer liner (3) with index line at 12 o'clock position, engaging flange of small exit duct with sealing ring on rear of inner liner.

(3) Align bolting flanges on inner liner (2) with flanges on outer liner (3), and install bolts (1). Tighten bolts 36 to 40 lb.in.

(4) Install power section/power section module (Ref. 72-00-00, REMOVAL/INSTALLATION).

NOTE: Verify and confirm the T5 immersion thermocouples are compatible with the configuration of combustion chamber liner installed in GGM.

6. Inspection/Check

A. General

Examine combustion chamber liners for cracks, buckling and burning. Cracks in the liner surface are usually of a stress relieving nature and are usually not serious as rate of growth decreases as crack lengthens. Thermal stresses, in effect, relieve original stress conditions. It is normal to observe a given type of deterioration repeated from liner to liner in the same engine, or engines of the same model. Typical liner distress consists of buckling and cracking of cooling rings and cracking at inner wall of the exit duct section of the outer liner.

B. Inspection of Combustion Liners

(1) Acceptable Conditions, Repair Unnecessary:

NOTE: Refer to Para. (2) for the acceptable conditions of combustion liners that must be repaired.

(a) Localized buckling which reduce gap by less than 50% and/or burning of cooling rings, lips, except louvered type, accompanied by cracking is acceptable provided cracks do not extend into the seam weld (Ref. Fig. 206, Detail B).

(b) Cracks in louvered type cooling ring (Ref. Fig. 206, Detail A) are acceptable provided that do not extend into seam weld and do not span the entire cooling ring width. Circumferential cracks in the seam weld (Ref. Fig. 202) not exceeding 0.300 inch in length are stop drilled with a $^{1}/_{16}$ (0.0625) inch drill.

NOTE: Refer to Para. (2)(d) for converging cracks disposition.

(c) Straight line cracks running in same direction and which could join are not acceptable unless:

1 Cracks through three consecutive holes in the row with 70 holes (Hole Dia. 0.103 in. to 0.107 in.) are permitted only if they are separated by a minimum of four consecutive holes without cracking on either side of the crack (Ref. Fig. 201).

2 If applicable, cracks through two consecutive holes in the row with 56 holes (Hole Dia. 0.158 in. to 0.164 in.) are permitted only if they are separated by a minimum of three consecutive holes without cracking on either side of the crack (Ref. Fig. 201).

3 If applicable, cracks through 11 consecutive holes in the row with 280 holes (Hole Dia. 0.028 in. to 0.032 in.) are permitted only if they are separated by a minimum of 15 consecutive holes without cracking on either side of the crack (Ref. Fig. 201).

NOTE: In Post-SB14048 and Pre-SB14139 parts, there are no 56 or 280 row holes.

(d) Cracks along, or next to, outer liner flange to wrapper seam weld (Ref. Fig. 203), are acceptable provided there are not more than seven and they are no nearer than one-half inch to the fuel manifold support collar.

(e) Maximum seven cracks, each crack not exceeding one inch long, is acceptable in the inner wall of domed end of inner liner (Ref. Fig. 204).

(f) Localized areas that have been heated to an extent as to cause buckling of the liner are considered acceptable provided the buckling is shallow, and it is not associated with burning, which would reduce the wall thickness and weaken the structure (Ref. Fig. 203, Sheet 2).

(g) Cracks up to 1.00 inch long in the large exit duct section inner wall are acceptable provided they are stop drilled using a $^{1}/_{16}$ (0.0625) inch drill.

(h) Coating loss of any amount is acceptable on large exit duct section provided there is no evidence of burning or erosion of parent metal.

(i) Localized coating loss in other areas is acceptable providing each area does not exceeds 1 sq.in., the total area does not exceeds 3 sq.in. and there is no evidence of burning of parent material.

(j) Multiple hairline cracks in outer liner flange heat shield (Ref. Fig. 203, Sheet 3) are acceptable provided they do not converge or extend into the radius and are at least 1.5 in. apart. Stop drill cracks using a $^{1}/_{16}$ (0.0625) inch drill.

(k) Outer liner large exit duct inner wrapper (vane contact area) localized erosion of parent material in front of CT vane airfoi LE providing wall thickness is not less than 0.011 in. (i.e. max 0.007 in. deep erosion).

(l) Erosion of outer liner flange heat shield lip up to 0.125 in. below original profile.

(m) Examine cooling holes in liners after repairs. Make sure they are not obstructed by excessive plasma coating or weld repair. Make sure shank of correct size drill, outer liner $^{1}/_{16}$ (0.0625) inch and 'E' size (0.025 inch) (Ref. Fig. 203, Sheet 2), or inner liner No. 43 (0.089 inch) (Ref. Fig. 204) will pass through each cooling hole in lines indicated. Clean out cooling holes if necessary.

(2) Acceptable Conditions, Repair Necessary:

NOTE: Repair the following conditions if not covered in Para. (1) above.

(a) Buckled cooling rings where the gap has been reduced by more than 50% must be reworked. Use a suitable bar to restore a uniform gap to dimensions shown (Ref. Fig. 205).

(b) Cracks not exceeding two inches in length must be repaired (Ref. Para. 7.).

(c) Circumferential cracks next to seam welds must be repaired (Ref. Para. 7.).

NOTE: Crack openings in excess of 0.030 inch are not repairable.

(d) When cracks progress from a free edge so that their meeting is imminent, and could subsequently allow a piece of liner material to break loose, they must be repaired by welding (Ref. Para. 7.).

(e) If necessary, clean out cooling holes in liners with appropriate size drill.

(f) Outer liner inner wrapper edge (vane contact area) warping and delamination is permitted unless:

1 Prevent the CT vane removal or installation.

2 Converging cracks from edge that could subsequently allow a piece of liner material to break loose (Ref. Fig. 205).

(3) Unacceptable Conditions, No Repair Permitted:

NOTE: Rejected combustion chamber inner and outer liners removed during maintenance activities should be returned to an overhaul facility for possible restoration to a usable condition. It is recommended that "run" inner and outer liners be kept together in pairs, if possible.

(a) Multiple cracks that are not repairable (Ref. Fig. 204).

(b) Cracks in outer liner flange heat shield (Ref. Fig. 203, Sheet 3), which extend into the radius, are less than 1.5 inch apart or which could join to cause loss of material.

(c) Severe buckling causing kinked metal (Ref. Fig. 203, Sheet 4).

(d) Cracks exceeding two inches in length, except where otherwise stated.

(e) Circumferential cracks which are opened more than 0.030 inch and are next to seam welds.

(e) Circumferential cracks which are opened more than 0.030 inch and are next to seam welds.

7. Approved Repairs

A. Repair of Liners - Cracks

CAUTION: HOLES THAT BECOME PLUGGED AS A RESULT OF WELDING MUST BE REDRILLED TO ORIGINAL SIZE AND THEN DEBURRED. CHECK PATTERN AND SIZE OF ADJACENT HOLES USING SUITABLE DRILL GAGE. LOOSE WELD MATERIAL MUST BE REMOVED.

(1) Stop drill ends of crack with a $^{1}/_{16}$ (0.0625) inch drill. Vee out crack using a suitable abrasive wheel.

(2) Lightly grind area with a suitable abrasive wheel to remove all traces of coating.

(3) Thoroughly wire brush area and swab with cleaner (PWC11-014).

(4) Repair prepared area with tungsten inert gas (TIG) equipment (Ref. 70-00-00, REPAIR, Blend Repairs) and small diameter welding wire (PWC05-151) to minimize weld bead size. Stress relief after welding is not necessary.

NOTE: Use copper back-up plate to reduce distortion, with addition of argon gas backup, if available.

(5) If outer liner heat shield is repaired in Area B (Ref. Fig. 203, Sheet 3), smooth weld bead flush to parent metal. Remove ceramic coating from Area C of inner liner.

List of Figures

Figure 201 Removal/Installation of Combustion Chamber Inner Liner

Figure 202 Acceptable Cracks in Louvered Cooling Ring Seam Weld

Figure 203 Combustion Chamber Outer Liner

Figure 204 Combustion Chamber Inner Liner

Figure 205 Combustion Chamber Liners

Figure 206 Cooling Rings - Inspection

72-50-00
TURBINE SECTION - DESCRIPTION AND OPERATION

1. General

There are two turbines incorporated in the engine, a compressor turbine in the gas generator section coupled to the compressor rotor and a two stage "free" power turbine in the power section mounted on the power turbine shaft driving the propeller reduction gearbox. The term "free" is used to indicate that the power turbine is not mechanically linked to the compressor turbine.

2. Description and Operation (Ref. Fig. 1)

The compressor turbine is driven by the gas flow from the combustion section being deflected onto the turbine blades by a stator assembly. The compressor turbine comprises a bladed disk assembly running in a shroud housing assembly.

The power turbine is rotated by the remaining energy in the gas flow from the compressor turbine being deflected on to each power turbine disk by their respective stator assemblies.

List of Figures

Figure 1 Compressor Turbine and Power Turbine - Cross-section

COMPRESSOR TURBINE STATOR - DESCRIPTION AND OPERATION

1. Description and Operation

The compressor turbine classified stator assembly is made up of integrally cast, air-cooled vanes located between inner and outer rings. Cooling air passes through cored passages inside the vanes, and exits at the vane trailing edges. The airfoil section of the vanes directs the expanding gases from the combustion chamber to the compressor turbine blades at the optimum angle for maximum efficiency. Lugs extending inward from the inner ring engage with slots in the No. 2 bearing cover flange, and lugs extending outward from the outer ring engage with slots in the rear face of the compressor turbine shroud housing. An external circumferential groove accommodates a sealing ring to seal the stator assembly and shroud housing.

The shroud housing accommodates the compressor turbine classified shroud segments which act as a seal and provide a running clearance for the compressor turbine. The segments are held in position by retention pads located around the adjacent face of the compressor turbine stator.

An interstage sealing ring is located in a circumferential groove in the outer surface of the shroud housing and provides a seal between the combustion section and the interturbine area.

The rear section of the combustion chamber outer liner forms the large exit duct and is located next to the diffuser in the front section of the gas generator case. The duct section of the liner incorporates a heatshield at the rear, which forms a duct through which compressor discharge air (P3) is routed to cool the duct. The inner section of the duct incorporates a bolting flange for mounting at the gas generator case centerbore.

The small exit duct is attached to the compressor turbine shroud housing and is located at the rear of the combustion chamber inner liner. The duct incorporates a heatshield and a mounting flange at the front. Holes in the heatshield allow cooling air to be routed through the space between the duct wall and heatshield and into the gas stream at the inside diameter of the duct wall.

The large exit duct section of the combustion chamber outer liner and the small exit duct form a guide path which changes the direction of the gas flow through 180 degrees and directs it inward and forward to the compressor turbine stator guide vanes.

The shroud housing is assembled over the stator assembly and bolted to the small exit duct. This assembly is secured by a circular lockplate, and bolts which pass through the No. 2 bearing housing cover flange and stator assembly, combustion chamber outer liner into the gas generator case. A separate cover for the No. 2 bearing housing, together with the compressor turbine air baffle, attaches to the bearing housing.

COMPRESSOR TURBINE STATOR - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC09-002	Compound, Locking and Retaining
PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC32209	Adapter	
PWC32380	Gage	
PWC32396-400	Jackscrew	Alternate to PWC42034

PWC32823	Puller	
PWC34128	Wheel	
PWC34478	Spacer	
PWC34522	Puller	
PWC37917	Dresser, Diamond	
PWC37918	Grinder	
PWC42034	Jackscrew	Obsolete-Replaced by PWC32396-400
PWC64241	Guidepin	
PWC64247	Puller, Cover	

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

A. Removal of CT Stator

(1) Separate power section/power section module (PS/PSM) from gas generator module and install PS/PSM in stand (Ref. 72-00-00, SERVICING).

(2) Remove CT disk and blade assembly (Ref. 72-50-02, Removal/Installation).

(3) Remove combustion chamber inner liner (Ref. 72-40-01, Removal/Installation).

(4) Remove bolts, washers and stator air seal baffle (13, Fig. 201) from gas generator case central mount position.

(5) Pre-SB14438: Remove No. 2 bearing cover (12) with puller (PWC34522).

NOTE: Make sure not to change the alignment of turbine stator air seal (14) and gasket (15) when you remove No. 2 bearing cover (12). If air seal and gasket alignment changes, install new gasket during assembly.

(6) Post-SB14438: Remove No. 2 bearing cover (12) with puller (PWC64247).

NOTE: Make sure not to change the alignment of turbine stator air seal (14) and gasket (15) when you remove No. 2 bearing cover (12). If air seal and gasket alignment changes, install new gasket during assembly.

CAUTION: BEFORE REMOVING CT STATOR, MARK LOCATION RELATIVE TO NO. 2 BEARING COVER FLANGE WITH AN APPROVED MARKER (Ref. 70-00-00, MAINTENANCE PRACTICES, Marking of Parts) TO ENSURE CORRECT ALIGNMENT OF MATING SURFACES ON REASSEMBLY.

(7) Remove bolts and keywashers, air seal (18), lockplate (11), CT stator assembly (10), shroud housing assembly (4) and small exit duct (9) and No. 2 bearing cover flange (8) from gas generator case.

CAUTION: HANDLE SMALL EXIT DUCT WITH CARE. IMPACT WITH HARD OBJECT MAY CAUSE DEFECT IN CERAMIC COATING.

(8) Install jackscrews (PWC42034) or (PWC32396-400) and remove No. 2 bearing cover flange (8).

(9) Remove combustion chamber outer liner (7) from gas generator case, as necessary.

NOTE: Removal of outer liner involves removal of fuel manifold adapters (Ref. 73-11-05, Removal/Installation) and igniter plugs (Ref. 74-20-00, Removal/Installation).

(10) Using an approved marker (Ref. 70-00-00, MAINTENANCE PRACTICES, Marking of Parts), mark position of compressor stator (10), small exit duct (9), and shroud housing (4), to align mating surfaces at re-assembly.

(11) Remove bolts, shroud housing (4) and stator assembly (10) from small exit duct (9).

(12) Separate stator assembly (10) from shroud housing (4) and small exit duct (9). Remove and discard seal rings (16 and 17).

(13) Using an approved marker (Ref. 70-00-00, MAINTENANCE PRACTICES, Marking of Parts), mark position of interstage sealing rings (2 and 19) and remove rings from circumferential groove in shroud housing, if necessary.

NOTE: If shroud segments (4) require replacement, remove and install (Ref. Para. 7.)

B. Installation of CT Stator

CAUTION: HANDLE SMALL EXIT DUCT WITH CARE. IMPACT WITH HARD OBJECT MAY CAUSE DEFECT IN CERAMIC COATING.

(1) Make sure stator assembly, shroud housing and lockplate have been lapped and lug-to-slot clearances have been checked (Ref. Approved Repairs).

(2) Install new seal rings (16 and 17, Fig. 201) in small exit duct (9) and CT shroud housing respectively.

(3) Install seal ring (19) in outer circumferential groove of stator assembly (10). Seal ring (19) to be installed with pressure side, marked on ring, towards leading edge of vane. Align all index marks.

NOTE: 1. If new parts are being installed, no index marks will be found: parts should be rotated until best fit is obtained (Ref. Approved Repairs) and then marked.

NOTE: 2. If a new or repaired CT vane is installed, the large exit duct should not have a burnt outer skin lip.

NOTE: 3. If a small exit duct with a burnt area on the outer skin lip is installed, rotate the CT vane to make sure the CT vane outer ring large exit duct burnt marks are not aligned.

(4) Install seal ring (19) in outer circumferential groove of stator assembly (10). Seal ring (19) to be installed with pressure side, marked on ring, towards leading edge of vane. Align all index marks.

(5) Assemble shroud housing (4) and CT stator assembly (10) to small exit duct (9). Align index marks and install bolts. Tighten bolts 30 to 35 lb.in., and lockwire.

(6) Check for axial gap (REF. NO. 515, Table 204) between CT stator and shroud segments.

(7) If removed during disassembly, install three plug bolts in shroud housing flange. Tighten bolts 15 to 20 lb.in., and lockwire each bolt to adjacent pair of shroud and stator retaining bolts.

(8) If removed, make sure combustion chamber outer liner meets inspection requirements (Ref. 72-40-01, Inspection/Check).

(9) Install combustion chamber outer liner (7) in gas generator case, aligning offset holes, fuel manifold adapter holes and igniter plug holes. Install fuel manifold adapters (Ref. 73-11-05, Removal/Installation) and igniter plugs (Ref. 74-20-00, Removal/Installation).

(10) Locate No. 2 bearing cover flange (8) in combustion chamber outer liner (7), aligning offset holes.

NOTE: Due to relative tolerances, tightness may be encountered when fitting flange on gas generator case. When these conditions prevail, use of a soft-faced hammer is permissible.

(11) Install assembled stator and shroud housing assembly in gas generator case, engaging compressor turbine stator inner lugs with corresponding slots on No. 2 bearing cover flange, in original position as previously marked. Check clearance between shroud segments and compressor turbine stator (REF. NO. 515, Fits & Clearances).

(12) Position air seal (18) and lockplate (11) with keywasher tab holes facing front of engine, in center of stator. Install air seal, lockplate, stator assembly, shroud housing and combustion chamber outer liner to gas generator case, with bolts and keywashers. Tighten bolts 36 to 40 lb.in., and lock keywashers.

(13) Make sure assembly does not rotate.

NOTE: Due to tolerances involved, a slight axial movement may be evident (REF. NO. 489, Table 204).

(14) If air seal (14) and gasket (15) have been inadvertently disturbed (Ref. NOTE following step (5)), install two guidepins (PWC64241) into gas generator case.

(15) Install gasket (15) with proud side towards No. 2 bearing, air seal (18) and No. 2 bearing cover (12) over guidepins. Light tapping with a soft faced hammer is permitted.

(16) Locate CT stator air seal baffle (13) over guidepins. Install keywashers and bolts fingertight. Do not lock keywashers.

(17) Remove guidepins and install remaining bolts. Tighten bolts in diametric sequence initially 15 to 20 lb.in., and then 32 to 36 lb.in. Lock keywashers and remove locator.

(18) Install compressor turbine disk and blade assembly (Ref. 72-50-02, Removal/Installation) and check blade tip clearances .

(19) Install combustion chamber inner liner (Ref. 72-40-01, Removal/Installation).

(20) If removed, install the interstage sealing ring (2) in the shroud housing (4) as follows:

(a) Make sure that the pressure side on the sealing ring is points to the mating flange of the CT shroud housing (4).

(b) Align the index mark on the sealing ring with the index mark on the shroud housing as marked during removal.

(c) Install the interstage sealing ring (2) in the circumferential grooves of the shroud housing (4).

6. Inspection/Check

A. General

Acceptance criteria outlined herein is based on structural integrity considerations and apply only if engine performance was satisfactory prior to HSI. Replace stator assembly if its condition appears to be the cause for loss of performance. If stator assembly must be replaced, an assembly of same class or ± 0.03 as that from the last test cell run must be used.

A stator assembly having defects in excess of Maximum Serviceable limits must be replaced.

If distressed vanes are found, check fuel nozzles for proper functioning .

Cracks which have propagated to a condition which would result in a potential loss of material are not acceptable.

Cracks which are converging, but would not result in material loss, are acceptable.

Stators considered unacceptable for continued service may be sent to P&WC for possible repair.

Pratt & Whitney Canada
7007 de la Savane
St. Hubert,, Quebec
Canada
J3Y 3X7

Attention: Receiving Area No. 9

B. Terminology

Pinch Fit	Amount of stator assembly outer ring sealing surface protruding beyond shroud housing sealing surface.
Snug Fit	Close fit without shake or play.
Sealing Surface	Contact areas which are critical to engine performance.
Hairline Crack	A crack less than 0.001 inch wide at its maximum width.
Open Crack	A crack greater than 0.001 inch wide at its maximum width.

C. Inspection of CT Stator Assembly

(1) Examine vanes, inner, and outer rings (Ref. Table 201 and Fig. 202).

(2) Examine cooling air inlet and outlet ports for damage and blockage.

(3) Examine air seal baffle for damage and attachment.

(4) If distressed vanes are encountered, check fuel nozzles for proper functioning.

Table 201 Compressor Turbine Stator Assembly

D. Inspection of CT Shroud Housing and Shroud Segments

(1) Examine shroud housing for distortion and fretting wear in interstage sealing ring groove. If damage is excessive, ship housing to an approved overhaul facility for repair.

(2) Install selected sealing ring (2, Fig. 201) in power turbine shroud housing.

(3) Hold a suitable light source behind ring around contact area. Make sure actual contact is made around at least 80 percent of circumference and that gap between ring and contact area does not exceed 0.002 inch. Rotate sealing ring, if necessary, to achieve maximum contact. Parts with uneven sealing pattern, or new parts, must be lapped before use (Ref. Approved Repairs).

(4) Examine sealing rings for condition.

(5) Examine shroud segments (Ref. 72-50-02, Inspection/Check).

E. Inspection of Small Exit Duct

CAUTION: HANDLE SMALL EXIT DUCT WITH CARE. IMPACT WITH HARD OBJECT MAY CAUSE DEFECT IN CERAMIC COATING.

(1) Examine for excessive interference with combustion chamber inner liner. Loose to snug fit recommended.

(2) Examine for fretting wear at duct flange which contacts combustion chamber inner liner. Wear to 0.015 inch deep is acceptable. If wear is in excess of 0.015 inch, duct should be shipped to an approved overhaul facility for possible repair.

(3) Radial cracks to 1.00 inch long in outer wall are acceptable provided they are stop-drilled using a $^{1}/_{16}$ (0.0625) inch drill.

(4) Coating loss of any amount is acceptable provided there is no evidence of burning or erosion of parent metal.

(5) Burning of coating/parent material immediately adjacent to vanes is acceptable to 0.750 inch circumferentially by 0.500 inch axially. Maximum 14 places. Reject if limits are exceeded.

(6) Sealing surfaces must be continuous and unbroken. New part, or part with uneven sealing must be lapped.

(7) Align index marks of CT shroud housing and small exit duct, and press together. Excessive interference not permitted.

7. Approved Repairs (Heavy Maintenance Only)

A. Replacement of Shroud Segments

NOTE: Correct selection of segment class is essential at this stage of assembly; this will avoid unnecessary removal at a later stage of stator, shroud housing and exit duct assembly for replacement of segments if clearance is excessive. It also reduces hand-grinding operations to obtain minimum blade tip to shroud segment clearance. Excessive grinding tends to stress (workharden) segments which can result in premature cracking.

(1) Place shroud housing (Fig. 203) with flange down, on work bench, and remove shroud segments with a fiber drift. Lightly tap each segment to free it from inside housing.

(2) Measure leading/trailing edge OD of compressor turbine disk assembly (Ref. Fits and Clearances, Table , REF. NO 509) at several locations, and record largest diameter.

(3) Select segment class that corresponds with bladed turbine disk OD plus minimum blade tip clearance (Ref. Table 202).

NOTE: When selecting class of replacement segments, refer to 72-50-01, MAINTENANCE PRACTICES, Fits and Clearances, TABLE 204, REF. NO. 318 for the minimum radial tip clearance (RTC).

(4) The following example provides the method of obtaining the class of segments required:

Example 1:

If turbine OD = 9.524 inch

Add minimum radial tip clearance (REF. NO. 318) x 2 = 0.032 inch

Therefore, shroud segment ID (minimum) = 9.556 inch

From the example, a bladed disk of 9.524 in. OD would require shroud segment ID of 9.556 in. to provide a minimum radial tip clearance of 0.016 inch (0.032 inch dia.). Select class 11 segments for assembly, and grind as necessary to obtain minimum tip clearance.

CAUTION: SOLVENTS ARE FLAMMABLE AND TOXIC. OBSERVE SAFETY PRECAUTIONS.

(5) Clean shroud segments and housing contact surfaces with isopropyl alcohol (PWC11-014) or solvent (PWC11-023) or (PWC11-025).

(6) Apply locking compound (PWC09-002) to shroud segment, and install in locating grooves of shroud housing. Align middle of segment with index mark (X) on housing.

(7) Check clearance (REF. NO. 675, Fits & Clearances, TABLE 204) is maintained between shroud housing (1) and shroud segments (5).

(8) Install remaining segments with locking compound. Maintain 0.011 inch gap (Dim. C) between segments. Cumulative gap not to exceed 0.110 inch. Use shim stock to facilitate gap equalization.

NOTE: Ends of segments may be lightly stoned to obtain required clearances.

(9) With shim stock in position, cure locking compound 3 to 4 hours at room temperature or 5 to 10 minutes at 176°C (350°F).

(10) Remove shim stock.

(11) If segments must be repositioned, heat shroud housing to 260°C (500°F) and repeat previous steps.

Table 202 Compressor Turbine Shroud Segment Classification Engines

B. Grinding of Compressor Turbine Shroud Segments

NOTE: Replacement of compressor turbine shroud segments may entail localized grinding to remove high spots and/or any slight eccentricity of segments to obtain correct CT blade tip clearance. If tip clearance exceeds specified limit refer to 72-50-01, MAINTENANCE PRACTICES, Fits and Clearances, REF. NO. 318, TABLE 204, after removal of high spots and/or eccentricity, select next class (thicker) of shroud segments (Ref. Table 202). Install segments and grind as necessary.

(1) Install adapter (6, Fig. 204) on compressor stubshaft with bolts (5).

(2) Install four spacers (11, Fig. 205) under small exit duct. Set spacers approximately 90 degrees apart.

(3) Select contact point (3, Fig. 204) for radius to be measured and fasten to radius gage tip (2).

NOTE: Radius gage and gage master are common to all PT6 engines. The gage is supplied with four contact points of different lengths, while the gage master has four "steps" of different radius. These variables allow the gage and master to be used on all PT6 engine models.

(4) Install gage body (9) on adapter (6) with bolts (7). Tighten bolts 20 to 30 lb.in. Check for correct mounting by trying to insert 0.001 inch shim stock between gage and adapter.

(5) Position contact point (3) at center of segment (4) using adjuster (1).

(6) Take four readings, 90 degrees apart around shroud segments. Adjust spacers (11, Fig. 205) as necessary to obtain concentricity.

(7) Remove radius gage from adapter (6, Fig. 204) and install in gage master (8). Set dial indicator (10) to zero.

(8) Remove radius gage from master (8). Make sure dial indicator setting is not disturbed.

(9) Install radius gage on adapter (6) with bolts (7). Tighten bolts 20 to 30 lb.in. Check 0.001 inch shim stock will not fit between gage and adapter.

(10) Rotate gage and record high and low readings. Adjust gage in and out to determine segment taper. Low reading and/or segment taper will determine whether segments are suitable for further use or if replacement is required.

(11) Calculate grinding or replacement of shroud segments as shown in following typical examples:

A = True radius as stamped on gage master.

B = Radius of bladed disk, $^1/_2$ OD, as measured with micrometer.

C = Dial indicator reading on shroud segments.

D = Radius of shroud segments.

E = Existing blade tip clearance, before grinding.

EXAMPLE 1:

A = 4.605 inches

B = 4.585 inches

C = 0.013 inch clockwise reading on minus side of gage zero datum

D = A minus C = 4.605 inches minus 0.013 inch = 4.592 inches

E = D minus B = 4.592 inches minus 4.585 inches = 0.007 inch

In this example, 0.009 inch must be ground from existing shroud segments to provide minimum blade tip clearance of 0.016 inch.

EXAMPLE 2:

A = 4.605 inches

B = 4.585 inches

C = 0.004 inch counterclockwise reading on plus side of gage zero datum

D = A plus C = 4.605 inches plus 0.004 inch = 4.609 inches

E = D minus B = 4.609 inches minus 4.585 inches = 0.024 inch

In this example, existing blade tip clearance exceeds maximum limits. Shroud segments must be replaced. Replace segments and grind to "New Segment " radial tip clearance.

EXAMPLE 3:

A = 4.605 inches

B = 4.585 inches

C = 0.003 inch, clockwise on minus side of gage zero datum.

D = A minus C = 4.605 inch minus 0.003 inch = 4.602 inches

E = D minus B = 4.602 inches minus 4.585 inches = 0.017 inch

In this example, existing blade radial tip clearance is within limits and therefore no grinding of shroud segments is required except for removal of local high spots.

(12) Blank off cavities around combustion chamber outer liner, CT stator assembly and trailing edge cooling exit slots (25 places) with suitable material (3, 10 and 12, Fig. 205).

(13) Install dresser (14) and grinding wheel (1) on grinder (7), and install grinder (7) on adapter with bolts (13). Tighten bolts 20 to 30 lb.in. Check 0.001 inch shim stock will not fit between grinder and adapter.

NOTE: Dressing of wheel may be done before or after installation of grinder on adapter, or during grinding operation.

(14) Position wheel (1) in line with and slightly overlapping segments, using axial adjustment (6). Allow wheel to touch compressor turbine stator. Back off adjustment (6) one turn and lock using screw (8).

(15) Rotate grinder around segments, adjusting radial adjustment (9) until wheel (1) contacts high spots. Back off one turn.

(16) Connect grinder air hose (4) to shop air of 90 psig with a flow rate of 36 scfm.

(17) Operate grinder. Adjust wheel (1) with radial adjustment (9) until wheel contacts segments, and grind upper half of segment ID to required dimension.

NOTE: When grinding upper half of segments, do not load grinder to compensate for any compressor rotor bearing play. Support grinder when grinding lower segment half to prevent taper grinding.

(18) Loosen radial adjuster until grinding wheel contacts high spot on lower segments. Continue grinding, using complete revolutions, until required dimension is obtained on lower segments.

(19) Disconnect air hose (4) and remove grinder from adapter.

(20) Install radius gage and recheck shroud segment diameter. Check segment taper by running contact point across width of segments.

(21) Remove radius gage and return to gage master. Remove adapter.

(22) Remove all grinding residue from gas generator case with suitable suction cleaner.

(23) Remove all blanking material and repeat step (22).

(24) Remove all masking adhesive residue with solvent (PWC11-027) or (PWC11-031).

C. Restoration of Hot Section Sealing Surfaces

NOTE: Gas tightness and sealing of hot section parts depends on sealing surface finish, flatness and degree of oxidation and fretting. Surface finish must be 32AA minimum, and surface waviness 0.0005 inch maximum. Before installing hot section parts, sealing surfaces must be lapped. After lapping, each part must be index marked to its mating part. Lapping must not be used to remove deep pitting, scratches or severe distortion. When surfaces cannot be restored by lapping, offending parts should be shipped to an approved overhaul facility for repair.

(1) Lap face (5, Fig. 207) of small exit duct (4) until 100 % lapped surface is achieved.

(2) Lap face (6) of CT stator (1) until 100 % lapped surface is achieved.

(3) Lap face (3) of CT stator (1) until 100 % lapped surface is achieved.

(4) Lap face of CT shroud housing (7) until 100 % lapped surface is achieved.

(5) Fasten lockplate (2, Fig. 206) and No. 2 bearing cover flange (1) to suitable backup ring with bolts and washers (5). Tighten bolts evenly and progressively, 36 to 40 lb.in.

(6) Lap face of lockplate (2) until 100 % lapped surface is achieved. Disassemble lockplate, No. 2 bearing cover flange and backup ring after lapping.

(7) Thoroughly clean all lapped surfaces to ensure all lapping compound is removed. Clean parts using solvent (PWC11-027) or (PWC11-031) and let air dry. Check all air passages are free of lapping compound.

D. Fitting of Hot Section Parts

NOTE: If new part is to be fitted, no index marks will be found; thus it will not be possible to align index marks as described following. New part should be indexed (rotated) until best fit is obtained, and then marked.

(1) Place shroud housing assembly (1, Fig. 208) on bench with slotted flange uppermost and temporarily install compressor turbine stator assembly (3) in shroud housing to previously marked indexed position.

NOTE: The term "loaded side" is used to define which side of vane ring lugs are in contact with wall of mating slots, due to action of compressor air. As air flows through stator it tends to turn or "load" stator in a clockwise direction until restricted by slots in mating parts.

(2) Hold the stator so that the loaded sides of the outer lugs (4) are touching side of the shroud housing slots, then measure clearance at both loaded and unloaded sides of the lugs with feeler gages. Clearance at the loaded side of each lug must be 0.001 to 0.002 in. and at least one of the lugs must have no gap (i.e. a gap of 0.000 in.). Clearance at the unloaded side of each lug must be 0.001 to 0.007 in. The rotational motion (play) must not be more than 0.004 in. when measured at the outer lugs.

(3) If lug-to-slot fit is not within limits, rotate stator assembly (3) into another position; recheck and repeat if necessary until suitable fit is obtained.

(4) It is permissible to remove offending part and stone lug(s) and/or slot(s) to obtain required fit. After stoning, lug or slot width must not exceed minimum or maximum dimensions, as applicable (Ref. Table 203).

(5) When required fit is obtained, remove previous index mark from repositioned part and re-mark for subsequent assembly, using an approved temporary marker (Ref. 70-00-00, Marking of Parts). Remove stator assembly (3) from shroud housing.

NOTE: If clearance(s) at lug-to-slot is/are found to exceed limits (Ref. Step (2) preceding), or lug or slot widths exceed limits (Ref. Table 203), the offending part(s) must be sent to an approved overhaul facility for repair.

(6) Place CT stator assembly (3) on bench with inner lugs uppermost, and temporarily install No. 2 bearing cover flange (5) on stator to previously marked indexed position. Hold No. 2 bearing cover flange so that loaded side of inner lugs (2) are touching side of No. 2 bearing cover flange slots; then, using feeler gages measure clearance at both loaded and unloaded side of lugs. Clearance at loaded side of each lug should be 0.000 to 0.002 inch. Clearance at unloaded side of each lug should be 0.000 to 0.005 inch. There should be no rotational motion.

(7) If lug-to-slot fit is not within limits, rotate No. 2 bearing cover flange (5) into another position, recheck and, if necessary, repeat until suitable fit is obtained.

(8) It is permissible to remove offending part and stone lug(s) and/or slot(s) to obtain required fit. After stoning, lug or slot width must not exceed minimum or maximum dimensions, as applicable (Ref. Table 203).

(9) When required fit is obtained, remove previous index mark from repositioned part and re-mark for subsequent assembly, using an approved temporary marker (Ref. 70-00-00, MAINTENANCE PRACTICES, Marking of Parts). Remove No. 2 bearing cover flange (5) from vane ring assembly.

NOTE: If clearances at lug-to-slot are found to exceed limits (Ref. Step (6) preceding), or lug(s) or slot(s) exceed minimum or maximum limits (Ref. Table 203), offending parts must be sent to an approved overhaul facility for rework.

Table 203 Lug and Slot Widths (Ref. Fig. 208)

8. Fits and Clearances

A. General

The following provide the fits and clearances, torques, spring pressures, special assembly, and backlash checks where applicable.

The REF. NO. should be used in conjunction with Figure 209.

B. Dimensional Checks

The DIMENSIONS FOR REF. column indicates minimum and maximum manufacturing dimensions of two mating parts. These dimensions are provided for information only.

The LIMITS column indicates the desired minimum and maximum fits and clearances between new parts, and also the allowable limit to which these parts may wear before replacement is necessary.

The letter T indicates a tight fit; L or no letter, a loose fit.

BY SELECTION means parts must be matched by selection to provide a required fit.

FIT TO means a fitting operation may be required at assembly to obtain the required fit.

An asterisk (*) indicates part(s) should be replaced if any looseness is evident.

Unless otherwise stated, all fits are diametrical. Spline fits are calculated from chordal dimensions.

C. Torque Limits

Unless otherwise stated, apply thread lubricant to all parts that are to be torque-loaded.

Use engine lubricating oil or equivalent, unless otherwise specified.

Where torque limits for castle nuts are provided in the MINIMUM column only, these nuts should be tightened to the designated torque and then further tightened, if necessary, to properly align the locking slots and holes.

Where MINIMUM and MAXIMUM values are given, the alignment of the locking slot must be obtained without loosening the nut and without exceeding the maximum limit. If this is not possible, back-off the nut half a turn, then retighten. If alignment cannot be accomplished, select another nut.

Torque requirements for interference fit applications, such as studs, may be obtained with or without lubrication, unless otherwise specified.

Table 204 Fits and Clearances

Table 205 Torque and Stretch

Table 206 Spring Pressures

Table 207 Special Assembly Procedures

Table 208 Backlash

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Figure 202 Compressor Turbine Stator Inspection (Typical)

Figure 203 Shroud Housing Assembly

Figure 204 Compressor Turbine Shroud Segments - CT Blade Radial Tip Clearance Check

Figure 205 Compressor Turbine Shroud Segment Grinding

Figure 206 Compressor Turbine Vane Ring Lockplate - Repair

Figure 207 Compressor Turbine Stator, Housing and Small Exit Duct - Repair

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201 Compressor Turbine Stator Assembly

202 Compressor Turbine Shroud Segment Classification Engines

203 Lug and Slot Widths (Ref. Fig. 208)

204 Fits and Clearances

205 Torque and Stretch

206 Spring Pressures

207 Special Assembly Procedures

208 Backlash

72-50-02
COMPRESSOR TURBINE - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

   The turbine drives the compressor rotor assembly in a counterclockwise direction through the shaft extension, which is externally splined to fit into the internally splined compressor stubshaft. A master spline ensures positive location of the turbine assembly to retain original balance. A center bolt and keywasher secure the turbine assembly to the compressor rotor assembly.

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Figure 1 Compressor Turbine Installation

COMPRESSOR TURBINE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used which unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-103	Marker, Pencil
PWC06-004	Compound, Antiseize

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC30304-04	Set
PWC30304-07	Set
PWC30331	Wrench
PWC30335	Spreader
PWC30336	Protector

PWC30403	Puller
PWC30458	Squeezer
PWC32058	Riveter
PWC50060	Injector
PWC89927	Riveter

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of CT Disk Assembly

      (1) Remove power section/power section module (Ref. 72-00-00, REMOVAL/INSTALLATION).

      (2) Using wire or tapered feeler gages, measure the clearance of each blade at the 6 o'clock position and determine the longest blade. Put a mark on the longest blade with marker (PWC05-103).

      NOTE: Measure the tip clearance at the highest point of the blades (leading or trailing edge).

      (3) Using wire or feeler gages measure tip clearance over each blade. (Ref. Chap. 72-50-01, FIT. No. 318, Fits and Clearances).

      NOTE: During clearance checks, turbine bladed disk should be loaded radially, by hand pressure, to obtain smallest possible gap.

      (4) Check that tip clearances are within acceptable limits (REF. NO. 318, 72-50-01, Fits & Clearances). If the tip clearances are not within limits, length of longest blade must be calculated and one or more shroud segments may require replacement or grinding (Ref. 72-50-01, Approved Repairs).

      (5) Install holding wrench (2, Fig. 201) on flange C (1) of gas generator case. Make sure slots are correctly seated on turbine disk balancing rim lugs (4). Install protector (3) (PWC30336).

      NOTE: The wrench prevents disk rotation during removal of center bolt and keywasher.

(6) Insert spreader (6, PWC30335) into centerbore over CT disk center bolt. Uncrimp keywasher locking center bolt. Remove spreader.

(7) Remove bolt, cupwasher, wrench, and protector.

CAUTION: DO NOT TORQUE THE BOLT MORE THAN 150 LBF.FT.

(8) Apply sufficient amount of penetrating oil (50% kerosene, 50% engine oil is suitable) into the bolt center hole to flood stubshaft cavity.

(9) Rotate compressor turbine several times to allow the oil to reach slots in bolt thread, and allow it to soak for 20 minutes minimum.

CAUTION: DO NOT TORQUE THE BOLT MORE THAN 150 LBF.FT.

(10) Break torque on bolt (50 to 100 lbf.ft.). If bolt does not move, apply sufficient torque enough to move the bolt, then loosen. Tighten/loosen the bolt until it is free and can be removed.

(11) If you are not able to remove the bolt after applying penetrating oil, that indicates permanent seizure. Send the engine to a P&WC approved overhaul facility for repair.

CAUTION: CONTINUED OPERATION OF PULLER DURING REMOVAL OF DISK MAY DAMAGE BLADE TRAILING EDGES IF SHROUD HOUSING IS CONTACTED.

(12) Insert puller (PWC30403) into centerbore of turbine disk and release turbine disk snap diameters. Withdraw compressor turbine assembly from gas generator case.

NOTE: A drop of the disk or freedom of puller operation will be observed when the disk snap diameters are released.

CAUTION: HANDLE COMPRESSOR TURBINE ASSEMBLY WITH CARE.

(13) Place compressor turbine assembly on clean bench and remove puller. Install assembly in a suitable container.

(14) If compressor turbine disk assembly is to be replaced, remove trim weights (Ref. Para. 7.).

B. Installation of CT Disk Assembly (Ref. Fig. 201)

CAUTION: HANDLE COMPRESSOR TURBINE ASSEMBLY WITH CARE.

(1) Align master splines and install compressor turbine on compressor front stubshaft.

(2) Check that new keywasher is dry and free from burrs and other surface damage. Apply light film of compound (PWC06-004) to inside of washer and to shoulder and threads of CT bolt. Make sure bolt, lubricating axial hole and slots in threads are free of compound.

(3) Install keywasher and bolt into center of CT disk (5).

(4) Install holding wrench (2) on flange C (1) of gas generator case. Make sure slots are correctly seated on turbine disk balancing rim lugs (4). Install protector (3).

NOTE: The holding wrench prevents CT disk rotation during installation and tightening of CT bolt.

(5) Tighten CT bolt (REF. NO. 541, 72-50-01).

(6) Check CT blade radial tip clearance (Ref. Para. 5.A.).

(7) Install squeezer (PWC30458) in centerbore of disk, and lock keywasher. Remove squeezer carefully from disk.

(8) Remove protector and wrench from gas generator case.

(9) Install power section (Ref. 72-00-00, REMOVAL/INSTALLATION).

6. Inspection/Check

NOTE: The entire set of CT blades must be rejected when CT stator vane trailing edge burning has resulted in loss of airfoil area of 0.125 sq.in. or more, on any one vane and burned area can be seen from the leading edge of stator when viewed parallel to longitudinal axis of engine (Ref. 72-50-01, Inspection/Check, Table 201).

A. Checking of CT Blade Radial Tip Clearance (RTC)

(1) Turbine blade radial tip clearance should be measured after installation of the compressor turbine and whenever engine performance/handling is unsatisfactory (Ref. Removal/Installation and 72-00-00, FAULT ISOLATION).

(2) Measure and record the blade radial tip clearance (Ref. Removal/Installation).

(3) Tip clearance at any one location should not normally exceed maximum or be less than minimum. If clearance exceeds maximum at one location only, shroud segments may remain in service provided engine performance/handling has been satisfactory.

(4) If tip clearance is less than minimum because of a high spot on a shroud segment, the offending segment may be ground locally, as required, over a length not exceeding one inch on any one segment (Ref. 72-50-01, Approved Repairs).

(5) Examine turbine shroud segments for evidence of metal buildup and/or cracks (Ref. Fig. 202).

B. CT Blade Corrosion or Coating Loss (Ref. Fig. 203, 204 and Table 201)

(1) Inspect the blade airfoil surfaces, particularly concave surface for corrosion and loss of coating with 10-power magnification. A loss of up to 25% of coating is permissible. Assess stage of deterioration and accept or reject the bladed disk as follows (Ref. Fig. 205):

(a) Stage 1 - Initial Coating Deterioration (Sulfidation)

Evidenced by light color change of part of coating area, can be rust colored or dark gray. Coating has deteriorated but is probably still intact. Blades are acceptable for further service.

(b) Stage 2 - Initial Corrosion

Evidenced by apparent rise of sulfidated coating over surrounding surface, with small, scattered blisters appearing in coating. Corrosion of base material has started. Accept or reject disk, based on previous experience of the operator. If blades are to remain in service, operator must increase desalination washes and schedule regular borescope inspection of blades every 200 hours.

(c) Stage 3 - Advanced Corrosion

Evidenced by clusters of ruptured blisters that show bare material. Craters so formed deepen progressively, and crater surfaces darken with glazed appearance. Send the disk assembly to an approved P&WC overhaul facility for blade replacement in accordance with Overhaul Manual.

CAUTION: SEVERE CORROSION CAN RESULT IN IMBALANCE OF THE COMPRESSOR TURBINE ASSEMBLY AND SUBSEQUENT DAMAGE.

(d) Stage 4 - Severe Corrosion

Deep penetration with large ruptured blisters that show large areas of bare material. Send the power section to an approved P&WC overhaul facility for the disk repair, and inspection of No. 2 bearing area in accordance with Overhaul Manual.

NOTE: Corrosion can be identified as metal loss or pitting, but more usually it appears as local swelling or build-up due to greater volume occupied by the nickel oxides. These condition products vary in color from green to black and in the advanced state there will be associated flaking. Care must be taken to identify the difference between corrosion build-up and possible light brown or rust colored deposits which are essentially harmless combustion by-products. The latter are more widespread over hot section components and while possibly affect the performance, will not directly affect the blade integrity.

Table 201 Compressor Turbine Blade Inspection (Ref. Figs. 203 and 204)

7. Approved Repairs

A. Replacement of Trim Weights (Ref. Fig. 206)

NOTE: The No. 1 hole is identified as the hole nearest to "1" marked with an arrow on the CT disk.

(1) Check and record disk assembly trim weight location and offset, with reference to engine data plate on the compressor inlet case.

CAUTION: REMOVE TRIM WEIGHTS ONLY.

(2) Remove fastening rivets with a flat chisel and a 0.0625 ($^1/_{16}$) inch parallel pin punch.

(3) Install the trim weights in same location on the new CT disk assembly with the riveter (PWC32058) or (PWC89927) and the rivet set (PWC30304-04) or (PWC30304-07). Make sure that the trim weights are equal in class, location and offset on both planes A and B with manufactured heads are on inner of the balancing rim.

(4) Alternatively, install the trim weights in same location on the new CT disk assembly with the riveter (PWC89927). Make sure that the trim weight are equal in class, location and offset on both planes A and B with manufactured heads are on inner of the balancing rim.

(5) If trim weight location on new disk assembly is occupied by new detail weights, determine alternative trim weight location as follows:

(a) From engine data plate, obtain class of original trim weight, e.g., B, which is CL2.

(b) Locate CL2 column in the table.

(c) From the table, one CL1 can be located 5 holes on each side or 6 holes on each side of original trim weight location (Ref. Data Plate), or one CL3 7 holes on each side, or one CL4 8 holes on each side.

NOTE: 1. When a new detail weight occupies a trim weight original location, alternative trim weights must be used in pairs, one each side of and equidistant from original trim weight location.

NOTE: 2. If the alternative trim weight location is also occupied, another balanced CT disk assembly must be used.

(d) Attach the trim weights with the riveter (PWC32058) or (PWC89927) and the rivet set (PWC30304-04) and (PWC30304-07).

(e) Alternatively, attach the trim weights with the riveter L (PWC89927).

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Figure 202 Metal Buildup on CT Shroud Segments (Typical)

Figure 203 Compressor Turbine Blade Inspection

Figure 204 Compressor Turbine Blade Shift

Figure 205 Stages of corrosion

Figure 206 CT Disk Assembly Trim Weights

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201 Compressor Turbine Blade Inspection (Ref. Figs. 203 and 204)

72-50-03
POWER TURBINE INTERSTAGE - DESCRIPTION AND OPERATION

1. Description and Operation

The power turbine stator housing consists of a stepped conical casting, machined with open ends to accommodate the power turbine stator and interstage stator assemblies. A flange at the front of the housing is attached to the rear inner flange of the exhaust duct, while a machined inner diameter on the housing rear extension fits over the interstage sealing rings and provides a mechanical joint and seal between the compressor and power turbines.

Ten equi-spaced thermocouple bosses are provided on the rear of the housing for the temperature sensing system bus-bar and probe assembly. Clips are welded on the outer face of the housing for location and safety wiring of the thermocouple wiring harness. The interstage baffle assembly is between the compressor turbine assembly and the first-stage power turbine, and forms part of the first-stage power turbine stator assembly. The baffle prevents dissipation of turbine gases and consequent transmission of heat to the turbine disk faces. The center section of the baffle incorporates lipped flanges on the front and rear faces. The flanges fit over corresponding rotor seal flanges on the turbine disks to provide control of cooling air flow through the bore of the compressor turbine and a hole in the center of the baffle. Cooling air is allowed to bleed through the seal and flange interface to cool the front and rear faces of the compressor and first-stage power turbine disks respectively; cooling air is then exhausted into the gas stream at the turbine blade roots.

The stator assembly consists of a vane ring and baffle assembly. The vane ring consists of an inner and outer ring with forward extension acting as the first-stage power turbine shroud. Integrally cast vanes between the rings direct the compressor turbine discharge gases onto the first-stage power turbine blades at the most efficient angle and velocity. The outer ring is located within the power turbine stator housing by slots at the rear of the extension that engage with the T5 probe bosses and by a retaining ring located on the central flange. The front extension of the outer ring provides the running clearance for the first-stage power turbine. The interstage baffle assembly is secured to a flange in the center of the inner ring by locating lugs and rivets.

72-50-03
POWER TURBINE INTERSTAGE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-019	Compound, Lapping Silicon Carbide
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC32111	Puller

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

NOTE: When replacing power section module, it is recommended that the power turbine stator assembly be transferred from power section/power section module being removed to power section being installed to maintain optimum engine match.

A. Removal of Power Turbine Stator

(1) Remove power section (Ref. 72-00-00, REMOVAL/INSTALLATION).

(2) Index mark power turbine stator assembly (2, Fig. 201) at 12 o'clock position with suitable marker (Ref. 70-00-00, MAINTENANCE PRACTICES, Marking of Parts).

(3) Remove T5 thermocouple wiring harness (6) terminal lugs (8 and 11) from T5 bus-bar and probe assembly (13) (Ref. 77-20-01, Removal/Installation).

(4) Check power turbine stator assembly (2) for axial play. If any, remove and discard retaining ring (16) (Ref. Step (9), following).

(5) Remove wire fastening wiring harness sleeves (5) to clips (4) on stator housing (3). Tie back harness to prevent damage during further disassembly.

(6) Remove bolts (15) from inner flange on exhaust duct (1).

CAUTION: DO NOT ROTATE STATOR HOUSING DURING REMOVAL. ROTATION MAY DAMAGE T5 PROBES WHICH PASS THROUGH SLOTS IN VANE RING. USE EXTREME CARE TO AVOID DROPPING STATOR ASSEMBLY.

(7) Carefully withdraw stator housing from power section using puller (1, (PWC32111), Fig. 202).

(8) Remove stator assembly (2) from power section. Withdraw assembly axially to avoid damaging power turbine first-stage turbine blades.

(9) Remove retaining ring (16) from central flange on stator.

B. Installation of Power Turbine Stator

(1) Locate power turbine stator assembly (2, Fig. 201) on power section with index mark at 12 o'clock position. Align assembly axially to avoid damaging power turbine first-stage blades.

(2) Install retaining ring (16) on central flange of stator assembly (2); make sure dimples on retaining ring provide a snug fit.

(3) Carefully install power turbine stator housing (3) over interstage stator. Make sure probes fit into slots at rear face of vane ring.

(4) With bolt holes at front flange of stator housing and inner flange of exhaust duct (1) aligned, install stator housing on inner flange of exhaust duct with bolts (15). Tighten bolts in diametric sequence 36 to 40 lb.in.

(5) Install thermocouple wiring harness lugs (8 and 11) to terminals on bus-bar and probe assembly (Ref. 77-20-01, Removal/Installation).

(6) Fasten wiring harness sleeves (5) to clips (4) on stator housing (3) with lockwire (Ref. 77-20-01, Removal/Installation).

(7) Install power section on gas generator case (Ref. 72-00-00, REMOVAL/INSTALLATION).

6. Inspection/Check

A. General

Acceptance criteria outlined herein is based on structural integrity considerations and apply only if engine performance /handling was satisfactory prior to HSI. Replace stator assembly if its condition appears to be the cause for loss of performance.

Stator assemblies considered unacceptable for continued service may be sent to PWC for possible repair.

Pratt & Whitney Canada Inc.
7007 de la Savane
St. Hubert, Quebec
Canada
J3Y 3X7

Attention: Receiving Area 5-1

B. Inspection of Power Turbine Stator Assembly

(1) Examine power turbine stator assembly (Ref. Table 201).

NOTE: Refer to 72-50-04 for interstage stator inspection criteria.

(2) Install power turbine stator assembly carefully over first-stage turbine. Locate flange concentrically with interstage stator assembly and align lugs.

(3) Apply axial force to hold assembly in firm contact, and check sealing Faces A and B (Ref. Fig. 205) all around with 0.001 inch feeler gage. If gage enters more than 90 degrees cumulative, rectify sealing faces by lapping (Ref. Para. 7.).

Table 201 Power Turbine Stator Assembly Inspection

C. Inspection of Power Turbine Stator Housing

(1) Examine power turbine stator housing sealing rings contact area Face D (Ref. Fig. 205) for fretting wear; deburr raised material. If damage is excessive, send stator housing to an approved overhaul facility for repair.

(2) Check for adequate sealing at Faces D and E:

(a) Install selected interstage sealing ring (6, Fig. 205) in stator housing contacting area on Face D.

(b) Hold a suitable light source behind ring around contact area. Make sure actual contact is made around at least 80 percent of circumference and that gap between ring and contact area does not exceed 0.002 inch. Rotate sealing ring, if necessary, to achieve maximum contact. Index mark ring at new position.

(3) Examine stator housing inner slots for excessive fretting wear, deburr raised material if necessary.

(4) Examine stator housing for cracks, particularly around T5 probe bosses. Maximum allowable cracks are 1.5 inches across boss on external surface. Cracks of any length at same boss on internal surface are acceptable. If two adjacent cracks are at max. limit, inspect housing after another 2000 hours in service.

(5) If cracked beyond above limits, send stator housing to an approved overhaul facility for repair.

D. PT Stator Assembly Classification (Reference Only) (Ref. Fig. 204)

(1) Replace assembly with same class ± 0.1 variation of the class from the last test cell performance run (Ref. Engine Log Book). For available classes, refer to I.P.C.

(2) The following definitions are given to identify various codes marked and located on the power turbine stator (vane ring).

T C = TOOL CLASS	Basic class of a selected mold (tool).
R C = RAW CLASS	"As Produced" class from a selected mold.
R 1 to R 4 = REWORKS	Class adjustment obtained by bending the vane trailing edge (TWEAKING).
V C 6936 = SUPPLIER CODE	Typical supplier identification code.

(2) The following definitions are given to identify various codes marked and located on the power turbine stator (vane ring).

T C = TOOL CLASS	Basic class of a selected mold (tool).
R C = RAW CLASS	"As Produced" class from a selected mold.
R 1 to R 4 = REWORKS	Class adjustment obtained by bending the vane trailing edge (TWEAKING).
V C 6936 = SUPPLIER CODE	Typical supplier identification code.
1 S 2 = CAVITY NUMBER	Mold number.

NOTE: 1. 1 - Minor modification of mold.

NOTE: 2. S - Sink.

NOTE: 3. 2 - Major modification of tool for same part number.

7. Approved Repairs

A. General

Gas tight contact between sealing surfaces depends on surface finish, flatness and degree of oxidation and fretting. Before installing the power turbine stator assembly and the power turbine interstage stator assembly, sealing surfaces must be lapped. After lapping, each part must be index marked to its mating part. Lapping must not be used to remove deep pitting, scratches, or severe distortion. When surfaces cannot be restored by lapping, parts should be sent to an approved overhaul facility for repair.

B. Repair of Sealing Surfaces

(1) Lap Face B of power turbine stator assembly (Ref. Fig. 205) on a lapping table until a 100% lapped surface is achieved.

CAUTION: CARE MUST BE TAKEN WHEN APPLYING LAPPING COMPOUND TO FACE OF INTERSTAGE STATOR TO MAKE SURE NONE FALLS INTO ENGINE.

(2) Carefully apply compound (PWC05-145) to Face A of interstage stator. Lap Face A to Face B until a 100% lapped finish of the contacting area is achieved.

(3) Thoroughly clean all lapped surfaces to remove all traces of compound. Clean parts with solvent (PWC11-027) or (PWC11-031) and let air dry.

(4) Recheck sealing surfaces (Ref. Para. 6.).

C. Replacement of Interstage Baffle Rivets (Ref. Fig. 206)

(1) Grind or drill off heads of twelve rivets (2) which attach the baffle assembly (3), (4), and (5) to the vane ring (1).

(2) Carefully punch out rivet (2) stems with parallel pin punch.

NOTE: Baffle assembly rivets are 0.094 inch in diameter.

(3) Remove the locating lugs (6) and baffle assembly (3), (4), and (5) from the vane ring. Reject all the damaged lugs.

(4) Put the locating lugs (6) in vane ring slots, then install the serviceable baffle assembly (3), (4), and (5) in position. Install the 12 rivets (2) with manufactured heads to rear of assembly.

(5) Upset rivets to dimensions shown in Detail B.

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Figure 201 Removal/Installation of Power Turbine Stator

Figure 202 Removal of Power Turbine Stator Housing

Figure 203 Power Turbine Stator Assembly - Inspection

Figure 204 Power Turbine Stator Assembly Classification -Typical

Figure 205 Power Turbine Section Sealing Surfaces (Typical)

Figure 206 Replacement of Interstage Baffle Rivets

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201 Power Turbine Stator Assembly Inspection

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POWER TURBINE - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. 72-50-00, DESCRIPTION AND OPERATION, Fig. 1)

The power turbine installation consists of first and second-stage disk and blade assemblies which are mounted on the balanced power turbine shaft assembly and retained by a spanner nut and slotted washer. A rotor air seal mounted between the two disk and blade assemblies provides a running face for the interstage air seal. The first and second-stage disk and blade assemblies incorporate 47 and 43 blades respectively. The blades differ from those of the compressor turbine blades in that they are forged with notched and shrouded tips. Each blade is located in a fir tree serration in the circumference of the turbine disk and retained by a rivet. The first and second-stage disk and blade assemblies rotate within shrouds machined in the first and second-stage vane ring assemblies respectively.

Each power turbine disk incorporates a flange for disk balancing. The required number of classified weights and rivets is determined during assembly balancing procedures.

The power turbine interstage stator installation, comprising second-stage vane ring and interstage seal, is installed between the first and second-stage power turbine disk and blade assemblies. The vane ring consists of an outer ring, with integral vanes, and an inner ring. The interstage seal consists of an abradable element installed in the interstage seal housing and fastened by the seal retaining plate bolted to the housing. The housing is secured to the inner vane ring with the turbine vane ring clamping ring. The rotor air seal mounted between the first and second-stage turbine disks provides the running clearance between the rotating parts and the abradable seal element. Lugs on the outer circumference of the vane ring, immediately forward of the vanes, locate in slots in the bore of the power turbine stator housing.

The front extension of the outer ring provides the running clearance for the second-stage power turbine. The front face of the vane ring is located on the rear inner flange of the exhaust duct and retained by bolts passing through power turbine stator housing and exhaust duct (flange D).

The power turbine shaft assembly, mounted in the centerbore of the shaft housing, consists of the shaft, turbine coupling, rear rotor air seal, No. 3 bearing inner race and rollers, No. 4 bearing inner race and balls, and the power turbine shaft coupling.

The front extension of the outer ring provides the running clearance for the second-stage power turbine. The front face of the vane ring is located on the rear inner flange of the exhaust duct and retained by bolts passing through power turbine stator housing and exhaust duct (flange D).

The power turbine shaft assembly, mounted in the centerbore of the shaft housing, consists of the shaft, turbine coupling, rear rotor air seal, No. 3 bearing inner race and rollers, No. 4 bearing inner race and balls, and the power turbine shaft coupling.

The rear rotor air seal is installed on the outer circumference of the turbine coupling rear extension. The centerbore of the rear extension is splined to accommodate the second-stage turbine disk. A machined circumference on the turbine coupling forward of the extension is provided for the No. 3 bearing inner race which is secured by a spacer, keywasher and spanner nut. The split inner races of the No. 4 bearing are located on a machined circumference at the front end of the shaft, while the power turbine shaft coupling is splined onto the shaft forward of the bearing. The bearing and coupling are secured on the shaft by a keywasher and spanner nut.

The power turbine shaft housing consists of a fabricated steel cylindrical housing with a mounting flange at the front end. The housing is secured to studs on the rear face of the reduction gearbox rear case. The housing provides a support for the power turbine shaft assembly and the outer races of the No. 3 and No. 4 bearings. A stator air seal, located and secured in the rear centerbore of the housing by a dowel pin and retaining ring, prevents oil leakage from the bearing area into the turbine section. A No. 3 bearing heatshield assembly, surrounds the rear end of the housing. The outer races of the No. 3 and No. 4 bearings are bolted to internal flanges in the housing. Two oil transfer tubes are incorporated in the housing; one tube provides pressure oil via four nozzles to the front and rear faces of the No. 3 roller bearing and to the front and rear face of the No. 4 ball bearing. The tube, which contains a strainer element, is coupled to a port in the rear case of the reduction gearbox by a short transfer tube, and is secured and positioned by one of the No. 3 bearing upper retaining bolts. The second tube, in the bottom of the housing, transfers scavenge oil from the vicinity of the air seal and No. 3 bearing to the reduction gearbox via a cored passage in the rear case.

POWER TURBINE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-076	Oil, Penetrating

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC31050	Wrench	
PWC31515	Bar	Replaced by PWC37515-06
PWC32089	Pusher	
PWC32120	Pusher	
PWC32121	Adapter	Replaced by PWC50589

PWC32136	Fixture	
PWC32137	Socket	
PWC32507	Pump	Used in conjunction with PWC50588
PWC37515-06	Bar	
PWC37906	Adapter	Used in conjunction with PWC50588
PWC50442	Socket	
PWC50588	Puller	
PWC50589	Adapter	
PWC50591	Adapter	Obsolete - replaced by PWC71489
PWC51777	Crimper	
PWC71410	Rod Assembly	Replaces PWC51748
PWC71489	Adapter	Alternate to PWC50591
PWC89837	Cylinder, Hydraulic	Replaces PWC32506

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

NOTE: Removal of the power turbine should not be done unless power turbine interstage stator is damaged beyond limits (Ref. Table 202).

A. Removal of Power Turbine

(1) Remove power turbine stator housing and power turbine stator assembly (Ref. 72-50-03, Removal/Installation).

(2) Uncrimp power turbine retaining nut slotted washer (1, Fig. 201).

(3) Using fixture (PWC32136), drill two holes in power turbine retaining nut (2) to the depth limited by stop on drill.

NOTE: 1. Use of oil is recommended during drilling operation.

NOTE: 2. Drills are specially prepared for this operation; do not re-sharpen.

CAUTION: TURN THE HANDLE OF WRENCH (PWC31050) COUNTERCLOCKWISE TO REMOVE THE NUT.

(4) Remove the power turbine retaining nut (2) and slotted washer (1) with the socket (PWC32137) (1, Fig. 202), adapter (PWC50591) or (PWC71489) (4), wrench (PWC31050) (2), bar (PWC31515) or (PWC37515-06) (3). Discard nut and washer.

CAUTION: TWO PERSONS ARE NECESSARY TO DO THE REMOVAL OF POWER TURBINE DISKS. ONE PERSON TO SEE IF THE DISK IS REMOVED EASILY. IF THE DISK IS NOT REMOVED EASILY, LUBRICATE THE MATING DIAMETERS WITH PENETRATING OIL (PWC05-076) AND SEAT DISK. TURN THE DISKS AND INSTALL THE TOOLS AGAIN, THEN TRY TO REMOVE THE DISKS. IF YOU CAN NOT REMOVE THE DISKS EASILY, STOP THE REMOVAL AND CONTACT P&WC.

(5) Remove power turbine first-stage disk (3, Fig. 201) from shaft with puller (1, (PWC32123), Fig. 204) or puller (PWC50588) with adapter (PWC37906), hydraulic cylinder (PWC89837) and pump (PWC32507). Place power turbine disk carefully into a suitable protective container.

NOTE: If both turbine disks withdraw together, separate them on bench using pusher (2, (PWC32120), Fig. 203) in conjunction with puller (3, PWC50588) and adapter (1, (PWC32121) or PWC50589).

(6) Remove interstage stator assembly.

NOTE: Do not remove interstage rotor air seal from power turbine second-stage disk.

B. Installation of Power Turbine

(1) Clean all parts prior to re-assembly.

(2) If both turbine disks were withdrawn together at removal, lightly coat snap diameters of PT second-stage disk (5, Fig. 201) with oil (PWC03-001). Install second-stage disk (5) on power turbine shaft, pushing disk firmly by hand only, onto shaft coupling.

(3) Install interstage stator assembly (4).

(4) Lightly coat snap diameters of first-stage disk (3) with oil (PWC03-001), install against second-stage disk (5), aligning large lug with corresponding slot. Check 'X' marks on disk hub and end of shaft are aligned.

(5) Using pusher (1, Fig. 205), push power turbine disks fully into shaft coupling. Remove pusher.

(6) Install new slotted washer (1, Fig. 201) on power turbine shaft.

(7) Lightly coat PT shaft thread, retaining nut thread and washer-to-nut interface with oil (PWC03-001), and install nut (2), hand tight.

(8) Install the socket (PWC32137) (1, Fig. 202) and the adapter (PWC50591) or (PWC71489) (4) on the nut (2, Fig. 201). Torque the nut 2400 lbf.in. with the wrench (PWC31050) (2, Fig. 202) and the bar (PWC31515) or (PWC37515-06) (3). Loosen the nut to zero. Remove the nut and do Step (7) again.

(9) Tighten nut 300 lb.in., increase force until nut turns 50 degrees ± 2 degrees. DO NOT exceed 3000 lb.in. Record final value. Loosen and remove nut. Repeat step (7).

(10) Retighten nut to 300 lb.in., then increase force until nut turns 50 degrees ± 2 as previous. DO NOT exceed 3000 lb.in. Record final value.

(11) If second value exceeds first value, loosen nut and repeat steps (7) thru (10) until final value is LESS THAN, but WITHIN 10 percent of previously recorded value.

(12) Remove wrench, adapter, bar and socket.

(13) Crimp keywasher into nut scallops at two locations 180 degrees apart, using (PWC51777).

(14) Install power turbine stator and stator housing (Ref. 72-50-03, Removal/Installation) and T5 wiring harness (Ref. 77-20-01, Removal/Installation).

6. Inspection/Check (Heavy Maintenance Only)

A. General

The power turbine second-stage disk and blades and stator vanes should only be inspected as detailed in the following section when the power turbine stator and stator housing have been removed (Ref. 72-50-03, Removal/Installation).

Acceptance criteria outlined herein is based on structural integrity considerations and apply only if engine performance /handling was satisfactory prior to HSI. Replace vane ring if its condition appears to be the cause for loss of performance.

Vane rings considered unacceptable for continued service may be sent to P&WC for possible repair.

Pratt & Whitney Canada Inc.
7007 de la Savane
St. Hubert, Quebec
Canada
J3Y 3X7

Attention: Service Center
Receiving Area 5-1

B. Inspection of Power Turbine Installation

(1) Examine power turbine blades (Ref. Figs. 206, 207 and Table 201).

(2) Inspect power turbine interstage stator (Ref. Fig. 208 and Table 202).

(3) Examine second-stage turbine for condition and damage. Inspection of rear face can be done by viewing through ports in exhaust duct if second-stage turbine is not removed.

(4) If damage is found beyond limits, send the power section to an approved overhaul facility for blade replacement.

Table 201 Power Turbine Blade Inspection (Ref. Figs. 206 and 207)

Table 202 Power Turbine Interstage Stator Assembly Inspection (Ref. Fig. 208)

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Figure 201 Removal/Installation of Power Turbine and Interstage Stator

Figure 202 Removal/Installation of Power Turbine Nut

Figure 203 First and Second-stage Power Turbine Disks

Figure 204 Power Turbine

Figure 205 Installation of Power Turbine

Figure 206 Power Turbine First-Stage Blade Shift

Figure 207 Power Turbine Second-Stage Blade Inspection

Figure 208 Power Turbine Interstage Stator Assembly Inspection

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201 Power Turbine Blade Inspection (Ref. Figs. 206 and 207)

202 Power Turbine Interstage Stator Assembly Inspection (Ref. Fig. 208)

EXHAUST DUCT - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

The exhaust duct installation comprises an exhaust duct assembly and a shaped insulation blanket.

The exhaust duct assembly consists of a heat-resistant nickel-alloy sheet, truncated cone fabrication with twin opposed exhaust ports and an annular sheet metal inlet. The exhaust port flanges provide the mounting for the airframe-supplied exhaust nozzles. Exhaust gases from the power turbine area enter a bifurcated tube which carries the exhaust gases to the exhaust ports.

The front flange of the duct (flange A) provides the support and mounting flange for the reduction gearbox. Two flanges are provided at the rear of the duct; the inner flange (flange D) shank nuts provide the mounting for the power turbine stator housing, while the outer flange (flange C) forms the major dividing flange between the gas generator assembly and the power section/power section module.

A sealed tube in the exhaust duct assembly provides a passageway and mounting flange for the T5 lead-out wiring harness.

The two piece texturized stainless steel/ceramic fiber laminated insulation blanket is laced together and installed between the bifurcated tubes of the duct and the power turbine shaft housing to minimize transfer of heat from the exhaust gases to the power turbine shaft bearings and rear section of the reduction gearbox.

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Figure 1 Exhaust Duct and Insulation Blanket

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72-50-05
EXHAUST DUCT - MAINTENANCE PRACTICES

1. General

A. Maintenance practices for the exhaust duct are restricted to Inspection/Check, Cleaning/Painting, and Approved Repairs.

2. Consumable Materials

Not Applicable

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Cleaning/Painting

A. Cleaning of Exhaust Duct

(1) Remove salt and smog deposits from outer surface of exhaust duct with clean water. Dry with clean, dry compressed air.

(2) Clean light surface corrosion build-up with with suitable non-metallic brush.

6. Inspection/Check

A. Inspection of Exhaust Duct

NOTE: For periodic, hot section, or unscheduled inspections such as engine sudden-stoppage (Ref. 72-00-00, INSPECTION, General) or suspected aircraft heavy landing, examine exhaust duct critically for evidence of the following:

(1) Examine outer surface condition for buckling, ripples or similar distortion.

(2) Examine outer surface, particularly in vicinity of flanges A and C and exhaust ports, for cracking in metal skin, welds or flange bolt holes. Check T5 system exit tube for security.

(3) Examine exhaust duct port flanges for cracks that are not more than 0.500 inch in length and do not progress into stitch weld or cracks in tangential direction not more than 1.000 inch in length are acceptable, provided they are stop drilled with a $^{1}/_{16}$ (0.0625) inch drill.

(4) A maximum of two outward radial cracks per port flange are acceptable but not in consecutive holes (atleast one uncracked in between).

(5) Cracks that run from a bolt hole in a tangential direction are not acceptable.

(6) Check for integrity of internal structure through exhaust ports.

NOTE: Refer to Aircraft Maintenance Manual for removal/installation of exhaust stubs.

(7) Examine inner exhaust duct (gas path wall) structure as far as possible for cracks with suitable lighting or borescope.

(a) Acceptable conditions; repair unnecessary:

1 Cracks up to 1 inch long, not opened more than 0.030 inch and separated from each other by a minimum of 3 inches are acceptable.

2 Re-inspect at an interval not exceeding 200 hours of operation.

(b) Acceptable conditions; repair necessary:

1 Cracks up to 1.5 inch long not opened more than 0.030 inch and separated from each other by a minimum of 3 inches are acceptable provided they are stop drilled using a quality high-speed 1/16 (0.0625) inch drill.

NOTE: A back-up ring is located under a portion of the inner duct. Stop drilling through this ring is optional and may be incomplete.

2 Re-inspect at an interval not exceeding 200 hours of operation.

(c) Unacceptable conditions; no repair permitted:

1 Cracks opened more than 0.030 inch.

2 Cracks longer than 1.5 inch.

3 Five or more cracks.

4 Converging cracks within 3 inches of each other.

NOTE: Ship the power section/power section module to an approved overhaul facility for evaluation and possible exhaust duct repair by welding.

7. Approved Repairs (Heavy Maintenance Only)

A. Replacement of Shanknut

(1) Replace unserviceable shanknuts on flange D using same procedure described for gas generator case (Ref. 72-30-04, Approved Repairs).

NOTE: Other repairs that may be deemed necessary are considered beyond the capability of field level maintenance. Send power section/power section module, or complete engine if desired, to an approved overhaul facility.

72-60-00
ACCESSORY GEARBOX ASSY - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

The accessory gearbox assembly, located at the rear of the engine, consists of two alloy castings, bolted together at their outer flanges and installed on flange G of the compressor air inlet case.

The front casting, provided with preformed packings at the front and rear mating faces, forms an oil-tight diaphragm between the oil tank compartment in the compressor inlet case and the accessory gearing. The diaphragm also provides support for the oil pump, oil pressure regulating and cold oil pressure relief valve assemblies, and the accessory drive gear front bearings and seals. The valves are mounted side by side at the top of the oil pressure pump housing, with the relief valve downstream of the regulating valve. The regulating valve assembly is accessible through the compressor inlet case. Oil pressure adjustment is accomplished by rotating the adjuster, which increases or decreases spring tension on the regulating valve. The cold oil relief valve has no adjustment provision and is accessible by removal of the accessory gearbox from the gas generator. The center of the diaphragm is sealed from the oil tank by the inlet case center tube. The diaphragm is mounted on the gearbox rear housing by four countersunk head screws and self-locking nuts located at the 4th, 8th, 14th and 18th positions in clockwise rotation, assuming the 1st to be at the 12 o'clock position.

The rear casting forms the gearbox housing and provides support bosses for the accessory drive gear rear bearings and seals. A roller bearing fastened to a boss at the center provides the rear support for the input gearshaft. The input gearshaft incorporates an internal spline at its front end for mating with the compressor rear hub coupling external spline; positive engagement is obtained by a lock in the spline coupling arrangement, which transmits thrust to the compressor No. 1 ball bearing.

The internal scavenge oil pump, consisting of front and rear elements, is mounted at the bottom of the gearbox compartment and driven by the No. 3 drive. Each element consists of twin gears operating in a ported housing; the front element scavenges the No. 2 bearing area and dumps the oil into the gearbox sump. The rear element scavenges the gearbox sump and returns the oil, via the oil-to-fuel heater and, depending on the oil temperature, either directly to the oil tank or to the airframe-mounted oil cooler and then to tank, as determined by a thermostatic bypass and check valve.

The external scavenge oil pump, consisting of front and rear elements, is mounted on an external pad on the gearbox housing and driven by the No. 4 drive. The pump is similar to the internal pump; however, the housings of each element incorporate large input elbows which accommodate their respective external scavenge tubes. The front element scavenges the No. 3 and 4 bearing area and dumps the oil into the gearbox sump, while the rear element scavenges the reduction gearbox and directs the oil through an airframe-mounted cooler, and eventually to tank.

All main accessory drives are supported on identical roller bearings. With the exception of the front bearing of the starter-generator gearshaft, which has a carbon face seal, all drives are fitted with garter-type oil seals. An oil tray is incorporated in the lower section of the gearbox adjacent to the scavenge pump drive gears (drives 3 and 4), to minimize oil foaming during engine operation. A centrifugal oil separator, installed on the starter-generator gearshaft, separates oil from engine breather air and discharges relatively oil free air to atmosphere via cored passages in the gearbox diaphragm. Oil drains into the gearbox sump. A carbon-face seal fitted at the front end of the gearshaft and within the cored breather air passage prevents oil leakage through the bearing assembly.

Mounting pads, complete with studs, are incorporated on the external face of the gearbox housing for the fuel control unit/fuel pump, airframe-supplied starter-generator and Ng tachometer-generator. Two additional pads are incorporated on the left side of the housing and are available for additional bolt-on airframe-supplied equipment. The drive gears at these pads are optional equipment. A mount pad, complete with studs, is also provided at the rear face of the external scavenge pumps for airframe-supplied equipment. The drive gear is a customer-option. An oil nozzle, located below the starter-generator pad, provides access for a puller tool which must be used to disengage the locked coupling gearshaft and compressor rear hub coupling shaft during disassembly.

An oil tank filler cap and gage assembly is located at the 11 o'clock position on the accessory gearbox housing.

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Figure 1 Accessory Gearbox Assembly - Cross-section

72-60-00
ACCESSORY GEARBOX ASSEMBLY - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire unless otherwise specified shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC04-001	Grease, Synthetic
PWC05-037	Enamel, Epoxy
PWC05-061	Cloth, Abrasive Coated Crocus
PWC05-101	Cloth, Abrasive
PWC06-011	Assembly Fluid

PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC13-001	Primer, Epoxy

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC30046-52	Puller, Oil Seal Carrier
PWC30046-57	Puller
PWC30051-01	Base
PWC30051-02	Drift
PWC30052	Puller
PWC30075	Drift, Oil Seal Carrier
PWC30128-04	Puller
PWC30373	Pusher/Puller, Gearbox

PWC30499-50	Gage, Accessory Gearshaft
PWC30854	Adapter
PWC32076	Holder, Shaft, Coupling
PWC32174	Base, Impeller
PWC32175	Ring, Impeller
PWC32375	Drift, Seal
PWC32396	Jackscrew, Accessory Gearbox
PWC32486	Socket, Housing
PWC34060	Fixture
PWC34062	Puller
PWC34418	Puller
PWC37088-1	Drift
PWC37088-2	Drift
PWC37088-3	Drift
PWC50135	Fixture, Locking, AGB Coupling Shaft Insert Locking

PWC50237	Drift, Accessory Gearbox, Oil Seal
PWC50502	Compressor, AGB Centrifugal Impeller Ring
PWC50713	Puller, Seal
PWC50717	Puller, Seal
PWC51165	Base, Carrier Seal
PWC51166-3	Sleeve, Carrier Seal
PWC51166-5	Sleeve, Carrier Seal
PWC51167-1	Drift, Assembly, Carrier Seal
PWC51167-3	Drift Assembly, Carrier Seal
PWC51167-4	Drift, Assembly, Carrier Seal
PWC51167-5	Drift, Assembly, Carrier Seal
PWC51482	Puller, Carbon Seal Carrier
PWC51767	Installer
PWC51771	Drift
PWC70030	Drift, Carrier

PWC70838	Puller, Seal Carrier
PWC70869	Drift, Lip Seal

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Accessory Gearbox (Heavy Maintenance Only)

NOTE: Depending on airframe type and installation clearances, the ability to remove accessory gearbox as a complete entity, without removal of engine from airframe, would override the "Heavy Maintenance Only" statement. Primary reasons for gearbox removal are for replacement of centrifugal breather carbon seal or center oil tube preformed packing.

(1) Drain oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) If engine is installed in airframe and access permits, disconnect the following and remove as necessary (Ref. Aircraft Maintenance Manual).

1. Connection to overboard breather line.
2. Connections to oil pressure and temperature sensors, and Ng tachometer-generator.
3. Connection to starter-generator seal cavity drain.
4. Connections to fuel input at oil-to-fuel heater.
5. Electrical connections to fuel flowmeter transmitter, if applicable.
6. Mechanical linkage connections to FCU and reversing linkage.

(7) Remove propeller governor Py air tube between FCU and center fireseal mount ring (Ref. 73-10-08, Removal/Installation).

(8) Remove fuel tubes between FCU and rear mount ring (Ref. 73-10-03, Removal/Installation), including fuel flowmeter transmitter, if fitted.

(9) Disconnect loop clamps fastening ignition cables to No. 2 bearing scavenge oil tube, if applicable (Ref. 74-20-00, Removal/Installation).

NOTE: There is some variation in ignition cable clamping according to airframe installation.

(10) Remove No. 2 bearing scavenge oil tube (Ref. 79-20-01, Removal/Installation) and remove short oil transfer tube ((25), Fig. 201) from accessory gearbox diaphragm using puller (PWC30128-04).

(11) Remove oil level indicator assembly and oil filler tube from accessory gearbox housing (Ref. Approved Repairs).

(12) Remove oil filter and oil filter housing from compressor inlet case (Ref. 79-20-02, Removal/Installation).

(13) Remove nuts ((23), Fig. 201), and washers (22), fastening oil pressure regulating valve cover (21). Remove cover with puller (PWC34418). Remove and discard preformed packing (20).

(14) Remove self-locking nuts (6), washers (4), spacers (28) and oil tube support bracket, fastening lifting bracket (5) and accessory gearbox assembly to compressor inlet case at flange G.

NOTE: Accessory gearbox diaphragm is secured to accessory gearbox housing by four countersunk screws and self-locking nuts. Assuming nut at 12 o'clock position to be No. 1, these nuts are 4th, 8th, 14th and 18th in clockwise rotation and must not be removed at this stage.

(15) Remove access plug or oil nozzle (7) as applicable from accessory gearbox housing. Remove and discard preformed packing(s) (8) from plug or nozzle.

(16) Remove oil nozzle (7) from accessory gearbox housing. Remove and discard preformed packing (8).

(17) Insert fixture (PWC34060) through nozzle hole, into coupling shaft (13), and engage tangs of fixture with slots in spring lock insert (34), insert puller (PWC34062) into fixture, and screw into spring lock insert. Remove insert, puller and fixture.

(18) Install four jackscrews (PWC42034) or (PWC32396-400) in relevant locations on flange G and carefully separate accessory gearbox assembly from studs on compressor inlet case. Remove and discard preformed packing (27) and seal ring (14). Remove oil tank center tube (18). Remove and discard preformed packings (17) and 19).

(19) Lift the tang on the expander spring (32) from the hole in the sleeve (30), then remove and discard the expander spring (32). If the lockpin (31) drops from the locking arrangement, remove and retain.

(20) Remove and discard preformed packings from transfer tubes (1), (29) and (26). If transfer tubes (26) and (29) remain in diaphragm bosses when separating gearbox from inlet case, remove tubes from diaphragm, replace preformed packings, install tubes in inlet case and install suitable protective covers.

(21) Remove and discard seal ring (14) from compressor rotor hub coupling (16).

(22) Support accessory gearbox assembly on suitable wooden blocks with diaphragm down. (Ref. Fig. 203)

(23) Provide support under coupling shaft, then unscrew puller/pusher. Remove four self-locking nuts, washers and screws fastening housing to diaphragm. Lift housing from diaphragm; use a soft-faced hammer to separate flanges, if necessary. Remove and discard preformed packing from mating flange.

(24) Remove transfer tubes (2), (4) and (5) and remove and discard preformed packings from tubes. Remove preformed packing(s), as applicable from No. 2 bearing scavenge tube and relief valve housing assembly (6).

B. Removal of Chip Detector (Ref. Fig. 201)

(1) Remove cover or airframe electrical connector from chip detector (9), as applicable. Discard preformed packing from cover, if applicable.

(2) Remove chip detector. Remove and discard preformed packing (10).

C. Removal of External Oil Scavenge Pump (With a Vacuum Pump Drive) (Ref. Fig. 202)

(1) Remove nuts (10), washers (9) and bolts (23) and (6), fastening pump rear housing (11) and spacer (8) to front housing (24). Withdraw pump assembly from front housing.

(2) Straighten tabs of keywashers (21) and remove nuts (20) with socket (PWC32486). Remove nuts (5) and washers (4). Remove front housing (24) from mounting pad studs.

(3) Remove oil deflector (1) and shaft (2).

(4) Remove and discard preformed packings (3) and (22).

(5) Withdraw front spur gears (19).

(6) Remove two half collars (15) from shaft (13).

(7) Withdraw shaft (13).

(8) Remove spacer (8) and discard preformed packings (18).

NOTE: Two locating dowels (7) fitted in spacer (8) are an interference fit, and should not be removed.

(9) Withdraw rear spur gears (17).

(10) Remove bolts (12) and adapter assembly (14). Remove and discard preformed packing (16).

D. Installation of Accessory Gearbox

(1) Align the lockpin slot of the sleeve (30), with hole in hub coupling and install anew expander spring (32). Make sure that the tab of the expander spring is located in the hole in the sleeve for positive lock.

(2) Install new lubricated preformed packings on transfer tubes (2, 4 and 5, Fig. 203) and insert into respective bosses on accessory gearbox housing (1).

(3) Install new lubricated preformed packing(s), as applicable, on No. 2 bearing scavenge tube and relief valve housing assembly (6), and dual scavenge oil tubes.

CAUTION: FOR Post-SB14374 ENGINES, IF THE AGB HOUSING IS SEPARATED FROM THE DIAPHRAGM, THE LIP SEAL MUST BE REMOVED AND DISCARDED BEFORE INSTALLING THE HOUSING ON THE DIAPHRAGM. IT IS NOT POSSIBLE TO RE-MATE THE AGB WITH THE LIP SEAL INSTALLED.

(4) Install new lubricated preformed packing on rear flange of accessory gearbox diaphragm (8), and position housing (1) over diaphragm. Lead-in chamfer on gearshafts permits easy entry into respective bearings and oil seals.

NOTE: Make sure flanged transfer tube (2) is fully installed in center boss of housing, with flat aligned with center bearing flange before assembling onto diaphragm.

(5) Seat housing (1) on diaphragm (8). Make sure proper engagement of locating dowels (7), without forcing.

(6) Install four countersunk screws, washers and self-locking nuts at 4th, 8th, 14th and 18th positions from top center in clockwise direction. Tighten nuts 32 to 36 lb.in.

(7) Install holder (PWC32076) through center boss of housing to engage thread of coupling shaft. Screw body into housing to prevent shaft falling out through center tube.

(8) Make sure new lubricated preformed packings are installed on transfer tubes (1, 29 and 26, Fig. 201), and remove protective covers.

(9) Install new seal ring (14) on hub coupling (16).

(10) Install new lubricated preformed packing (27) on front flange of diaphragm (12) and install oil tank center tube (18) with new lubricated preformed packings (17 and 19) into boss at centerbore of compressor inlet case.

(11) Slowly rotate compressor rotor in engine until hole in splined end of rear hub coupling (16) is at 12 o'clock position.

(12) Position accessory gearbox assembly on studs of compressor inlet case. Align coupling shaft (13) with compressor rear hub coupling (16), tubes (1, 18, 29, and 26) with respective bosses, and external oil tubes with scavenge pump elbows.

(13) Remove holder, and install puller/pusher (PWC34062).

(14) Install fixture (PWC34060) over puller/pusher (PWC34062), and thread into lock spring insert (33), Insert through coupling shaft. Engage insert into hub coupling, and remove fixture and puller/pusher.

(15) Check coupling shaft locking (Ref. Inspection/Check).

(16) Install rear lifting bracket (5), washers (over short studs), spacers (over long studs) and oil tube support bracket at flange G with self-locking nuts (6). Tighten nuts 32 to 36 lb.in.

NOTE: Washers are not required at rear lifting bracket (5).

(17) Install a new lubricated preformed packing (8) on oil nozzle (7) and screw into adapter on gearbox housing. Tighten plug or nozzle 150 to 160 lb.in., and lockwire.

(18) Install oil filter and oil filter housing (Ref. 79-20-02, Removal/Installation).

(19) Install oil filler tube and oil level indicator assembly in accessory gearbox housing (Ref. Approved Repairs).

(20) Install new lubricated preformed packing (20), oil pressure regulating valve cover (21) with washers (22) and nuts (23). Tighten nuts 32 to 36 lb.in.

(21) Install new lubricated preformed packings (24) on short oil transfer tube (25), install in compressor inlet case and connect No. 2 bearing scavenge oil tube to boss on case (Ref. 79-20-01, Removal/Installation).

(22) Fasten ignition cable loop clamps to similar loop clamps on No. 2 bearing scavenge oil tube if applicable, with bolt and self-locking nut (Ref. 74-20-00, Removal/Installation). Tighten nuts 36 to 40 lb.in.

(23) Install propeller governor Py air tube (Ref. 73-10-08, Removal/Installation).

(24) Install compressor discharge air tube to P3 air filter housing (Ref. 73-10-07, Removal/Installation).

(25) Install propeller reversing linkage cambox on flange G (Ref. 76-10-00, Removal/Installation).

(26) Install fuel control unit and fuel pump as complete assembly on pump mount pad (Ref. 73-20-00, Removal/Installation).

(27) Install oil-to-fuel heater (Ref. 73-10-01, Removal/Installation) and oil tube between thermostatic bypass and check valve and scavenge oil tee (Ref. 79-20-03, Removal/Installation).

(28) Connect fuel tubes between FCU and rear mount ring (Ref. 73-10-03, Removal/Installation).

(29) Install new lubricated preformed packing (10) on accessory gearbox drain plug (9) and install in boss at 6 o'clock position on gearbox assembly. Tighten plug 215 to 240 lb.in., and lockwire.

(30) Fill oil tank (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(31) Pressure test pneumatic system (Ref. 73-10-07, Adjustment/Test).

(32) Install and connect the following as necessary: (Ref. Aircraft Maintenance Manual.)

1. Connections to airframe oil cooler.
2. Starter-generator and accessories on optional power takeoff mount pads.
3. Mechanical linkage connections to FCU and propeller reversing linkage cambox.
4. Electrical connections to fuel flowmeter if applicable.
5. Connections to fuel input at oil-to-fuel heater.
6. Connections to starter-generator seal cavity drain.
7. Connections to oil pressure and temperature sensors, and Ng tachometer.
8. Connection to overboard breather line.

(33) Check engine installation (Ref. Adjustment/Test)

E. Installation of Magnetic Chip Detector

(1) Install new preformed packing (10) on chip detector (9).

> CAUTION: THE MAGNETIC CHIP DETECTOR MAY EASILY BE OVERTIGHTENED BY MODERATE HAND PRESSURE. THEREFORE USE OF A TORQUE WRENCH IS IMPORTANT TO AVOID OVERTIGHTENING WHICH COULD RESULT IN FRACTURE OF DETECTOR BODY.

(2) Install chip detector in boss at 6 o'clock position in accessory gearbox and tighten 45 to 55 lb. in.

(3) If necessary, install new preformed packing in cover.

(4) Install cover on chip detector, or connect airframe electrical cable as applicable. If cover was installed, tighten fingertight only. DO NOT use tools. Lockwire cover and/or chip detector.

F. Installation of External Oil Scavenge Pump (With a Vacuum Pump Drive) (Ref. Fig. 202)

(1) Install oil deflector (1) in cavity of No. 4 mounting pad on gearbox housing.

(2) Install preformed packing (3) on spigot of pump front housing (24).

(3) Install preformed packings (22) in two lower holes (countersunk) in mounting flange of pump front housing (24).

(4) Install bolts (6) and one bolt (23) in pump front housing (24) flange.

(5) Position front housing (24) on No. 4 mount pad studs, and secure with washers (4), self-locking nuts (5), keywashers (21) and nuts (20). Torque self-locking nuts 75 to 85 lb.in. Torque plain nuts 32 to 36 lb.in. with socket (PWC32486). Lock keywashers (21).

(6) Install two spur gears (17) in pump rear housing (11). Rotate gear and check for correct meshing.

(7) Install preformed packings (18) on spacer (8). With dowels (7) in spacer aligned with pump rear housing (11), press firmly together.

(8) Insert vacuum pump drive shaft (13) through rear housing (11) into upper spur gear (19), with front splines of drive shaft protruding through spacer.

(9) Install two half-collars (15) in groove of drive shaft (13). Locate upper spur gear (19) on drive shaft and half-collars, and check for correct engagement.

(10) Install lower spur gear (19) in lower hole of spacer (8). Check for correct engagement and meshing of gears.

(11) Install assembled pump rear housing assembly to pump front housing (24) (already mounted on gearbox housing) and check scavenge pump drive shaft (13) engages coupling (2).

(12) Secure pump rear housing to pump front housing with four washers (9) and nuts (10) to previously installed bolts (6) and (23). Torque nuts 75 to 85 lb.in.

(13) Install preformed packing (16) on adapter (14), and secure to rear housing (11) with bolts (12). Torque bolts 36 to 40 lb.in. and lockwire.

6. Cleaning/Painting

A. Cleaning of Oil Pressure Regulating Valve (Ref. Fig. 216)

(1) Flush or spray all components with solvent (PWC11-027) or (PWC11-031), to remove all deposits and contaminants.

(2) Use lint free, cotton cloth swab soaked in solvent to remove all deposits and contaminants from bore.

(3) Dry components using clean, dry compressed air.

B. Cleaning of Cold Oil Pressure Relief Valve (Ref. Fig. 216)

(1) Flush or spray all components with solvent (PWC11-027) or (PWC11-031), to remove all deposits and contaminants.

(2) Use lint-free, cotton cloth swab soaked in solvent to remove all deposits and contaminants.

(3) Dry components using clean, dry compressed air.

C. Cleaning of Magnetic Chip Detector

CAUTION: DO NOT SOAK THE DETECTOR IN SOLVENT.

(1) Clean the magnetic chip detector as follows:

(a) Seal the contacts and insulation of the electrical connector to prevent contact with solvent.

(b) Use a medium stiff brush to clean the threads and exterior of the detector housing with solvent (PWC11-027) to remove surface deposits.

(c) Dry the surfaces of the part with clean, dry compressed air.

D. Cleaning of Internal Scavenge Pump Screen (Ref. Fig. 204)

(1) If the screen mesh has carbon or debris, carefully remove it with a suitable small plastic scraper or brush. Do not deform the screen mesh.

(2) Flush any carbon or debris residue from the AGB as follows:

(a) Remove the oil filler cap (Ref. Removal/Installation)

(b) Remove the retaining ring and oil filler tube (Ref. Removal/Installation)

(c) Place a suitable container under the AGB drain, and pour approximately 34 fluid ounces of new engine oil (PWC03-001) heated to 122°F (50°C), into the AGB filler tube opening. Make sure the oil does not enter the oil tank.

(d) Let the oil drain. Examine the inlet screen and surrounding area to make sure the residue is removed. If not, repeat the cleaning and flushing procedure above.

(3) Install the oil filler tube and retaining ring (Ref. Removal/Installation).

(4) Refill the oil tank (Ref. 72-00-00, SERVICING, Lubricating Oil System).

7. Inspection/Check

A. Inspection of Accessory Gearshaft Spline (Typical)

NOTE: Gearshaft should be checked for spline wear at associated component removal/installation.

(1) Release the clamp screw (3) of the gage (PWC30499-50)(1). Adjust the screw assemblies (4), then measure the Dim. A on ball ends. The dimension must be 0.660 in. Tighten the clamp screws, then measure the Dim. A again.

(2) Tilt the gage (PWC30499-50)(1), then make sure that the outer end is up. Put the gage (PWC30499-50) into the shaft centerbore until ball ends are approximately in middle from vertically opposite splines.

(3) Gradually release the gage, then make sure that the gage stays in position in the shaft. If the gage stays in the horizontal position, then the gearshaft is serviceable. If the gage extension falls below the horizontal position, then replace the gearshaft in the next 50 flight hours (Ref. Para. 8.).

B. Checking of AGB Coupling Shaft Axial Position

(1) Install coupling gage (PWC50135) in the coupling shaft (2, Fig. 206). Make sure that Face A of the gage plunger (4) contacts the end of the spring lock insert.

(2) Slide gage sleeve (3) forward until Face B of sleeve contacts aft end of coupling shaft (2).

(3) Check that Face C of gage sleeve (3) is located within step of gage plunger (4), indicating proper engagement of lockpin (36) and coupling shaft (13). If Face C of gage sleeve is outside of step, the coupling shaft must be repositioned, and check must then be repeated.

(4) Remove coupling gage.

C. Inspection of Oil Filler Cap/Gage Assembly and Filler Tube

(1) Examine filler cap and gage assembly and oil filler tube for corrosion and signs of damage. Check gage for attachment and damage, replace if necessary.

(2) With cap locked in position check for movement, if movement visible remove cap and tighten self-locking nut 6 to 11 lb.in. This should bottom out nut, install and lock in position, if movement still visible replace filler cap.

(3) Check spring-loaded locking feature of cap for serviceability, if force required to depress/lift handle is outside limit (8 to 11 lbs.), remove cap and tighten or loosen self-locking nut to meet required limit.

D. Inspection of Oil Pressure Regulating Valve

(1) Inspect cover (3, Fig. 216) and lock (7) for pitting, nicks, scoring and deformation. Make sure cover preformed packing groove is free of dirt and/or damage.

(2) Inspect adjustment seat (9), regulating valve (11) and valve sleeve (13) for corrosion, pitting and/or damage. Inspect adjustment seat and valve sleeve internal and external threads for damage.

(3) Make sure valve sleeve bore has no obstructions and valve moves freely within bore.

(4) Inspect valve sleeve preformed packings (14, 15 and 16) and retaining ring grooves for damage.

(5) Inspect retaining rings (8 and 12) for burrs, cracks, nicks, corrosion, sharp edges and distortion.

(6) Inspect lock spring (5) and regulating spring (10) for burrs, nicks, cracks, corrosion and deformation. Free length of lock spring is 2.035 inches. Free length of regulating spring is 3.157 inches.

E. Inspection of Cold Oil Pressure Relief Valve

(1) Examine cover (19, Fig. 216), valve (21) and valve sleeve (22) for pitting, nicks, scoring, corrosion and deformation. Make sure valve sleeve bore is not obstructed and valve moves freely within bore.

(2) Examine valve sleeve preformed packing (23) and retaining ring grooves for dirt and/or damage.

(3) Examine retaining ring (18) for burrs, cracks, nicks, sharp edges and distortion.

(4) Examine valve spring (20) for burrs, corrosion, cracks, nicks and distortion. Free length of valve spring is 3.309 inches.

F. Inspection of Springlock Insert

(1) Examine insert for wear, nicks, and distortion. Insert is acceptable provided main body Dia. A (Ref. Fig. 207) is not less than 0.435 inch. Surface discoloration, wear all over, or local wear due to fretting is acceptable.

(2) Examine locking tangs for cracks, wear. Localized scoring /wear is acceptable provided tang thickness (Dim. b) is not less than 0.040 inch. Diameter at tangs (Dia. B) is 0.328 inch minimum.

(3) Reject insert if wear exceeds limits.

G. Inspection of Magnetic Chip Detector

(1) For detailed inspection instructions and debris analysis, refer to Chap. 79-20-02, MAINTENANCE PRACTICES.

(2) Examine threads for damage. Chase threads as required. Replace detector if threads are badly damage or crossed.

(3) If detector housing remains in AGB, check for excessive oil leaks which may indicate either preformed packing or valve seat is deteriorated, or detector valve is not seating properly.

(4) Movement of electrical connector relative to detector body may short internal connections and give false indications. This condition is cause for rejection of detector.

(5) Connect ohmmeter across detector terminals, and place suitable ferrous bar across magnet poles. Circuit continuity must exist. Remove the bar and check that an open circuit is indicated.

(6) Check integrity of output terminal pins and condition of potting compound. If pins are loose, or if compound is cracked, reject detector.

H. Inspection of Internal Scavenge Pump Inlet Screen

(1) Remove the chip detector located on the AGB housing (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Collect drained oil in a clean container and check for any debris (Ref. Chap. 79-20-02, MAINTENANCE PRACTICES).

(3) Use a mirror and suitable light source (or borescope) and inspect the scavenge oil pump inlet screen for carbon or debris (Ref. Chap. 79-20-02, MAINTENANCE PRACTICES).

NOTE: Any foreign material found blocking the screen or contained in the oil should be identified. Look especially for paint flakes approximately 1/8 inch to 1/2 inch in diameter (Ref. Chap. 79-20-02, MAINTENANCE PRACTICES).

(4) If carbon or debris is present, clean the inlet screen (Ref. Cleaning/Painting, Fig. 204).

(5) Install the chip detector on the AGB housing (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(6) Replenish the drained oil (if not contaminated by foreign material) in oil tank (Ref. 72-00-00, SERVICING, Lubricating Oil System).

8. Approved Repairs

A. Repair of Corrosion - Accessory Gearbox Housing

NOTE: Corrosion must not be deeper than 0.010 in. and must not cover an area greater than 10 percent of the total surface of the AGB housing.

(1) Apply a suitable covering material over the compressor section.

(2) Clean the surface of the area to be repaired with a swab soaked in isopropyl alcohol (PWC11-014) and crocus cloth (PWC05-061).

(3) Remove all traces of corrosion (magnesium oxide) using a suitable steel brush, crocus cloth (PWC05-061), abrasive cloth (PWC05-101), file or grit paper. Remove all traces of debris using a vacuum cleaner.

(4) Flush the area with clean water at room temperature.

(5) Dry the area with clean compressed air at 29 psig.

WARNING: REFER TO THE MATERIAL SAFETY DATA SHEETS BEFORE YOU USE THESE MATERIALS FOR INFORMATION SUCH AS HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES. SOME OF THESE MATERIALS CAN BE DANGEROUS. YOU CAN GET THE DATA SHEETS FROM THE MANUFACTURERS OR THE SUPPLIERS OF THESE MATERIALS.

(6) Prepare a chrome pickle solution (Ref. Chap. 70-00-00, MAINTENANCE PRACTICES, Touch-Up Solution).

(7) Using a swab or brush, apply the chrome pickle solution, at a temperature of 17° to 29°C (55° to 85°F), to the prepared surface for 30 to 45 seconds.

NOTE: Repeat the application frequently to make sure that the affected surface is continually wet with the solution.

(8) Swab the area with clean water until successive swabs are no longer stained yellow.

(9) Dry the area with local heating (air dry or a heat gun at a low setting).

(10) Clean the affected area with a rag soaked in clean water.

(11) Dry the area with clean, compressed air at 29 psig.

(12) Apply two coats of primer (PWC13-001).

(13) Allow the primer to air dry for eight hours before applying enamel paint. Use compressed air at 29 psig to accelerate the drying time.

(14) Apply three to four coats of enamel (PWC05-037) to the primed surface. Allow the surface of the enamel to become tacky (approximately 15 minutes) between each coat. The final coat of enamel must dry for 24 hours before returning the engine to service.

NOTE: Drying time for the primer and paint can be reduced with the use of a heat gun at a low setting. Refer to the manufacturers instructions.

B. Replacement of Accessory Drive Oil Seals (Ref. Figs. 208 to 211)

(1) Removal:

(a) Remove accessory unit, or cover and gasket, as applicable, from mounting pad on accessory gearbox housing (Ref. Fig. 208).

(b) Remove the retaining ring (3) from starter-generator mounting pad (No. 1 boss) and the retaining ring (4) from the FMU mounting pad (No. 2 boss).

(c) Remove the lip seal (2) using puller (PWC70838). Remove and discard the preformed packing (1).

(d) Remove oil seal carriers (5, 10, 13, 14 and 17) with puller (PWC30046-52) or (PWC30046-57), as applicable.

NOTE: Use of puller shown in Figure 209.

(e) Turn drift (PWC51167-1), (PWC51167-3), or (PWC51167-5), upside down, as applicable and remove the seals (8, 11, 16, and 19, Fig. 208) from their respective carriers. Discard the seals.

(f) Turn drift (PWC50237) upside down and remove the seal (6) from the carrier (5). Discard the seal.

(g) Remove and discard preformed packings (7, 9, 12, 15 and 18).

(2) Installation:

(a) Lightly lubricate a new preformed packing (1) with engine oil and install on the lip seal (2) (with mandrel).

NOTE: Do not remove the mandrel from the lip seal prior to installation. The mandrel is used to install the lip seal.

(b) Align the seal/mandrel assembly with the starter-generator gearshaft (No. 1 boss). Push the seal/mandrel assembly on the gearshaft with drift (PWC70869) (Ref. Fig. 211).

(c) Discard the assembly mandrel.

(d) Secure the seal in the No. 1 boss with retaining ring (3).

(e) Heat the oil seal carrier (5) (No. 2 boss) in an oven 250°F to 300°F for 15 minutes minimum.

(f) Remove the carrier (5) from the oven and install on the base (PWC51165).

(g) Lightly lubricate the seal (6) with engine oil. Install the seal (with mandrel) in the carrier (5) with drift (PWC50237).

NOTE: Do not remove the mandrel from the seal prior to installation. The mandrel is used to install the seal.

(h) Lightly lubricate a new preformed packing (7) with engine oil and install on the carrier (5).

(i) Align the seal/mandrel and carrier assembly with the gearshaft. Push the seal/mandrel and carrier assembly on the gearshaft with drift (PWC70030) (Ref. Fig. 211).

NOTE: Make sure that the assembly mandrel is aligned with the gearshaft when you install the seal/mandrel assembly.

(j) Discard the assembly mandrel.

(k) Secure the carrier (5) in No. 2 boss with retaining ring (4).

(l) Install carriers (13, 10 and 14) on the base (PWC51165).

(m) Lightly lubricate seals (8 and 11) with engine oil. Install seals in carriers (10 and 13) with drift (PWC37088-1), (PWC37088-2), (PWC37088-3) or (PWC51167-1), (PWC51167-5), as applicable.

(n) Lightly lubricate seal (16) with engine oil. Install seal in carrier (14) with drift (PWC51167-3).

(o) Install the retainer (17) in holding base (PWC51165).

(p) Lightly lubricate seal (19) with engine oil. Install seal in retainer (17) with drift (PWC51167-1).

(q) Lightly lubricate a new preformed packing (18) with engine oil and install on retainer (17). Install retainer with puller (PWC30046-52) in external scavenge pump housing.

(r) Install oil seal carriers (10, 13, 14 and 17) with drift (PWC30075) or puller (PWC30046-52) or (PWC30046-57), as applicable.

(3) Install accessory unit, or new gaskets and covers, as applicable, in appropriate position on accessory gearbox housing. Secure covers, if installed, with either bolts or nuts and torque 65 to 75 lb.in.

(4) Check for oil leakage (Ref. 71-00-00, ADJUSTMENT/TEST).

(5) Check for oil leakage after 5 to 10 hours of operation (Ref. 71-00-00, ADJUSTMENT/TEST).

C. Oil Pump Drive Seal (Ref. Fig. 212)

(1) Remove accessory gearbox assembly from engine (Ref. Para. 5.).

(2) Remove main pressure oil pump (5) from diaphragm (1).

(3) Remove oil pump drive seal carrier from diaphragm (1) with puller (PWC30046-57) or (PWC50713).

(4) Remove and discard seal element (8) and preformed packing (6).

(5) Heat the oil seal carrier (7) in an oven to 250°F to 300°F for 15 minutes minimum.

(6) Moisten new seal element with engine oil (PWC03-001).

(7) Gently press seal (8) into oil seal carrier (7) from non-pressure side with drift (PWC37088-1) or (PWC51165), (PWC51166-3) and (PWC51167-3).

(8) Install new lubricated preformed packing (6) on OD of oil seal carrier (7).

(9) Install assembled oil seal and carrier in respective boss on accessory gearbox diaphragm. Press into position with drift (PWC32375).

(10) Install oil pump (5) on gearbox diaphragm (1) with bolts. Tighten bolts 32 to 36 lb.in., and lockwire.

D. Replacement of Starter-generator Gearshaft Carbon Seal

(1) Remove accessory gearbox assembly from engine and separate housing from diaphragm (Ref. Para. 5.).

(2) Remove starter-generator gearshaft (3, Fig. 203) from gearbox housing (1).

(3) Remove bolts and tabwashers (9) fastening flanged bearing (10) to diaphragm. Remove bearing.

(4) Withdraw seal and seal carrier (2) with puller (PWC30052) or (PWC51482). Remove and discard preformed packing (4).

(5) Remove seal and casing (3) from carrier (2) using base (PWC30051-01) or (PWC51165) and drift (PWC30051-02) or (PWC51167-4).

(6) Immerse new carbon seal in engine oil (PWC03-001) and move seal in and out within seal casing to check freedom of movement.

(7) Heat the carbon seal carrier (2) in an oven to 250°F to 300°F for 15 minutes minimum.

(8) Remove the carrier from oven and install in base (PWC51165).

(9) Place a new carbon seal (3) on sleeve (PWC51166-5) and install seal in the carrier with drift (PWC51167-4).

(10) Install new lubricated preformed packing (4) on seal carrier and press carrier into boss on diaphragm, with drift (PWC30075) or (PWC32375).

(11) Install flanged bearing (10, Fig. 203) on boss with bolts and tabwashers (9). Tighten bolts 36 to 40 lb.in., and lock tabwashers.

(12) Install starter-generator/centrifugal breather gearshaft (3) in gearbox housing.

CAUTION: IF, FOR ANY REASON, OTHER ACCESSORY DRIVES WERE REMOVED DURING PROCEDURE, EXERCISE CARE NOT TO INTERCHANGE THE EXTERNAL SCAVENGE PUMP GEARSHAFT (NO. 4) WITH THE HYDRAULIC PUMP GEARSHAFT (NO. 6). THESE GEARSHAFTS ARE SIMILAR IN APPEARANCE AND MUST BE IDENTIFIED BY PART NUMBER.

(13) Install accessory gearbox housing on diaphragm.

(14) Install accessory gearbox assembly on engine (Ref. Para. 5.).

E. Replacement of Starter-generator Gearshaft Centrifugal Breather.

(1) Remove accessory gearbox assembly from engine and separate housing from diaphragm (Ref. Para. 5.).

(2) Remove starter-generator/centrifugal breather gearshaft (3, Fig. 203) from gearbox diaphragm (8).

(3) Place ring (5, Fig. 213) on base (6).

(4) Position gearshaft/impeller assembly on ring (5). Make sure pins (7) align with shouldered pins (9).

(5) Install compressor (2) on impeller (4) and mate lugs of compressor with corresponding slots in impeller.

CAUTION: SEPARATION OF GEARSHAFT AND IMPELLER SHOULD NOT REQUIRE EXCESSIVE FORCE. IF DIFFICULTY IS EXPERIENCED, CHECK THAT RETAINING RING IS CLEAR OF GROOVE IN IMPELLER.

(6) Using adapter (1) inserted in compressor (2), separate assemblies.

(7) Fully disengage gearshaft (8) from three shoulder pins installed in impeller (4). Remove gearshaft from impeller.

(8) Remove retaining ring (16, Fig. 203), remove and discard preformed packings (14 and 15).

(9) Install new lubricated preformed packing (14) on OD of impeller.

(10) Install new lubricated preformed packing (15) on starter-generator gearshaft.

(11) Install retaining ring (16) in groove in gearshaft.

NOTE: Check integrity of shoulder pins before mating parts.

(12) Position impeller on gearshaft; align shoulder pins in impeller with holes in gearshaft and press parts firmly together by hand to engage retaining ring. Make sure parts are locked together.

(13) Install starter-generator/centrifugal breather gearshaft on diaphragm (8) by mating with related gearshafts.

(14) Install accessory gearbox housing on diaphragm and install accessory gearbox assembly on engine (Ref. Para. 5.).

F. Replacement of Oil Filler Tube

(1) Unlock and remove the oil filler cap and gage assembly (2, Fig. 215, Pre-SB14301) or the oil filler cap and gage assembly (8, Post-SB14301/Pre-SB14394) or the oil filler cap and gage assembly (12, Post-SB14394) from the accessory gearbox housing. Remove and discard the preformed packing (1).

(2) Remove the retaining ring (3) fastening the filler tube (4, Pre-SB14301) or the valve oil filler tube (7, Post-SB14301/Pre-SB14396) or the valve oil filler tube (9, Post-SB14396) to the accessory gearbox.

(3) Remove the filler tube (4) or the valve oil filler tube (7) or the valve oil filler tube (9) from the gearbox housing. Remove and discard the preformed packings (5) and (6).

(4) For Post-SB14396 Engines: Remove the retaining ring (11) and the plastic ball (10) from the oil filler tube (9).

(5) When the dipstick requires replacement:

(a) Remove the locknut (17) and the Pre-SB14394 washer (15) or the Post-SB14394 keywasher (16) that attaches the dipstick (14) to the underside of the oil filler cap body and remove the dipstick (14).

(b) Fit a new dipstick (14) on the oil filler cap spindle (13) and attach with the Pre-SB14394 washer (15) or the Post-SB14394 keywasher (16) and the locknut (17).

(6) Tighten the locknut (17) 6 to 11 lb.in.

(7) For Post-SB14394 Engines: Lock the keywasher (16).

NOTE: The oil filler cap and gage assembly (2) or (8) or (12) is not repairable and should be returned to an approved overhaul facility.

(8) Install the retaining ring (3) and the new lubricated preformed packings (5) and (6) on the filler tube (4) or the valve oil filler tube (7) or the valve oil filler tube (9).

(9) For Post-SB14396 Engines: Install the plastic ball (10) and the retaining ring (11) on the oil filler tube (9).

(10) Insert the filler tube (4) or the valve oil filler tube (7) or the valve oil filler tube (9) into the accessory gearbox housing. Align the notch in the flange of the tube with the dowel pin on the boss of housing, and install the retaining ring (3).

(11) Install the new preformed packing (1) on the oil filler cap and gage assembly (2) or the oil filler cap and gage assembly (8) or the oil filler cap and gage assembly (12) and insert into the filler tube (4) or the valve oil filler tube (7) or the valve oil filler tube (9). With the filler cap correctly positioned and locked, no movement is allowed.

(12) If movement occurs remove the oil filler cap and gage assembly (2) or the oil filler cap and gage assembly (8) or the oil filler cap and gage assembly (12) and tighten the self-locking nut, which fastens the gage to the filler cap, 6 to 11 lb.in. Check the force required to depress/lift lock tab (Ref. Inspection/Check)

G. Replacement of Oil Pressure Regulating Valve (Ref. Fig. 216)

(1) Remove nuts (1) and washers (2) from cover (3).

(2) Using puller (PWC34418), remove cover assembly (3). Remove and discard preformed packing (4).

(3) Compress spring (5), and remove pin (6), lock (7) and spring (5).

(4) Insert puller (PWC50717) through boss in compressor inlet case. Engage lip of valve sleeve (13) and remove regulating valve assembly. Remove and discard preformed packings (14, 15 and 16).

(5) Remove retaining ring (8).

WARNING: USE CARE WHEN REMOVING ADJUSTMENT SEAT AND RELEASE SPRING PRESSURE SLOWLY.

(6) Unscrew adjustment seat (9) until free of threaded section of valve sleeve (13).

(7) Remove adjustment seat (9), spring (10) and valve (11) from sleeve.

(8) Remove retaining ring (12).

(9) Install retaining ring (12) in sleeve (13) bore lower groove.

(10) Insert valve (11) and spring into valve sleeve (13).

(11) Position adjustment seat (9) on spring (10). Install retaining ring (8) into sleeve (13) using installer (PWC51767) and drift (PWC51771), in the groove inside the sleeve.

(12) Compress spring and turn adjuster seat (9) into bore of sleeve (13).

(13) Turn adjustment seat (9) into sleeve (13) until spring (10) is compressed and unscrew adjustment seat eight turns.

(14) Install new, lubricated preformed packings (14, 15 and 16) into respective sleeve grooves.

(15) Install regulating valve assembly with puller (PWC50717), through compressor inlet case into oil pump housing (17).

(16) Insert spring (5) into lock (7) and position in cover (3). Align slots of lock (7) with holes in cover (3). Compress spring, and insert pin (6) through cover holes.

(17) Install new lubricated preformed packing (4) on cover assembly (3) and install in compressor inlet case boss. Install washers (2) and nuts (1) and tighten nuts 32 to 36 lb.in.

(18) Run engine and check oil pressure (Ref. 71-00-00, ADJUSTMENT/TEST, General).

H. Replacement of Cold Oil Pressure Relief Valve (Heavy Maintenance) (Ref. Fig. 216)

NOTE: No field adjustment of cold oil relief valve is provided.

(1) Remove accessory gearbox (Ref. Para. 5.).

WARNING: USE CARE WHEN REMOVING RELIEF VALVE RETAINING RING. SPRING (20) UNDER HIGH COMPRESSION.

(2) Apply pressure to cover (19) to compress spring (20), and remove retaining ring (18) from oil pump housing bore.

(3) Release pressure on relief valve cover (19) and allow spring (20) to extend. Remove cover, spring and valve (21) from bore of valve sleeve (22).

(4) Remove sleeve (22) from housing (17), and remove and discard preformed packing (23).

(5) Install new lubricated preformed packing (23) in groove of sleeve (22) and insert into housing (17).

(6) Insert relief valve (21) and spring into valve sleeve.

(7) Position cover (19) on spring (20), apply enough pressure to compress spring (20), and let cover enter bore of housing (17), and install retaining ring (18).

(8) Install accessory gearbox on engine (Ref. Para. 5.).

9. Adjustment/Test

A. Procedure

(1) Do checks associated with Installation/Replacement of Engine (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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73-00-00
FUEL AND CONTROL - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The fuel system consists of an oil-to-fuel heater, fuel pump, fuel control unit, flow divider and dump/purge valve, dual fuel manifold with nozzles, fuel drain valves and interconnecting pneumatic control lines. For purposes of description and operation, the system also includes the propeller governor power turbine governing section, although further information relating to the propeller governor is contained in Chapter 61. On certain airframe installations, line adapters are provided to accommodate airframe-supplied fuel flowmeter and/or temperature sensing equipment.

The fuel pump delivers fuel to the fuel control unit (FCU), which determines the correct fuel schedule for engine steady state operation, both with and without power augmentation and acceleration. The flow divider supplies the metered fuel flow to the fuel manifolds as required. Full propeller control during forward and reverse thrust operation is provided by a governor which incorporates a propeller governing (CSU) section, a reversing (Beta) valve and a power turbine governing (Nf) section. The Nf governing section provides power turbine overspeed protection during normal operation. During reverse thrust operation, the propeller governing section is inoperative and control of power turbine speed is accomplished by the Nf section.

In the following text, references to various control levers and cockpit quadrant markings are generalized since there is no pattern of consistency among various airframe manufacturers. For instance, "fuel condition lever" may be called "fuel shut-off lever", or "GROUND-IDLE" may be labelled "MINIMUM GOVERNING SPEED". For individual engine operating procedures, speeds, markings and item names on specific airframe installations, refer to the aircraft operating manual.

2. Operation (Ref. Fig. 2)

A. Engine Starting

The engine starting cycle is initiated with the engine power control lever placed in the IDLE position and the fuel condition lever in CUT-OFF. Starter and ignition are switched ON and, as gas generator passes through minimum ignition speed, the fuel condition lever is advanced to the GROUND-IDLE position. Following ignition, the engine accelerates to idle speed.

During the start sequence, the fuel flow valve is in minimum flow position, the minimum pressurizing valve is closed and the pump unloading valve is closed. As the compressor rotor accelerates, the discharge air pressure (P3) increases. The increase in pressure is sensed by the P3 sensor bellows causing the fuel flow valve to move in an opening direction. As P3 pressure continues to increase, the metered fuel pressure increases, the minimum pressure valve opens to allow full metered fuel to pass to the engine. The engine accelerates to idle speed as selected by the fuel condition lever.

B. Speed Setting and Governing

When the power lever is advanced to select an increased gas generator speed (Ng), the angular motion of the lever is transformed through a gear into rotational movement of the 3D cam and movement of the fuel rotor valve through the cam follower lever. The movement of the fuel valve rotor increases the opening of the metering port and, subsequently, the fuel flow and gas generator speed.

The flyweight governor is the feedback element of the speed select system and controls the "on-speed" condition by controlling the metering port opening through the 3D cam and cam follower lever. The servo system consists of a fixed piston within the cam which allows fuel delivery pressure (P1) applied at the top of the piston to be bled through an orifice to the lower cavity. The flyweight governor regulates the differential pressure between the two cavities and, consequently, the cam position by bleeding lower cavity servo pressure as required to maintain the selected speed.

As gas generator speed increases, the resulting increased force of the governor flyweights compresses the governor feedback spring and closes the governor pilot valve. This results in an increased servo pressure, forcing the 3D cam downward to a position where the forces of the spring, pressure and flyweights reach equilibrium. In turn, this downward movement of the 3D cam is transformed into a movement of the fuel valve rotor until a valve opening is achieved corresponding to the fuel flow required to drive the gas generator at selected speed.

C. Acceleration Control

The required acceleration schedule is achieved by controlling the increase in fuel flow as a function of P3. The pneumatic section of the fuel valve performs this function by controlling the rate of metering port opening which is proportional to the change in pressure differential between the upper and lower cavities of the fuel valve. The fuel valve rotor allows fuel pump pressure (P1) to be bled to the lower cavity of the cylinder through an orifice. The movement of a hat valve linked to an evacuated bellows chamber is proportional to P3 and controls the differential pressure by regulating the bleed flow through a second orifice in the center of the fuel valve rotor. Desired speed change is accomplished by the power lever which determines rotational position of the 3D cam. When the power lever is advanced, positions of cam followers are changed, causing the fuel valve rotor to approach the hat valve seat, decreasing the cavity pressure differential. This results in a reduction in fuel valve speed relative to hat valve speed (or rate of fuel flow relative to engine response measured in terms of P3) thus maintaining the desired acceleration schedule.

D. Deceleration

When the engine power control lever is retarded, position of cam followers is changed causing the fuel valve rotor to move away from the hat valve, increasing fuel bleed through the rotor valve center orifice (reducing fuel flow through the metering port) and increasing the cavity pressure differential. The bellows chamber expands, moving the hat valve closer to the fuel valve rotor, reducing fuel bleed through the fuel rotor center orifice until new equilibrium is reached and the engine decelerates to the speed set by the power lever.

E. Power Turbine Limiting

The Nf governing section of the propeller governor senses Py pressure via an external line from the computing section of the FCU. If a power turbine overspeed should occur during forward thrust operation, the Nf governing orifice is opened by the governor flyweights and lever movement, to bleed off Py pressure. This decrease in Py pressure at the computing section of the FCU causes the metering valve to move in a closing direction, thus reducing fuel flow and, in consequence, Ng and Nf.

F. Engine Shutdown

The integral cutoff valve in the FCU provides a positive means of shutting off fuel flow to the engine. During operation of the engine, the valve is fully open and offers no restriction to metered fuel flow to the engine. Shutdown is accomplished by moving the fuel condition lever in the cockpit to CUT-OFF. Fuel is then returned to the fuel pump inlet via the internal bypass passages and ports in the FCU and fuel pump. Fuel in the manifold is purged or allowed to drain overboard via ports in the flow divider valve.

G. Manual Override

The retaining plate and cover containing the governor bellows stop are replaced by a shaft and stop assembly, which when operated after a pneumatic failure pushes against the governor bellows to increase fuel flow,

The assembly consists of an actuating shaft with a spiral slot. A drive pin passes through the slot activating an operating pin. The driving pin which cannot rotate moves in or out depending on slot position. Subsequent movement of the operating pin against the end of the governor bellows opens the metering valve and increases fuel flow. In the off position the operating pin acts as bellows travel stop.

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Figure 1 Fuel Control System Components

Figure 2 Fuel Control System Schematic

73-10-01
OIL-TO-FUEL HEATER - DESCRIPTION AND OPERATION

1. Description

The integral oil-to-fuel heater installation, comprising heater and related parts, is mounted below the fuel pump at the rear of the engine and bolted to flange G. The oil-to-fuel heater is essentially a heat exchanger which uses heat from the engine oil system to preheat the fuel in the fuel system. The heater incorporates a honeycomb two-pass oil circuit and a two-pass fuel circuit. A temperature-sensing oil bypass valve regulates the fuel temperature by either allowing oil to flow through the heater circuit, or to bypass. Oil flow from the outlet passes into a thermostatically controlled bypass and check valve.

2. Operation (Ref. Fig. 1)

The temperature-sensing oil bypass (thermal element) valve consists of a highly expansive material sealed in a metallic chamber. The expansion force is transmitted through a push rod to a valve sleeve. Since the element exerts only an expansive force, it is counterbalanced by a return spring which provides a contracting force during decrease in temperature.

When fuel temperature is low, the thermal element is in a retracted position and engine oil flows directly through the heat exchanger core. Oil is then returned to the engine through the discharge passages of the valve sleeve and oil outlet port.

At temperatures above 21°C (70°F), the thermal element begins to expand, the motion of the valve sleeve starts to open the bypass passages and simultaneously starts closing the discharge passages of the valve. At 32°C (90°F), the discharge passages are completely closed and oil flows through the bypass passages, bypassing the heater core.

Rate of oil flow through the heat exchanger varies in response to the temperature of fuel flowing around the thermal element.

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Figure 1 Integral Oil-to-Fuel Heater Schematic

73-10-01
OIL-TO-FUEL HEATER - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire unless otherwise specified shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Fuel, Engine
PWC03-001	Oil, Engine Lubricating
PWC05-061	Cloth, Abrasive Coated Crocus
PWC05-166	Solution, Chemical Treatment
PWC07-008	Coating, Thermal Insulating
PWC11-014	Isopropyl Alcohol
PWC11-024	Solvent, Methylene Chloride
PWC11-038	Solvent, Cleaning

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

CAUTION: WHEN REMOVAL OR INSTALLATION OF AN INDIVIDUAL ITEM IS REQUIRED, IT IS ESSENTIAL THAT TUBES ARE NOT SUBJECTED TO BENDING STRESSES. UNDER NO CIRCUMSTANCES BEND OR FORCE TUBES IN OR OUT OF POSITION. WHEN REMOVING ANY ONE TUBE, THE ADJACENT TUBE, COUPLING OR ELBOW, TOGETHER WITH SEAL RETAINING PLATES (IF APPLICABLE), MUST FIRST BE REMOVED, AND THE PROCEDURE REVERSED AT REINSTALLATION.

A. Removal of Oil-to-Fuel Heater (Ref. Fig. 201)

(1) Drain engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

CAUTION: OBSERVE FIRE SAFETY PRECAUTIONS.

(2) If oil-to-fuel heater (15) is being removed with engine installed in airframe, shut airframe fuel supply OFF, and disconnect fuel input from connection (14) on heater. Provide container for residual fuel in line. Suitably cap end of fuel line and heater connection.

(3) Remove drain plug (13), drain oil from oil-to-fuel heater, replace preformed packing (18) and reinstall plug.

(4) Remove bolts (8), retaining plate (10) from thermostatic bypass and check valve (9). Slide oil transfer tube (12) forward into cavity in bypass and check valve so that rear of tube clears oil-to-fuel heater. Remove and discard exposed preformed packing (11) from rear of transfer tube.

(5) Remove bolts (17) and retaining plate (16) from oil-to-fuel heater.

(6) Remove bolt (1), washer, and move hinged bracket (2) away from oil-to-fuel heater.

(7) Support oil-to-fuel heater (15) and remove bolts (6) and washers (7) to release mounting lugs of heater from engine flange G. Remove oil-to-fuel heater.

NOTE: Oil inlet transfer tube (3) will remain attached to accessory gearbox housing when oil-to-fuel heater is removed.

(8) Remove bolts (17) and transfer tube assembly (4) from flange of fuel pump.

(9) Remove and discard preformed packings (5) from exposed ends of transfer tubes (3, 4 and 12).

(10) To prevent ingress of foreign material cap all openings in oil-to-fuel heater (15) and all transfer tubes. If replacement oil-to-fuel heater is to be fitted, remove airframe-supplied fittings, if any, from oil-to-fuel heater at fuel inlet (14).

B. Installation of Oil-to-Fuel Heater (Ref. Fig. 201)

(1) If installing a new oil-to-fuel heater (15), depreserve:

NOTE: Depreservation is not required when original oil-to-fuel heater is being reinstalled.

(a) Remove shipping plugs from oil ports and flush oil circuit of heater with engine oil (PWC03-001). Drain surplus oil and reinstall shipping plugs until heater is required for installation.

(b) Remove shipping plugs from fuel ports and flush fuel circuit with engine fuel (PWC01-001). Drain surplus fuel and reinstall shipping plugs until heater is required for installation.

(c) Install airframe-supplied fitting, as applicable, at fuel inlet (14). Tighten to aircraft manufacturer's recommendations. Temporarily install blanking cap.

(2) Remove blanking caps from all transfer tubes. Make sure bore of each tube is clean and install new preformed packings on respective tubes.

(3) Remove the shipping plugs. Raise the oil-to-fuel heater (15) to engine. Use soft jaw pliers to install the transfer tubes (3) and (4) on the bosses of heater. Make sure preformed packings (5) are not displaced from seal grooves.

(4) Align holes in mounting lugs of oil-to-fuel heater with corresponding holes in flange G on engine and fasten heater loosely with washers (7) and bolts (6).

(5) Pull out oil outlet transfer tube (12) from cavity in thermostatic bypass and check valve (9) and engage with oil outlet port in oil-to-fuel heater. Make sure preformed packing (11) is not displaced from seal groove.

(6) Align retaining groove in transfer tube (12) and engage transfer tube retaining plate (10). Align holes and install retaining plate to bypass and check valve (9) with bolts (8). Torque bolts 36 to 40 lb.in. and lockwire to plate (10).

(7) Torque bolts (6) 36 to 40 lb.in. and lockwire.

(8) Install hinged bracket (2) to oil-to-fuel heater (15) with washer and bolt (1). Torque bolt 32 to 36 lb.in. and lockwire to bracket.

(9) Position retaining plate (16) around transfer tube assembly (4) and install to oil-to-fuel heater (15) with bolts (17). Tighten bolts fingertight.

(10) Install transfer tube assembly (20) to flange of fuel pump and secure with bolts (17).

(11) Torque bolts (17) 32 to 36 lb.in. and lockwire to plate.

(12) Check installation of drain plug (13):

(a) If plug is correctly lockwired on a replacement oil-to-fuel heater, it may be assumed that plug is correctly assembled.

(b) If plug is not lockwired and/or is loose, remove plug, install new preformed packing and reinstall plug. Torque plug 65 to 75 lb.in. and lockwire to boss on oil-to-fuel heater.

(13) If installation of oil-to-fuel heater (15) has been carried out with engine installed in airframe:

(a) Remove blanking cap from fuel input line and fuel inlet port or fitting as applicable.

(b) Connect fuel input to connection (14) on heater. Torque coupling nuts (Ref. Aircraft Maintenance Manual) and lockwire to holes in boss of heater.

(14) Refill engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(15) Check oil-to-fuel heater installation (Ref. Para. 9.).

6. Cleaning/Painting

A. Cleaning of Oil-to-Fuel Heater

CAUTION: DO NOT CLEAN EXTERIOR OF UNIT WITH SOLVENTS. THESE MATERIALS CAN DAMAGE INSULATION MOLDED AROUND UNIT. WASH OFF ANY SOLVENT INADVERTENTLY SPLASHED ON INSULATION USING SOAP AND WATER. CAP ALL PORTS TO PREVENT SOAP AND WATER ENTERING UNIT.

(1) Clean exterior with soap and water.

(2) Use a soft bristle brush and/or lint-free cloths and isopropyl alcohol (PWC11-014) to remove contamination from oil and fuel ports.

(3) If flushing of unit is required, the complete assembly must be sent to an approved overhaul facility for back flushing.

7. Inspection/Check

A. Inspection of Oil-to-Fuel Heater

(1) Examine the mounting lugs for cracks and other damages. Cracks are not permitted. Minor damage can be repaired.

(2) Make sure condition of insulating coating. Repair as necessary. (Ref. Para. 8.).

(3) Make sure identification plate for attachment.

(4) If the fuel heater is removed, do the inspection as follows:

(a) Examine bores of oil and outlet ports and fuel outlet port for damage on sealing surfaces.

(b) Examine fuel inlet port for damage to threads.

(c) Check for damage and correct installation of threaded inserts located at fuel outlet port and boss adjacent to oil inlet port. Replace threaded inserts as required (Ref. 70-00-00, STANDARD PRACTICES - REPAIR).

8. Approved Repairs

A. General

(1) Make sure all areas are cleaned and corrosion preventive treatment applied to aluminum surfaces, after doing minor repairs.

(2) Minor damage such as burrs, scores, scratches, nicks and other similar defects on sealing surfaces in oil and fuel ports may be cleaned up with a abrasive cloth (PWC05-061). Remove all high spots.

(3) Smooth minor surface defects on mounting lugs and other metal surfaces with a fine stone or Swiss file.

(4) Clean up minor thread damage in fuel inlet port or chase threads.

(5) Replace damaged or loose helical coil inserts (Ref. 70-00-00, REPAIR, Threaded Inserts).

B. Application of Anodic Surface Treatment

(1) The anodic anti-corrosion finish on exposed aluminum surfaces of oil-to-fuel heater may be repaired by local application of chemical treatment solution. This treatment must be used on areas where minor repairs have been done and on repaired threads. To apply treatment, proceed as follows:

WARNING: ALODINE SOLUTION IS EXTREMELY DANGEROUS. IT CONTAINS AN OXIDIZING INGREDIENT WHICH CAN CAUSE AN EXPLOSION IF IT COMES IN CONTACT WITH COMBUSTIBLE MATERIALS SUCH AS PAINTS AND SOLVENTS.

(a) Prepare surface by cleaning with solvent (PWC11-038). Keep surface wetted with cleaning agent for one to five minutes.

(b) Rinse with clean water to remove all traces of solvent.

(c) Apply chemical treatment solution (PWC05-166) to prepared surface by brush, swab or spray method and allow three to five minutes setting time.

(d) Rinse with clean water to remove all traces of excess chemical treatment solution and allow surface to air dry.

(e) Examine treated surface to make sure that repair area is completely covered. Reapply treatment as necessary.

C. Insulating Coating Repairs

(1) The flame retardant, insulating coating may be touched up with paint. Apply treatment:

(a) Clean surface with solvent (PWC11-024).

(b) Mix paint (PWC07-008) in accordance with manufacturer's instructions in an open container and only sufficient quantity for one application. Apply with a brush to exposed areas. Three coats should be applied with one hour drying between coats.

NOTE: Once mixed, the paint has a useful life of 45 to 60 minutes. Brushes and containers should be cleaned with solvent (PWC11-024) within 60 to 90 minutes after initial mixing of the two epoxy components.

(c) Examine treated surface to make sure that repair area is completely covered. Reapply treatment as necessary.

(d) Units shall be allowed to air dry at room temperature for an additional minimum 12 hour period before further handling.

9. Adjustment/Test

A. Oil-To-Fuel Heater

(1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and do checks associated with Installation/Replacement of Oil-to-fuel Heater (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

NOTE: Run engine above 72 % (Ng) until oil temperature stabilizes.

(2) Check the oil-to-fuel heater within 15 min. after engine shutdown for a high operating temperature. A heater fuel outlet or a fuel pump filter cover having a temperature above 140°F. (60°C.) after shutdown shows a heater that does not correctly operate. To measure the temperature of the oil-to-fuel heater, do one of the following procedures:

WARNING: MAKE SURE PROTECTIVE CLOTHING IS PUT ON WHEN MANUALLY CHECKING THE TEMPERATURE OF THE HEATER FUEL OUTLET OR THE FUEL PUMP FILTER COVER. THE OIL-TO-FUEL HEATER CAN GET HOT. THIS WILL PREVENT POSSIBLE INJURY TO PERSONNEL.

(a) Carefully feel the heater fuel outlet or the fuel pump filter cover.

1 If the temperature of the heater fuel outlet or the fuel pump filter cover feels unusually hot, replace the oil-to-fuel heater.

2 If a high temperature is not felt, remove the protective clothing and carefully check the heater fuel outlet or the fuel pump filter cover again. If the oil-to-fuel heater is operating correctly, the heater fuel outlet and the fuel pump filter cover should be comfortable to touch.

CAUTION: A NEW TEMPERATURE RECORDER MUST BE USED FOR EACH INSPECTION.

(b) Put a temperature recorder on the heater fuel outlet or the fuel pump filter cover. If the temperature recorder shows a temperature above 140°F. (60°C.), replace the oil-to-fuel heater.

NOTE: A temp-plate temperature recorder (PWC05-329) or similar can be used.

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Figure 201 Removal/Installation of Oil-to-Fuel Heater

73-10-02
FUEL PUMP - DESCRIPTION AND OPERATION

1. Description

The engine-driven fuel pump installation comprises a positive displacement gear-type pump and related parts, mounted on a pad at the 2 o'clock position on the rear face of the accessory gearbox. The pump incorporates spring and pressure loaded bushings and is shaft-driven off the accessory gearbox geartrain. A splined coupling is used to transmit the geartrain drive to the pump gears; the coupling splines are lubricated by oil mist from the gearbox via a hole in the associated gearshaft. Another coupling, on the other side of the pump gears, is used to transmit a speed signal to the fuel control unit (FCU).

2. Operation (Ref. Fig. 1)

Fuel from the oil-to-fuel heater enters the fuel pump chamber through a 74-micron (200 mesh) inlet screen. The inlet screen is spring-loaded and, should it become blocked, the increase in differential pressure overcomes the spring and allows unfiltered fuel to flow into the pump chamber. The pump gears increase the fuel pressure and deliver it to the FCU via a 10-micron filter in the pump outlet, and an external transfer hose assembly. Seepage fuel drain connection points are provided to conduct fuel to an airframe collection point. A bypass valve and cored passages in the pump body enables unfiltered high pressure fuel to flow to the FCU in the event of the outlet filter becoming blocked. An internal passage originating at the mating face of the FCU returns bypass fuel from the FCUmetering valve, directly into the pump gears. A pressure regulating valve in the bypass line serves to pressurize the bearings and direct excess bypass fuel to the pump fuel inlet downstream of the inlet screen.

The fuel pump is sized for starting requirements and has excess capacity for all steady running conditions.

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Figure 1 Fuel Pump

FUEL PUMP - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire unless otherwise specified shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Fuel, Engine
PWC03-001	Oil, Engine
PWC05-061	Cloth, Abrasive
PWC05-101	Cloth, Abrasive
PWC05-166	Solution, Treatment
PWC05-167	Grit, Abrasive
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-038	Solvent, Cleaning

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Servicing

A. Replacement of Filters (Ref. Fig. 201)

NOTE: A kit that contains four preformed packings is available from P&WC. The kit makes it easier to do the inspection/replacement procedure of the fuel pump filters. You can get the discharge filter independently from the kit (Ref. IPC).

(1) Removal of the fuel pump filters

(a) Remove discharge filter cover (9) from fuel pump (4).

(b) Remove filter element (7) and preformed packing (6). Discard the packing.

CAUTION: THE DISCHARGE FILTER ELEMENT IS DISPOSABLE AND MUST BE DISCARDED. DO NOT CLEAN.

(c) Inspect or discard filter element as necessary (Ref. Para. 8.).

(d) Remove and discard preformed packing (8) from cover (9).

(e) Remove the inlet filter cover (1) and attached filter assembly (3) with a 3/8 inch Allen wrench from the fuel pump (4). Do not disassemble parts.

(f) Remove and discard preformed packing (2) from inlet cover (1).

(2) Replacement of the Inlet Filter

CAUTION: WHEN INSTALLING INLET FILTER ASSEMBLY INTO ARGO-TECH PUMP HOUSING ASSEMBLY, MAKE SURE THE FILTER ELEMENT TOUCHES THE SEAT MACHINED IN HOUSING BEFORE YOU COMPRESS THE SPRING AND ENGAGE INLET FILTER COVER THREADS. DO A VISUAL INSPECTION TO MAKE SURE OF THE CORRECT INSTALLATION. THE TOP EDGE OF FILTER ELEMENT IS BELOW THE THREADS MACHINED IN PUMP HOUSING ASSEMBLY. IF NOT INSTALLED CORRECTLY, THE FILTER ELEMENT CAN HANG UP ON THE ELEMENT CENTERING LUGS. ALSO, THE TOP EDGE OF THE ELEMENT COULD PROTRUDE INTO THE THREADED PART OF THE HOUSING.

(a) Lubricate new preformed packing (2) with engine oil (PWC03-001). Install new preformed packing (2) in groove on inlet filter cover (1).

(b) Position cover (1) over spring, and thread cover with inlet filter assembly into pump housing. Turn in the cover (1) until the preformed packing (2) touches the housing (4). Continue to turn the cover (1) until you cannot see the cover packing (2) and the cover touches against fuel pump housing (4).

(c) When cover (1) is fully installed, and you cannot see the preformed packing and/or extrusion of preformed packing between cover (1) and fuel pump housing (4). Torque the cover 30 to 50 lbf.in.

(3) Replacement of the Discharge Filter

NOTE: In order to give surface film protection from abrasion, pinching or cutting damage during installation and assembly, coat the preformed packing with sufficient quantity of engine oil (PWC03-001). Make sure that the packing is fully wet.

(a) Lubricate new preformed packing (8) with engine oil (PWC03-001). Install new preformed packing (8) in seal groove around discharge filter cover (9).

(b) Lubricate new preformed packing (6) with engine oil (PWC03-001). Install new preformed packing (6) in seal groove of filter element (7).

CAUTION: DO NOT INSTALL OUTLET FILTER (7) IN OUTLET FILTER COVER (9), THEN TRY INSTALLATION OF FILTER AND COVER ASSEMBLY ONTO INTERNAL PUMP SPIGOT. FILTER DAMAGE CAN OCCUR AND CAUSE UNFILTERED FUEL TO ENTER THE SYSTEM.

(c) Insert filter element into fuel pump (4).

(d) Position cover (9) over end of filter element (7) and screw cover into fuel pump (4). Tighten cover above run-in force necessary to compress preformed packing (8), then torque cover 180 to 220 lbf.in., and lockwire.

6. Removal/Installation

A. Removal of Fuel Pump

(1) Optional: Remove oil-to-fuel heater (Ref. 73-10-01, OIL-TO-FUEL HEATER - MAINTENANCE PRACTICES).

NOTE: FCU and fuel pump can be removed by lowering fuel transfer tubes (11) into oil-to-fuel heater without removing oil-to-fuel heater.

(2) Remove fuel control unit (Ref. 73-20-00, Removal/Installation).

(3) Disconnect line from airframe-supplied fitting installed in seal drain port (15, Fig. 202). Suitably cap line connection and pump fitting.

(4) Remove bolts (13) and withdraw transfer tube assembly (11) from inlet port of fuel pump. Remove and discard preformed packing (12). Blank off inlet port of pump.

(5) Remove fuel outlet interconnecting hose (8) and suitably cap hose connections and nipple (7) in fuel pump.

(6) Support fuel pump (1), and remove self-locking nuts (2), washers (3), pump and support bracket (9), from accessory gearbox boss (3). Remove pump and discard gasket (2).

(7) If fuel pump is being replaced, remove parts for reassembly on replacement pump as follows:

(a) Remove straight nipple (7) and preformed packing (6) from outlet port of fuel pump. Install blanking plug in outlet port.

(b) Remove airframe-supplied fitting and preformed packing from drain port (15) of fuel pump and install blanking plug in drain port. If fitting is of elbow type, note angular position before removal.

B. Installation of Fuel Pump

CAUTION: ALL TRACES OF GREASE MUST BE REMOVED FROM PUMP COUPLING SPLINES. ONLY ENGINE OIL IS TO BE USED AS A LUBRICANT.

(1) When a replacement fuel pump is being installed, depreserve and assemble fittings prior to installation as follows:

NOTE: Depreservation is not required when original fuel pump is being installed.

(a) Remove blanking plugs from inlet and outlet ports of fuel pump.

(b) Connect a supply of filtered fuel (PWC01-001), at 5 to 15 psig, to inlet port of pump.

(c) Rotate drive shaft of pump for approximately one minute until clear fuel is ejected from outlet port.

(d) Remove rotation device, disconnect fuel supply and blank off inlet port.

(e) Install new, lubricated preformed packing (8, Fig. 202) on nipple (4) and install in fuel outlet port. Tighten 75 to 125 lb.in. Install suitable blanking cap.

(f) Install new, lubricated preformed packing on airframe-supplied fitting retained from previous pump and install fitting in seal drain port (15) of fuel pump. Tighten fitting (Ref. Aircraft Maintenance Manual). If fitting is of elbow type, position at same angle noted during removal. Install suitable blanking cap.

(2) Remove all traces of grease from gearshaft bore and pump driveshaft. Lubricate splines with engine oil only.

(3) Place gasket (4) on studs of accessory gearbox boss (5).

(4) Support fuel pump (1) and position on accessory gearbox boss. As pump is pushed on studs, carefully engage splines of driveshaft with corresponding splines in gearshaft in accessory gearbox. Fasten pump and support bracket (9) to gearbox with washers (3) and self-locking nuts (2). Tighten nuts 75 to 85 lb.in.

(5) Install P3 air tube loop clamp to support bracket (6) with bolt, spacer and nut. Tighten nut 36 to 40 lb.in.

(6) Install a new, lubricated preformed packing (12) in seal groove of fuel transfer tube (11).

(7) Remove blanking plug from inlet port of fuel pump and install transfer tube assembly (11). Check preformed packing (12) is not displaced from seal groove of tube.

(8) Install bolts (13) and torque bolts 36 to 40 lb.in. Lockwire bolts to flange of transfer tube assembly (11).

(9) Remove blanking caps from connection on fuel outlet interconnecting hose (8) and from nipple (7). Connect hose to nipple, but do not tighten until fuel control unit is installed.

(10) If installation of fuel pump has been done with engine installed; proceed as follows:

(a) Remove blanking caps from seal drain line and from airframe-supplied fitting in drain port (15) of fuel pump.

(b) Connect line to drain fitting and tighten coupling nuts. (Ref. Aircraft Maintenance Manual).

(11) Install fuel control unit (Ref. 73-20-00, Removal/Installation). Check interconnect hose between fuel pump outlet and fuel control unit is installed correctly without twisting. Tighten coupling nuts 170 to 200 lb.in.

CAUTION: WHEN FUEL PUMP IS INSTALLED, MAKE SURE THAT THE NEW PACKING (12) INSTALLED ON THE TRANSFER TUBE (11) IS NOT DAMAGED OR DISPLACED FROM SEAL GROOVE OF TUBE.

(12) Install oil-to-fuel heater (Ref. 73-10-01, OIL-TO-FUEL HEATER - MAINTENANCE PRACTICES).

(13) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do checks associated with Installation/Replacement of Fuel Pump (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

7. Cleaning/Painting

A. General

(1) Clean exterior surfaces of fuel pump with solvent (PWC11-027) or (PWC11-031). To prevent cleaning agent from entering unit, do not remove blanking caps and/or plugs.

(2) Wipe surfaces dry with clean, lint-free cloths and/or compressed air to remove all residual solvent and contamination.

B. Cleaning of Inlet Filter Element

(1) Supply solvent, (PWC11-027) or (PWC11-031) through a 10-micron filter at 30 psig, to outside of screen mesh. Rotate element during cleaning to ensure all areas of screen mesh are flushed.

NOTE: Contaminants will usually collect inside screen mesh at area of cone section where attachment bolt head is located.

(2) Reverse flush inlet filter element with solvent (PWC11-027) or (PWC11-031) to remove all contamination from screen mesh.

(3) Dry screen mesh using a blast of dry, clean, low-pressure air.

(4) Examine inlet filter element for cleanliness and, if necessary, repeat cleaning and reverse flushing operations until satisfactory.

8. Inspection/Check

A. General

(1) Examine mounting lugs for cracks and other damage. Cracks are not permissible; minor surface damage may be repaired.

(2) Examine machined mounting faces for gouges, nicks, scores, scratches and similar surface damage which can damage gasket between pump and accessory gearbox and/or prevent correct mating of fuel control unit to pump. Particular attention should be paid to seal recess at bypass port between studs in mounting face for fuel control unit. Remove any sharp/raised edges.

(3) Examine bore of inlet port for damage on sealing surface.

(4) Check studs for tightness and for damage to threads.

(5) Examine threaded inserts located in fuel inlet tube boss for tightness and damage.

(6) Examine seal seepage drain port and fuel outlet port adapter for damage to threads.

(7) Examine for leakage from seal drain port as follows:

(a) Coupling drive oil leaks should not exceed 3 cc per hour. If limits are exceeded, replace plain seal on AGB pad (Ref. 72-60-00, Removal/Installation).

(b) Fuel leaks should not exceed 30 cc per hour. If limits are exceeded, send fuel pump to supplier.

(8) Check drive coupling for axial movement. Coupling features a stop flange and retaining ring to prevent decoupling; there should be no axial movement.

(9) Examine splines on drive coupling for nicks, gouges and chips. Remove any sharp/raised edges.

(10) Examine external surfaces of pump for corrosion and for general condition of anodic treatment.

(11) Check for signs of leakage from joint between pump cover and pump housing. If leakage is evident, return for overhaul.

B. Inspection of Filter Elements

NOTE: Refer to Servicing, for replacement of filters.

(1) Examine inlet filter element for damage and/or breaks in screen mesh.

(2) Discharge filter is disposable and should be subjected only to examination for damage if life on part has not expired (Ref. 72-

C. Sundstrand Fuel Pump In-Situ Inspection

(1) Remove drain line and fitting from fuel pump drain port (Ref. Fig. 201).

CAUTION: IF A COTTON SWAB OR SIMILAR DEVICE IS USED FOR THE FOLLOWING INSPECTION, MAKE SURE NO FOREIGN MATTER REMAINS IN THE DRAIN PORT OR ASSOCIATED FITTINGS AND LINES.

(2) Insert a cotton swab, or equivalent, 1.0 to 1.5 in. deep into the drain port of the fuel pump (Ref. Fig. 203).

(3) Angle the cotton swab (Ref. Fig. 203) and roll it inside the drain port to collect evidence of a possible reddish-brown deposit (iron oxide).

(4) If no reddish-brown (iron oxide) stain is evident, the fuel pump may remain in service.

(5) If a reddish-brown (iron oxide) stain is evident:

(a) Remove fuel pump (Ref. Para. 6.).

(b) Examine the input coupling shaft area of the pump face (Ref. Fig. 201) for residue from fretting corrosion (iron oxide deposit). If none is present, the pump may remain in service.

(c) Evidence of corrosion residue indicates possible spline wear. Return the fuel pump to an approved overhaul facility.

(d) Install a replacement fuel pump (Ref. Para. 6.).

9. Approved Repairs

A. General

NOTE: Make sure all areas are cleaned and corrosion preventive treatment applied to aluminum surfaces after doing minor repairs. Do not let filings enter unit.

(1) Minor damage such as burrs, scores, scratches, nicks and similar surface defects may be removed with a fine stone and/or abrasive cloth (PWC05-061). Remove all sharp edges and high spots.

(2) Clean up minor thread damage in seal seepage drain port, and in fuel outlet port when adapter is removed, with a suitable Swiss file, or a 0.4375-20 UNJF-3B tap for drain port and 0.5625-18 UNJF-3B tap for outlet port.

(3) Clean up minor thread damage on studs with a suitable Swiss file, or chase threads using a 0.250-28 UNJF-3A die.

(4) Remove minor chips and nicks in edges of splines using a hard Arkansas stone.

(5) Replace damaged or loose threaded inserts, located in boss for fuel inlet tube (Ref. 70-00-00, REPAIR, Threaded Inserts).

B. Removal of Corrosion

(1) Light surface corrosion may be removed from pump housing and cover using one of the two methods outlined in following text. Severe corrosion, indicated by surface etching, is cause for rejection of pump, which must be sent for overhaul.

(a) Remove corrosion deposits by vapor blasting with abrasive grit (PWC05-167) or finer. Make sure areas adjacent to corrosion are masked to prevent damage.

(b) Remove corrosion deposits using abrasive cloth (PWC05-101) and (PWC05-061). Remove as little base metal as possible to remove corrosion.

(c) Apply anti-corrosion treatment to repaired area (Ref. Subpara. C.).

C. Application of Surface Treatment

(1) The anti-corrosion finish on pump housing and cover may be repaired by a local application of chemical treatment solution. This treatment must be used on areas where minor repairs have been done. Apply treatment, as follows:

(a) Prepare surface by cleaning with solvent (PWC11-038). Keep surface wetted with cleaning solvent for one to five minutes.

(b) Rinse with clean water to remove all traces of solvent.

WARNING: ALODINE SOLUTION IS EXTREMELY DANGEROUS. IT CONTAINS AN OXIDIZING INGREDIENT WHICH CAN CAUSE AN EXPLOSION IF IT COMES IN CONTACT WITH COMBUSTIBLE MATERIALS SUCH AS PAINTS AND SOLVENTS.

(c) Apply solution (PWC05-166) to prepared surface by brush, swab or spray, and allow three to five minutes setting time.

(d) Rinse with clean water to remove all traces of excess solution and allow surface to air dry.

(e) Examine treated surface and check that repair area is completely covered. Reapply treatment as necessary.

10. Adjustment/Test

A. Procedure

(1) Do checks associated with Installation/Replacement of Fuel Pump (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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Figure 201 Replacement of Fuel Pump Filters

Figure 202 Removal/Installation of Fuel Pump

Figure 203 Fuel Pump In-situ Inspection

73-10-03
FUEL DELIVERY TUBES - DESCRIPTION AND OPERATION

1. Description and Operation

The fuel supply to the engine is directed from the fuel pump to the fuel control unit (FCU) through a flexible interconnect hose, while the metered fuel from the FCU to the flow divider is directed through stainless steel lines.

The fuel interconnect hose assembly consists of a fluorocarbon plastic inner core with a stainless steel overbraiding and a fiberglass and synthetic rubber outer covering. The latter acts as a fireshield. Each end of the assembly is fitted with stainless steel fittings and coupling nuts.

Two preformed seamless tubes and spacer tube, with stainless steel end fittings, carry fuel forward from the to the rear fireseal mountring and connect with the front tube. The short spacer tube is supplied for shipping, and when removed, allows for a customer installed fuel flow transmitter.

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire unless otherwise specified shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine
PWC05-061	Cloth, Abrasive
PWC05-101	Cloth, Abrasive
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

CAUTION: WHEN REMOVAL OR INSTALLATION OF AN INDIVIDUAL ITEM IS REQUIRED, IT IS ESSENTIAL THAT TUBES ARE NOT SUBJECTED TO BENDING STRESSES. UNDER NO CIRCUMSTANCES BEND OR FORCE TUBES IN OR OUT OF POSITION. WHEN REMOVING ANY ONE TUBE, THE ADJACENT TUBE, COUPLING OR ELBOW, TOGETHER WITH SEAL RETAINING PLATES (IF APPLICABLE), MUST FIRST BE REMOVED, AND THE PROCEDURE REVERSED AT INSTALLATION.

A. Removal of Fuel Tubes

NOTE: To avoid contamination of work area, use a container to catch fluid when disconnecting fuel lines.

(1) Disconnect coupling nuts at each end of hose (1, Fig. 201) and remove hose from between FCU and fuel pump. Cap exposed connections.

(2) Remove bolts and nuts fastening ignition cable loop clamps to center fuel tube loop clamp, if applicable.

NOTE: Routing of engine ignition cables from rear fireseal to ignition exciter is dependent on left or right airframe installation (Ref. Aircraft Maintenance Manual).

(3) Turn electrical power OFF. Remove electrical leads from fuel flowmeter transmitter (21) (Ref. Aircraft Maintenance Manual).

(4) Note angular position of flowmeter transmitter for subsequent reassembly.

(5) Disconnect coupling nuts, and remove rear fuel tube (22) between FCU and spacer tube (20), or flowmeter transmitter (21), as applicable.

(6) Remove bolt fastening center fuel tube loop clamp (18) to accessory gearbox oil temperature sensor boss.

(7) Disconnect coupling nut (17) connecting center tube (18) to bulkhead fitting at rear mount ring.

(8) Remove center fuel tube (18) with spacer tube (20) or flowmeter transmitter (21) attached. Disconnect coupling nut of tube from spacer tube, or flowmeter transmitter, as applicable.

(9) Remove bolts (8 and 11), nut (9) fastening loop clamps (13 and 10) to No 2 bearing scavenge oil tube flange and ignition cable loop clamp (12) respectively.

NOTE: Retain clamp (12) with cable and move cable clear of fuel tube (2).

(10) Remove nut (16) and bolt (14) fastening loop clamp (15) to bracket at flange F on gas generator case. Leave loop clamp on tube.

(11) Remove jam nut (17) fastening front fuel tube to rear mount ring.

(12) Remove self-locking nuts (7) and bolts (3) fastening seal retaining plates (4), insulation plates (5) and seals (6) to center mount ring. Remove split insulation, insulation plates and seals from tube.

(13) Disconnect coupling nut from elbow on flow divider.

(14) Remove front seal retaining plate (4) from tube over coupling nut.

(15) Withdraw bulkhead coupling from rear mount ring, maneuver and remove front tube (2) rearward to clear center mount ring.

(16) Remove rear seal retaining plate (4) from tube.

(17) Install suitable caps/covers on exposed connections on FCU, flow divider valve and tube ends.

B. Installation of Fuel Tubes

(1) Install interconnect hose (1, Fig. 201) between fuel pump and FCU. Make sure hose fits snugly between FCU and fuel pump fittings without forcing or twisting, and that adequate clearances exist between hose and FCU interconnect rod. Tighten coupling nuts 170 to 200 lb.in., and lockwire.

(2) Install one seal retaining plate (4) over tube coupling nut onto front fuel tube (2).

(3) Insert front tube (2), coupling nut first, from the rear, through hole in center mount ring. Install second seal retaining plate (4) over tube coupling nut.

(4) Open slits and slide insulation plate (5) and seals (6) onto tube, each side of center mount ring underneath seal retaining plates (4). Locate seals next to mount ring.

NOTE: Aluminized face of insulation (4) to be adjacent to seal.

(5) Install front fuel tube bulkhead coupling through hole in rear fireseal and attach loosely with jam nut (17). Do not tighten.

(6) Attach the coupling nut of tube to flow divider and dump valve. Tighten the coupling nuts. Torque the coupling nuts 270 to 300 lbf.in. and install the safetywire.

(7) Tighten jam nut (17) 70 to 80 lb.in., and lockwire.

(8) Install retaining plates (4), insulation (5) and seals (6) to center mount ring with bolts (3), heads on air inlet side of mount ring, and self-locking nuts (7). Make sure slits in each insulation/seal pair are diametrically opposed. Tighten nuts until firm contact is made plus one half turn.

(9) Fasten loop clamp (10) to ignition cable loop clamp with bolt (12) and self-locking nut (9). Tighten 36 to 40 lb.in.

(10) Fasten loop clamp (15) to bracket at flange F with bolt (14) and self-locking nut (16). Tighten nut 36 to 40 lb.in.

(11) Fasten loop clamp (13) to No. 2 bearing scavenge oil tube flange with bolt (8). Tighten bolt 32 to 36 lb.in., and lockwire.

CAUTION: IF APPLICABLE TO TRANSMITTER TYPE, CHECK FOR PROPER DIRECTION OF FUEL FLOW.

(12) Loosely attach center fuel tube (18) to flowmeter transmitter (21), or spacer tube (20), as applicable.

(13) Loosely attach center rear fuel tube (22) to flowmeter transmitter (21), or spacer tube (20) as applicable.

(14) Install loosely assembled fuel tubes to FCU and to bulkhead coupling at rear mount ring. Align tubes, tighten end coupling at FCU and bulkhead coupling 270 to 300 lb.in. and lockwire.

(15) Install bolt and fasten loop clamp (19) to oil temperature and pressure sensing tee. Tighten bolt 36 to 40 lb. in.

(16) Set angular position of airframe-supplied flowmeter transmitter (21) as noted during removal, tighten coupling nuts 450 to 500 lb.in., and lockwire. If spacer tube (20) is installed, tighten coupling nuts 270 to 300 lb.in., and lockwire.

(17) Connect electrical leads (Ref. Aircraft Maintenance Manual).

(18) Check installation of fuel tubes (Ref. Adjustment/Test)

6. Cleaning/Painting

A. Cleaning of Interconnect Hose and Fuel Tubes

(1) Clean exterior of tubing by spraying with solvent (PWC11-027) or (PWC11-031), using a soft bristle brush, as necessary. Dry with compressed air, observing ventilation and fire safety precautions.

(2) Clean tubing interior by pressure flushing with solvent (PWC11-027) or (PWC11-031). Dry using clean, filtered, compressed air, taking particular care that no foreign matter remains in tubing.

(3) To prevent ingress of foreign matter, cap tube ends immediately after cleaning, until tube is to be installed on engine.

7. Inspection/Check

A. Inspection of Interconnect Hose

(1) Examine hose for cuts, crimping or buckling. Hoses with such defects must be replaced.

(2) Examine coupling nuts for cracks. Replace hose as necessary.

B. Inspection of Fuel Tube Assemblies

(1) Examine fuel tubes to the following limits:

(a) Minor scratches having no appreciable depth are acceptable. Scratches to 0.005 inch deep must be removed. Replace tubing with scratches over 0.005 inch deep.

(b) Individual nicks 0.062 inch long by 0.010 inch wide and 0.003 inch deep are acceptable. Nicks to a maximum depth of 0.005 inch must be smoothed to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(c) Round bottom dents on straight sections of tubing are permitted provided length and depth are not greater than 10 percent of nominal OD of tube. No more than one dent to a maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(d) Minor isolated pitting to 0.003 inch deep is acceptable. Clusters of pitting should be removed to a maximum a depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(e) Staining on tubing and surface corrosion is acceptable if removable by light polishing with crocus cloth (PWC05-061) and oil (PWC03-001)(Ref. Approved Repairs).

8. Approved Repairs

A. Repair of Fuel Tubes

(1) Smooth out small nicks with abrasive cloth (PWC05-061).

(2) Remove stains and/or corrosion by polishing with abrasive cloth (PWC05-101) and oil (PWC03-001).

9. Adjustment/Test

A. Procedure

(1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do checks associated with Installation/Replacement of Fuel Lines (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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Figure 201 Removal/Installation of Fuel Tubes

73-10-04
FLOW DIVIDER - DESCRIPTION AND OPERATION

1. Description

The flow divider is mounted on the fuel inlet manifold adapter at the six o'clock position on the gas generator case and incorporates a dump valve. The flow divider schedules the metered fuel from the FCU to the fuel manifold adapters as a function of primary manifold pressure. During engine start metered fuel is delivered initially by primary fuel manifolds, with the secondary cutting in above a preset value. All fuel manifolds are operative at above ground idle.

2. Operation

A. Flow Divider and Dump Valve (Ref. Fig. 1)

When the fuel cut off valve in the FCU closes during engine shutdown, a spring in the flow divider and dump valve overcomes the fuel inlet pressure and moves a piston within the body to block the fuel inlet port. This movement of the piston connects both primary and secondary manifolds to the dump valve port and lets residual fuel in the manifolds to drain to an airframe collection point. The unit is fitted with two elbow connectors for the inlet and drain functions.

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Figure 1 Flow Divider and Dump Valve

FLOW DIVIDER AND DUMP VALVE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire unless otherwise specified shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Fuel, Engine
PWC05-061	Cloth, Abrasive
PWC05-101	Cloth, Abrasive
PWC05-166	Solution, Chemical Treatment
PWC05-167	Grit, Abrasive
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-038	Solvent, Cleaning

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

CAUTION: WHEN REMOVAL OR INSTALLATION OF AN INDIVIDUAL ITEM IS REQUIRED, IT IS ESSENTIAL THAT TUBES ARE NOT SUBJECTED TO BENDING STRESSES. UNDER NO CIRCUMSTANCES BEND OR FORCE TUBES IN OR OUT OF POSITION. WHEN REMOVING ANY ONE TUBE, THE ADJACENT TUBE, COUPLING OR ELBOW, TOGETHER WITH SEAL RETAINING PLATES (IF APPLICABLE), MUST FIRST BE REMOVED, AND THE PROCEDURE REVERSED AT REINSTALLATION.

A. Removal of Flow Divider (Ref. Fig. 201)

NOTE: To avoid contamination of work area, use a container to catch fluid when disconnecting fuel lines, and during removal of flow divider.

(1) If flow divider (8, Fig. 201) is being removed with engine installed, disconnect line (12) from elbow (11). Suitably cap line connection and elbow.

(2) Disconnect fuel inlet line (3) from elbow (4) and suitably cap line connection and elbow.

(3) Support flow divider (8), and remove bolts (9) fastening valve to fuel manifold inlet adapter (1).

(4) Remove and discard preformed packings (2) from recesses in mounting face of valve.

(5) If flow divider (8) is being replaced, note angular positions of elbows (4 and 11), loosen nut(s) (5), and remove elbows. Discard back-up rings (6) and preformed packings (7). Install blanking plugs in ports.

B. Installation of Flow Divider (Ref. Fig. 201)

(1) When a replacement flow divider (1, Fig. 201) is being installed, depreserve, and install elbows as follows:

NOTE: Depreservation is not required when original flow divider is being installed.

(a) Remove shipping plugs from inlet and dump ports and drain as much preservation oil as possible. Make sure that the preservation oil is present if the unit is a replacement flow divider. If preservation oil is not present in the replacement flow divider, the unit must be returned to a P&WC approved overhaul facility for inspection.

(b) Flush out valve from dump port or air inlet end with fuel (PWC01-001), to remove all residual preservation oil. Continue flushing until clear fuel flows from manifold ports. Temporarily reinstall plug in dump or air inlet port.

(c) Install back-up ring (6) and preformed packing (7) on elbows (4 and 11).

(d) Remove plugs from inlet ports, install elbows (4 and 11), and position at angle noted during removal. Tighten jam nuts (5) 38 to 42 lb.in., and lockwire. Tighten tube nipple (12) 65 to 75 lb.in., and lockwire.

(e) To prevent ingress of foreign material, cap elbows and/or nipple until valve is ready for installation.

(2) Press preformed packings (2) into recesses at manifold ports in mounting face of valve (8).

(3) Position valve (8) on base of fuel manifold inlet adapter (1), align attachment holes and install bolts (9). Tighten bolts 32 to 36 lb.in., and lockwire bolts in pairs.

(4) Remove blanking caps from fuel inlet tube (3) and elbow (4) and connect tube to elbow. Tighten coupling nuts 90 to 100 lb.in., and lockwire.

(5) If installation of flow divider has been carried out with engine installed, remove blanking caps from dump/drain line and elbow (11), and connect air line to elbow. Tighten coupling nut 90 to 100 lb.in., and lockwire.

(6) Check function of flow divider (Ref. Adjustment/Test).

6. Cleaning/Painting

A. Cleaning of Flow Divider

(1) Clean exterior surfaces with solvent (PWC11-027) or (PWC11-031). To prevent cleaning agent from entering valve, do not remove blanking caps.

(2) Wipe surfaces dry with clean, lint-free cloths to remove all residual solvent and contamination.

7. Inspection/Check

A. Inspection of Flow Divider

(1) Examine mounting flange for cracks and other defects. Cracks are not permissible; minor surface damage may be repaired.

(2) Examine machined face of mounting flange for gouges, nicks, scores, scratches, and similar defects which can prevent correct mating of flange surface with fuel manifold inlet adapter. Particular attention should be paid to the two recesses for primary and secondary manifold port seals.

(3) If elbows have been removed, examine each port for thread damage.

(4) Check for signs of leakage at joint between valve housing and main body. If leakage is evident, return valve to supplier (Ref. IPC).

(5) Examine surfaces of valve for corrosion and for general condition of anodic treatment.

8. Approved Repairs

A. General

NOTE: Make sure all areas are clean and corrosion preventive treatment applied to surfaces after doing minor repairs. Do not allow debris to enter valve.

(1) Minor damage such as burrs, nicks, scores, scratches and other similar defects, may be removed with a fine stone or abrasive cloth (PWC05-061). Remove all high spots and sharp edges.

(2) Minor defects on machined face of mounting flange may be removed by lightly dressing with abrasive cloth (PWC05-061) held to a true flat plate.

(3) Clean up minor thread damage in inlet and air inlet ports with a 0.4375-20 UNJF-3B tap.

(4) Clean up minor thread damage on elbow fittings or chase threads with appropriate size die.

B. Removal of Corrosion

(1) Light surface corrosion may be removed from main body and valve housing by one of the following methods:

(a) Vapor blasting with abrasive grit (PWC05-167) or finer. Make sure areas around corrosion are masked to prevent damage to surrounding parts.

(b) Carefully polishing with abrasive cloth (PWC05-101), followed by (PWC05-061).

(2) Apply anti-corrosion treatment to repaired area.

C. Application of Anodic Surface Treatment

(1) The anodic anti-corrosion finish on surfaces of main body and valve housing may be repaired by local application of chemical treatment solution. This treatment must be used on areas where minor repairs have been carried out by local smoothing and/or polishing. To apply treatment, proceed as follows:

(a) Prepare surface by swabbing with solvent (PWC11-038). Keep surface wetted with cleaning agent for one to five minutes.

(b) Rinse with clean water to remove all traces of cleaning agent.

WARNING: ALODINE SOLUTION IS EXTREMELY DANGEROUS. IT CONTAINS AN OXIDIZING INGREDIENT WHICH CAN CAUSE AN EXPLOSION IF IT COMES IN CONTACT WITH COMBUSTIBLE MATERIALS SUCH AS PAINTS AND SOLVENTS.

(c) Apply chemical treatment solution (PWC05-166), to prepared surface by brush, swab, or spray method and allow three to five minutes setting time.

(d) Rinse with clean water to remove all excess chemical treatment solution and allow surface to air dry.

(e) Examine coating and make sure repair area is completely covered. Reapply treatment as necessary.

9. Adjustment/Test

A. Procedure

(1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do checks associated with Installation/Replacement of Flow Divider (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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Figure 201 Removal/Installation of Flow Divider

73-10-06

FUEL DRAIN VALVE - DESCRIPTION AND OPERATION

1. Description and Operation

The drain valve installation comprises a valve and gasket installed in the gas generator case at the 6 o'clock position, adjacent to Flange C. The valve lets all residual fuel accumulated in the bottom of the gas generator case to drain to an airframe collection point when the engine is shut down. The valve also accommodates any residual drainage from the bottom of the exhaust duct via a small hole in the bottom of the duct rear cone immediately in front of the valve. The drain is closed during engine operation by P3 air pressure against the spring-loaded valve.

FUEL DRAIN VALVE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire, unless otherwise specified shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-061	Cloth, Abrasive Coated Crocus
PWC06-004	Compound, Antiseize
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Drain Valve (Ref. Fig. 201)

(1) If drain valve is being removed with engine installed, disconnect airframe line (7, Fig. 201) from adapter (6), and install a suitable blanking cap on line connection.

(2) Remove adapter (6) from gas generator case. Remove and discard gasket (5).

(3) Remove retaining ring (2) from groove in bore of adapter (6) and withdraw valve (3) and spring (4).

B. Installation of Drain Valve (Ref. Fig. 201)

(1) Insert spring (4, Fig. 201) into bore of adapter (6).

(2) Position valve (3), flat side out, over spring (4). Press valve into adapter (6) and install retaining ring (2).

(3) Install the gasket (5) on large end of the adapter (6).

(4) Apply a thin coat of compound (PWC06-004) to threads at large end of the adapter (6).

(5) Install the adapter (6) in the gas generator case. Torque the adapter 450 to 550 lbf.in. DO NOT lockwire.

NOTE: You must do the final torque and lockwire of the adapter (6) after an engine wet motoring run (Ref. Adjustment/Test).

(6) If installation of drain valve has been done with engine installed, remove blanking cap from line connection and connect airframe drain to adapter. Tighten coupling nuts (Ref. Aircraft Maintenance Manual).

(7) Check function of drain valve (Ref. Adjustment/Test)

6. Cleaning/Painting

A. Procedure

(1) Clean all parts with solvent (PWC11-027) or (PWC11-031) and dry with filtered compressed air and/or clean, lint-free cloths.

7. Inspection/Check

A. Inspection of Drain Valve

(1) Examine valve surface for nicks, gouges, scores, scratches and burrs. Particular attention must be given to sealing surface around counterbore in spring side of valve.

(2) Check six drain holes in valve are clear and unobstructed. Holes which are blocked may be cleared by passing a 0.042 in. (No. 58) drill through by hand.

(3) Examine adapter for thread damage.

(4) Check centerbore in adapter is clear and unobstructed. Blockage may be cleared by passing a 0.246 in. (letter D) drill through by hand.

(5) Examine large bore of adapter for surface defects, especially on sealing surface of projection.

B. Inspection of Spring

(1) Check for distortion. Spring must pass freely over a 0.530 in. dia. gage rod and through a 0.600 in. dia. gage tube. Reject if distorted.

(2) Check compression loading of spring. Load required to compress spring to 0.250 in. length should be 4 oz. to 8 oz. Reject spring if load is not within limits.

(3) Examine spring for uniformity of coil spacing. Check surfaces are free from imperfections such as pits, scratches, nicks and other defects which may be detrimental to the fatigue resistance of spring.

8. Approved Repairs

A. Procedure

(1) Repair of drain valves is limited to removal of minor surface defects such as nicks, burrs, scratches, scores and gouges with a fine stone, and/or polishing with abrasive cloth (PWC05-061). Remove all sharp edges and high spots. Thread damage on adapter may be cleaned up with a suitable Swiss file or by chasing with appropriate size die. Prior to installation of adapters, check that threads in bosses on gas generator case are not damaged; clean up as necessary.

9. Adjustment/Test

A. Operation

(1) During the next engine test, do a wet motoring run (Ref. 71-00-00, ADJUSTMENT/TEST) and check the operation of the drain valve. The correct operation of the valve will be identified by the fuel flow from the drain line.

(2) If fuel does not flow from drain valve, remove the valve that does not flow, clean and install the valve again. Do a wet motoring run again and check the operation of the valve.

B. Procedure after Test

(1) Disconnect airframe drain lines from adapter.

(2) Loosen adapter two or three turns, and tighten 450 to 550 lb.in.

(3) Lockwire adapter to lug on gas generator case boss and reconnect airframe drain line(s).

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Figure 201 Removal/Installation of Fuel Drain Valves

73-10-07
COMPRESSOR DELIVERY AIR LINES - DESCRIPTION AND OPERATION

1. Description and Operation

Compressor discharge air (P3), derived from the diffuser section of the gas generator case, is routed to the metering section of the fuel control unit (FCU) through external lines and a fine-screen filter. The system consists of two tube assemblies, one on each side of the air filter housing.

The front tube assembly incorporates a flanged elbow fitting at its front for connection to the P3 boss at the 4 o'clock position on the gas generator case, and a coupling nut at its rear for connection to a long straight nipple in the air filter housing. The tube assembly is constructed from stainless steel, encased in a shrunk-on rubber insulation sheath, and carries unfiltered P3 air to the filter housing.

The rear tube assembly, of similar construction to the front tube, incorporates coupling nuts at both ends for connection to the air filter housing and the FCU.

The air filter housing is secured to the compressor inlet case and additionally functions as the rear adapter for the pressure oil line to No. 2 bearing and the reduction gearbox. Although there is no physical connection between the two systems, the proximity of the pressure oil ensures that P3 air is held to a fairly constant temperature. The disposable air filter element is contained in a removable, threaded cover fastened to the filter housing.

During compressor wash, P3 air pressure is low, and the valve is spring loaded open to allow cleaning fluid to drain. As engine speed builds, P3 air pressure increases and closes the valve.

COMPRESSOR DELIVERY AIR LINES - MAINT. PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-007	Fluid, Check
PWC05-061	Cloth, Abrasive Coated Crocus
PWC08-002	Adhesive, Fluorosilicone
PWC09-001	Sealant, Silicone Rubber
PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name
Cleaner, Electrosonic

5. Servicing

A. General

Servicing of the compressor delivery air lines installation is confined to cleaning or replacement of the air filter element. Frequency of element servicing is done in accordance with 72-00-00, INSPECTION, Periodic Inspection. Indications of need to change/clean element are, no or slow response to power control lever movements during engine run when it is known there are no leaks or restrictions in the pneumatic system. It is recommended, therefore, that operators monitor engine performance/handling characteristics and derive their own cleaning/replacement schedules. A filter replacement kit with unlimited shelf life is available.

B. Replacement of P3 Air Filter (Ref. Fig. 201)

NOTE: The following covers only replacement of the air filter element. The air filter housing is also utilized by the oil system. For removal or installation of the housing, refer to 79-20-01, Removal/Installation.

(1) Remove filter cover (6) and preformed packing (7).

(2) Pull down and remove air filter element (9) from locating spigot (11) inside air filter housing (12).

NOTE: The filter element is normally a permanent (stainless steel) type and is intended to be cleaned ultrasonically at an approved overhaul facility. However, the filter may be cleaned (washed) electrosonically at field level (Ref. Cleaning/Painting). Make sure element is stored in clean, dust-free container after cleaning.

(3) Remove and discard preformed packings (8 and 10) at inner end of filter element.

(4) Mask opening of air filter housing (12) to prevent ingress of foreign material.

(5) Remove protective masking from opening of air filter housing and check for cleanliness.

(6) Install new preformed packings (8 and 10) at inner end of serviceable air filter element (9). Push element onto spigot (11) inside air filter housing (12) as far as it will go.

CAUTION: DO NOT OVERTIGHTEN FILTER COVER.

(7) Make sure air filter cover (6) is clean and free of any foreign material. Install new preformed packing (7) on air filter cover (6). Lubricate preformed packing with oil (PWC03-001), and screw cover into air filter housing (12) by hand. Tighten 60 to 70 lb. in. DO NOT lockwire.

(8) Leak test fuel control pneumatic system (Ref. Adjustment/Test).

(9) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do check(s) associated with Installation/Replacement of P3 Air Filter (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

(10) Lockwire air filter cover (6) when no leaks have been detected or found.

6. Removal/Installation

CAUTION: WHEN REMOVAL OR INSTALLATION OF AN INDIVIDUAL ITEM IS REQUIRED, IT IS ESSENTIAL THAT TUBES ARE NOT SUBJECTED TO BENDING STRESSES. UNDER NO CIRCUMSTANCES BEND OR FORCE TUBES IN OR OUT OF POSITION. WHEN REMOVING ANY ONE TUBE, THE ADJACENT TUBE, COUPLING OR ELBOW, TOGETHER WITH SEAL RETAINING PLATES (IF APPLICABLE), MUST FIRST BE REMOVED, AND THE PROCEDURE REVERSED AT REINSTALLATION.

A. Removal of Compressor Delivery Air Lines

(1) Remove bolt (3, Fig. 202) and self-locking nut (11) fastening loop clamp (2) to support bracket (12). Leave loop clamp on rear tube assembly (1).

(2) Disconnect coupling nuts and remove rear tube assembly (1) from between FCU and filter housing (13).

(3) Remove self-locking nut (8) and bolt (3) fastening loop clamp (5) of front tube assembly (9) and bracket (4) mounted on gas generator case. Leave clamp on tube assembly.

(4) Disconnect rear coupling nut and remove front tube assembly (9) from filter housing (10), forward of rear mounting.

(5) Remove bolts (7) fastening front tube assembly (9) and gasket (6) to gas generator case. Discard gasket.

(6) Install suitable protective caps/covers on tubes and openings.

B. Removal of Air Filter Housing Drain Valve (Ref. Fig. 201)

(1) Remove filter cover (6) and discard preformed packing (7).

(2) Remove drain valve adapter (1) and discard preformed packing (2).

(3) Remove retaining ring (5), drain valve (4) and spring (3).

C. Installation of Compressor Delivery Air Lines

NOTE: It is important to ensure that all solid P3 lines are properly and correctly fitted before the coupling nuts are tightened. The coupling nuts should be seated without the use of tools (finger tight) before torquing. The installation of any brackets or clamps should not distort the line in any way.

(1) Install front tube assembly (9, Fig. 202) between P3 port on gas generator case and nipple on P3 air filter housing (10). Install gasket (6) under flange and loosely attach flange to gas generator case with bolts (7). Do not tighten coupling nut at rear of tube.

NOTE: Do not lockwire components until completion of pressure test (Ref. Adjustment/Test).

(2) Install rear tube assembly (1) between fitting at P3 input port on FCU and filter housing (10), passing tube assembly between fuel interconnect hose and fuel pump. Tighten coupling nuts 90 to 100 lb.in.

(3) Fasten loop clamp (2) and rear tube to bracket (12), with bolt (3) and self-locking nut (11). Tighten nut 36 to 40 lb.in.

(4) Leak test fuel control pneumatic system (Ref. Adjustment/Test).

D. Installation of Air Filter Housing Drain Valve (Ref. Fig. 201)

(1) Install spring (3), drain valve (4) into adapter (1) and install retaining ring (5). Make sure valve moves smoothly and freely, and that retaining ring is installed properly.

CAUTION: COVER (6) MUST NOT BE INSTALLED IN FILTER HOUSING WHEN YOU TIGHTEN THE ADAPTER.

CAUTION: THE P3 FILTER COVER IS MADE FROM ALUMINUM ALLOY. TAKE CARE NOT TO DAMAGE THE COVER ASSEMBLY WHEN LOCKWIRING THE DRAIN VALVE ASSEMBLY TO THE COVER ASSEMBLY. BEFORE LOCKWIRING, EXAMINE THE LOCKWIRE ATTACHMENT HOLES ON THE COVER ASSEMBLY FOR EVIDENCE OF TEARING. IF TEARING IS EVIDENT, SECURE LOCKWIRE TO AN ALTERNATE SERVICEABLE LOCATION (REF. 70-00-00, STANDARD PRACTICES - MAINTENANCE PRACTICES).

(2) Install preformed packing (2) on adapter (1), and install valve assembly in cover. Torque adapter (1) 225 to 250 lb. in. and lockwire to cover.

(3) Install preformed packing (7) on filter cover (6). Lubricate threads of cover with oil (PWC03-001) and install in filter housing. Torque cover 60 to 70 lb. in.

(4) Leak test fuel control pneumatic system (Ref. Adjustment/Test).

(5) Lockwire air filter cover (6) when no loaks have been detected or found.

7. Cleaning/Painting

A. Cleaning of P3 Air Filter (Ref. Fig. 203)

(1) Place P3 filter element vertically, with open end of element at bottom, in cleaning tank or suitable electrosonic cleaner, generating less than 10 kHz.

(2) Pour sufficient quantity of solvent (PWC11-014) into tank to a level approximately 1/4 inch below top.

(3) Operate cleaner for 10 minutes.

(4) Turn element 180 degrees (open end of element at top).

(5) Operate cleaner for five minutes.

(6) Turn element to original position in tank (Ref. Step (1)).

(7) Operate cleaner for five minutes.

NOTE: Cleaning duration should be adjusted to suit condition of filter element. However, for optimum results, cleaning solvent should be replaced every 20 minutes.

(8) Wear clean, lint-free gloves and remove element from tank.

(9) Dry element with clean, dry compressed air (30 psi).

(10) Inspect filter element (Ref. Inspection/Check).

(11) Vibropeen cleaning date on end cap.

(12) Store cleaned filter elements in clean polyethylene bags until required for installation.

B. Cleaning of Air Tubes

(1) Pressure flush tubes with solvent (PWC11-027) or (PWC11-031).

(2) Dry interior and exterior of tubes using clean, dry compressed air.

(3) Cap open ends to prevent ingress of dirt, oil or other contaminants until tubes are required for installation.

C. Cleaning of Air Filter Housing Drain Valve Adapter (Ref. Fig. 201)

(1) Clean adapter (1), spring (3), and valve (4) with solvent (PWC11-027) or (PWC11-031) and non-metallic bristle brush.

8. Inspection/Check

A. Inspection of Air Tubes

(1) Examine air tubes (Ref. 70-00-00, INSPECTION, Inspection of Fuel, Oil and Air Tubes).

(2) Examine insulation for cuts in outer rubber sheath. Surface cuts up to three inches long may be repaired (Ref. Approved Repairs).

B. Inspection of Air Filter Element

(1) Inspect air filter element at intervals recommended in Chapter 72-00-00, INSPECTION, Periodic Inspection. Filter must be free of visible heavy contamination, and should not provide undue restriction when blown through. If repeated electrosonic cleaning (Ref. Cleaning/Painting) fails to restore filter to an acceptable condition, filter element should be shipped to an approved overhaul facility for ultrasonic cleaning and flow checking.

(2) Use a 10x magnifying glass to inspect the filter element for detachment of end cap or broken wires. Reject element if any of these conditions are evident.

C. Inspection of Air Filter Housing Drain Valve Adapter (Ref. Fig. 201)

(1) Filter Cover (6):

(a) Check lockwire holes for damage (tearing, cracks).

(b) Check threads for damage.

(c) Check that contact area is free of nicks and/or scratches.

(2) Drain Valve Adapter (1):

(a) Check threads for damage.

(b) Check contact area is free of nicks and/or scratches.

(c) Check flats and lockwire holes are free of damage.

(d) Check retaining ring groove. Reject if damaged or worn.

(3) Drain Valve (4):

(a) Check contact area is free of nicks and/or scratches.

(b) Make sure drain holes are clear and unobstructed.

(4) Valve Spring (3):

(a) Check for corrosion and/or damage. Reject if unsatisfactory.

(5) Retaining Ring (5):

(a) Check for distortion. Replace if distorted.

9. Approved Repairs

A. Repair of Cuts in Tube Insulation

(1) Apply adhesive sealant (PWC08-002) or (PWC09-001) to damaged area of external rubber sleeve of insulated sections of tube in accordance with sealant manufacturer's instructions.

NOTE: If cut is close to maximum allowable, it may be necessary to bind the area lightly with plastic covered wire, after application of sealant, to keep cut closed. Remove wire after adhesive sealant has cured.

(2) Allow adhesive sealant to cure at room temperature for 24 hours.

(3) After curing, trim excess sealant as necessary.

B. Repair of Tubes

(1) Remove small nicks with abrasive cloth (PWC05-061).

(2) Remove corrosion by polishing with abrasive cloth (PWC05-061) and oil (PWC03-001).

10. Adjustment/Test

A. Testing of Fuel Control Pneumatic System

NOTE: Pneumatic system must be tested after removal/installation of lines, or components within, or associated with lines.

(1) Remove bolts (7, Fig. 202) which fasten the front tube assembly (9) to the gas generator assembly. Loosen the coupling nut at the rear of the tube assembly and remove the tube from the air filter housing. Remove gasket (6). Install suitable covers over the tube ends.

(2) Remove nut (8) and bolt (3) which fasten the front tube assembly (9) to the bracket assembly (4).

(3) Connect clean, dry compressed air at 75 to 85 psig to the air filter housing long nipple (Ref. Fig. 204).

(4) Apply leak check fluid (PWC05-007) to all connecting points throughout the pneumatic system. No leaks are permitted, other than from the bleed holes in the fuel control unit and propeller governor.

NOTE: 1. For minor leakage (Ref. NOTE 2) through the drain hole in the P3 filter drain adapter.

NOTE: 2. Excessive leakage at the P3 drain valve port may result in unacceptable engine starting or acceleration

(2) Remove nut (8) and bolt (3) which fasten the front tube assembly (9) to the bracket assembly (4).

(3) Connect clean, dry compressed air at 75 to 85 psig to the air filter housing long nipple (Ref. Fig. 204).

(4) Apply leak check fluid (PWC05-007) to all connecting points throughout the pneumatic system. No leaks are permitted, other than from the bleed holes in the fuel control unit and propeller governor.

NOTE: 1. For minor leakage (Ref. NOTE 2) through the drain hole in the P3 filter drain adapter.

NOTE: 2. Excessive leakage at the P3 drain valve port may result in unacceptable engine starting or acceleration characteristics.

(5) If leaks are detected, the affected parts must be inspected for defects before retightening. Replace defective parts. If no defects are found, retighten the connection and repeat the leak test.

(6) When no leaks are detected, wipe all leak checking fluid from the connecting parts throughout the system.

(7) Disconnect the air supply from the long nipple at the air filter housing.

(8) Install gasket (6) on the front tube assembly (9), and secure to the gas generator case with bolt (7). Tighten the coupling nut 90 to 100 lb.in. Tighten bolts (7) initially 15 to 20 lb.in., and then 32 to 36 lb.in. Lockwire the coupling nut and complete lockwiring of all connections throughout the pneumatic system.

NOTE: Do not lockwire the flange bolts (7) at this stage.

(9) Fasten the front tube loop clamp (5) to the bracket assembly (4), mounted on the gas generator case, with a self-locking nut (8) and bolt (3). Tighten the nut 36 to 40 lb.in.

(10) Perform an engine start and ground run (Ref. 71-00-00). Check for leaks at the junction of the front assembly tube and the gas generator case.

(11) If the air filter has been cleaned/repaired, do an engine acceleration test (Ref. 71-00-00, ADJUSTMENT/TEST). Reject filter if acceleration test fails after repeated cleaning.

(12) Check the installation of the air tubes (Ref. Adjustment/Test).

(13) After the ground run, retighten the flange bolts at the gas generator case boss and lockwire.

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Figure 201 Removal/Installation of P3 Air Filter Element

Figure 202 Removal/Installation of Compressor Delivery Air Lines

Figure 203 Cleaning of P3 Air Filter Element

Figure 204 Fuel Control Pneumatic System Pressure Test - Typical

73-10-08
GOVERNOR PNEUMATIC TUBES - DESCRIPTION AND OPERATION

1. Description and Operation

The power turbine control air (Py) is routed through an external line from the metering section of the FCU. The line consists of two stainless steel tube assemblies; the front assembly incorporates coupling nuts at each end for connection to the propeller governor (front) and to a bulkhead fitting in the center fireseal mount ring (rear).

The second tube assembly incorporates coupling nuts at each end for connection to the FCU (rear) and the center fireseal mount ring bulkhead fitting (front). A slot and retaining plate permit easy removal at the rear mount ring. The assembly is constructed from stainless steel tubing with a shrunk-on rubber insulating sheath.

A tube assembly connects from the tee fitting on the front tube assembly to the torque limiter solenoid valve. A second tube assembly connects from the solenoid valve to the torque limiter. These tubes route the Py air pressure through the solenoid valve (when it is energized) to the torque limiter.

GOVERNOR PNEUMATIC TUBES - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine
PWC05-061	Cloth, Abrasive Coated Crocus
PWC05-101	Cloth, Abrasive
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

CAUTION: WHEN REMOVAL OR INSTALLATION OF AN INDIVIDUAL ITEM IS REQUIRED, IT IS ESSENTIAL THAT TUBES ARE NOT SUBJECTED TO BENDING STRESSES. UNDER NO CIRCUMSTANCES BEND OR FORCE TUBES IN OR OUT OF POSITION. WHEN REMOVING ANY ONE TUBE, THE ADJACENT TUBE, COUPLING OR ELBOW, TOGETHER WITH SEAL RETAINING PLATES (IF APPLICABLE), MUST FIRST BE REMOVED, AND THE PROCEDURE REVERSED AT REINSTALLATION.

A. Removal of Governor Air Tubes

(1) Disconnect torque limiter air tube (10) at torque limiter and solenoid valve (17).

(2) Remove self-locking nut (13) and bolt (11) which secure loop clamp (12) to support bracket at engine mounting bracket (Ref. Detail H). Remove self-locking nut attaching angle bracket to engine mounting bracket. Retain support bracket and loop clamp with torque limiter air tube (10).

(3) Disconnect solenoid valve air tube (16) at tee fitting of front tube (9) and solenoid valve (17).

(4) Remove self-locking nut (13) and bolt (11) which secure loop clamp (12) to support bracket at Flange A (Ref. Detail J). Remove self-locking nut attaching angle bracket to Flange A. Retain support bracket with solenoid valve air tube (16) and reinstall self-locking nut at Flange A. Retain loop clamp on solenoid valve air tube (16).

(5) Remove self-locking nut (13) and bolt (11) which secure loop clamps (12) on governor air pressure front tube assembly (9) to support brackets at Flanges A and C (Ref. Details C and D). Remove self-locking nuts attaching angle brackets to Flanges A and C. Retain support brackets with front tube assembly (9) and reinstall two self-locking nuts at Flanges A and C. Retain loop clamps on front tube assembly (9).

(6) Disconnect front tube assembly (9) coupling nut from rear tube (15) (Ref. Detail B) and from propeller governor. Remove front tube assembly (9).

(7) Remove self-locking nuts (1) and bolts (6) which secure the seal retaining plates (2), insulation (3), seals (4) and retaining plate (5) to the rear fireseal mount ring. Lift out plate (5) (Ref. Detail A).

(8) Disconnect coupling nuts of the governor air pressure insulated rear tube assembly (15) from the fuel control unit elbow. Disconnect jam nuts (7) which secure the tube assembly (15) to the center fireseal mount ring.

(9) Remove nut (13) and bolt (11) which secure the loop clamp (12) to bracket (14) on the accessory gearbox (Ref. Detail E).

(10) Remove upper tube assembly of compressor wash spray ring (Ref. 72-30-02, Removal/Installation).

(11) Lift out and remove insulated rear tube assembly (15) from the rear fireseal slot. Remove seal retaining plates (2), seal insulation plates (3) and air line seals (4) from tube assembly.

B. Installation of Governor Air Tubes

(1) Install front air tube (7, Fig. 201) between center fireseal mount ring bulkhead coupling (6) and propeller governor. Tighten coupling nuts 90 to 100 lb.in.

NOTE: It is important to make sure that all solid air lines are properly and correctly fitted before the coupling nuts are tightened. The coupling nuts should be seated without the use of tools (finger tight) before torquing. The installation of any brackets or clamps should not distort the line in any way.

(2) Install front air tube loop clamps (12) to angle brackets at flanges A and C (Detail C and D), with bolts (11) and self-locking nuts (13). Tighten nuts 36 to 40 lb.in.

(3) Slide one retaining plate (2) onto rear air tube (15) and move plate to rear. Loosely position tube in slot in rear fireseal mount ring and slide on second retaining plate (2).

(4) Position insulation (3) and seals (4) on each side of mount ring by opening up slits and passing parts around tube. Make sure slits in insulation and seal are diametrically opposed.

(5) Connect rear air tube (15) to FCU. Tighten coupling nut 90 to 100 lb.in. Fasten loop clamp (14) to accessory gearbox bracket with self-locking nut and bolt. Tighten nut 36 to 40 lb.in.

NOTE: It is important to ensure that all P3 lines are properly and correctly fitted before the coupling nuts are tightened. The coupling nuts should be seated without the use of tools (finger tight) before torquing. The installation of any brackets or clamps should not distort the tube in any way.

(6) Insert slot sealing plate (5) to rear of mount ring between seals (4), to restore mount ring contour. Make sure joggle in plate enters slot. Slide seals, insulation (3) and retaining plates (2) up to mount ring. Install bolts (6), heads to front, and self-locking nuts (1). Tighten nuts until firm contact is made plus one half turn.

(7) Install torque limiter air tube (10) between solenoid valve (17) and torque limiter. Torque coupling nut at the solenoid valve end of the tube 70 to 80 lb.in. Torque coupling nut at the torque limiter end of the tube 90 to 100 lb.in.

(8) Secure clamp (12) on torque limiter tube (10) to support bracket on flange C mounting bracket with bolt (11) and self-locking nut (13). Torque nut 36 to 40 lb.in.

(9) Install solenoid valve air tube (16) between solenoid valve (17) and tee fitting on front tube assembly (9). Torque coupling nuts

(10) Secure clamp (12) on solenoid valve air tube (16) to support bracket on flange C with bolt (11) and self-locking nut (13). Torque nut 36 to 40 lb.in.

(11) Perform leak test (Ref. Adjustment/Test).

(12) Following satisfactory completion of pressure test, lockwire all coupling nuts, bulkhead coupling and jam nut.

(13) Install upper tube assembly of compressor wash spray ring (Ref. 72-30-02, Removal/Installation).

6. Cleaning/Painting

A. Cleaning of Air Tubes

CAUTION: DURING CLEANING, MAKE SURE SOLVENT DOES NOT CONTACT RUBBER INSULATED SECTIONS.

(1) Pressure flush tubes with solvent (PWC11-027) or (PWC11-031).

(2) Dry interior and exterior of tubes using clean, dry compressed air.

(3) Cap open ends to prevent ingress of dirt, oil or other contaminants until tubes are required for installation.

7. Inspection/Check

A. Inspection of Air Tubes

(1) Examine insulation for cuts in outer rubber sheath. Surface cuts up to three inches long may be repaired (Ref. 73-10-07, Approved Repairs).

(2) Examine exposed sections of air tubes:

1. Minor scratches having no appreciable depth are acceptable. Scratches 0.005 inch deep should be smoothed. Replace tube assembly if scratches exceed 0.005 inch deep.
2. Individual nicks 0.062 inch long by 0.010 inch wide and 0.003 inch deep are acceptable. Nicks 0.005 inch deep should have sharp edges removed.
3. Round bottom dents on straight sections are acceptable provided length and depth are not greater than 10 percent of tubing OD. No more than one dent, to max. depth, per 12 inch length of tubing is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.
4. Isolated minor pitting is acceptable provided it is not more than 0.003 inch deep. Clusters of pits not exceeding 0.005

5. Staining on tubing and surface corrosion should be removed by light polishing with abrasive cloth (PWC05-061) or (PWC05-101) and oil (PWC03-001). Any stain or corrosion that does not respond to this treatment is unacceptable.

8. Approved Repairs

A. Procedure

(1) Repair damaged insulation on air pressure rear tube (Ref. 73-10-07, Approved Repairs).

9. Adjustment/Test

A. Procedure

(1) After installation of pneumatic lines, or individual components within lines, or components associated with lines, pressure test the pneumatic system (Ref. 73-10-07, Adjustment/Test).

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Figure 201 Removal/Installation of Governor Air Tubes

TORQUE LIMITER AND SOLENOID VALVE - DESCRIPTION AND OPERATION

1. General

The torque limiter is installed in the torquemeter pressure transmitter boss on the front case of the reduction gearbox. The normally closed solenoid valve is installed on the torque transmitter static port on the reduction gearbox.

2. Description and Operation

The torque limiter incorporates a sealed bellows connected directly to the torquemeter oil pressure output, a pivoted platform, a Py bleed orifice and a torque-limit adjusting spring.

Torque pressure oil is sensed at the inside of the bellows assembly via internal passages and the annular chamber of the housing assembly. A restrictor dampens the torque pressure signal to prevent sudden surges and pulsations being applied to the bellows assembly. The bellows stop screw is set to a predetermined setting. This is to prevent compression of the bellows assembly at a non-operating or low torque condition and thus eliminate any excessive movement of the pivot and spring assembly. The adjustment screw and spring are set to a predetermined value to prevent low torque values from deflecting the pivot and spring assembly and opening the restrictor assembly. The bimetal disk group adjusts the spring compression value, to compensate for spring stiffness, due to changes in air temperature. The pivot and spring assembly seals the restrictor assembly during normal engine operation and speeds. In doing so, it prevents Py air bleed off from the fuel control system.

During normal operating conditions, the torque pressure signal is not high enough to compress the spring and cause the pivot and spring assembly to move away from the restrictor assembly.

When a high torque pressure signal is sensed at the bellows assembly, provided it is strong enough to overcome the force of the spring, the bellows will stretch and deflect the pivot and spring assembly. This will permit a limited amount of Py air pressure to be bled-off from the fuel control unit and will continue to do so until such time that the engine speed is reduced resulting in a proportional reduction in engine torque pressure.

The normally-closed solenoid valve gets 28 VDC from a switch in the flap lever (Ref. Aircraft Maintenance Manual). When it is energized the solenoid valve allows Py air pressure to get to the torque limiter. The torque limiter can bleed the Py air to limit the torque as applicable.

When the signal from the flap lever is removed (850 SHP position) the solenoid valve will de-enerigize. With it de-energized (closed), the Py air pressure cannot go to the torque limiter. The torque limiter still functions but it can no longer bleed Py air pressure to limit the torque.

TORQUE LIMITER and SOLENOID VALVE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-061	Cloth, Abrasive
PWC05-101	Cloth, Abrasive
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC32062	Socket

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Torque Limiter (Ref. Fig. 201)

(1) Remove electrical connection and torque transmitter (Ref. Aircraft Maintenance Manual).

(2) Disconnect Py air tube (7) from torque limiter (3). Install suitable protective covers/caps.

(3) Remove universal retainer (1) fastening torque limiter to adapter (5) on RGB front case.

(4) Remove and discard preformed packing (2).

(5) Note position of torque limiter (3), relative to RGB, and remove torque limiter and preformed packing (4). Discard preformed packing.

(6) If sending PS/PSM to an overhaul facility, remove universal adapter (5) from RGB front case with socket (PWC32062). Remove and discard preformed packing (6).

B. Removal of Solenoid Valve (Ref. Fig. 202)

(1) Disconnect electrical connector from solenoid valve (9) (Ref. Aircraft Maintenance Manual).

(2) Disconnect the torque limiter air tubes from the solenoid valve (Ref. 73-10-08).

(3) Remove the nut (11), clamp (8) and bolt (7) attaching the solenoid valve (9) to the bracket (10), remove the solenoid valve.

(4) Remove the reducer (13) and preformed packing (12) from the solenoid valve (9). Discard the preformed packing.

(5) Put protective covers on the openings of the solenoid valve.

C. Installation of the Solenoid Valve (Ref. Fig. 202)

(1) Remove the protective covers from the solenoid valve.

(2) Install a new preformed packing (12) onto the reducer (13) and install the reducer in solenoid valve (9). Torque the reducer 40 to 50 lb.in.

(3) Install the solenoid valve (9) on the bracket (10) with the bolt (7), clamp (8) and the nut (11).

(4) Torque nut (11) 36 to 40 lb.in.

(5) Connect to torque limiter tubes to the solenoid valve (Ref. 73-10-08).

(6) Connect the electrical connector to the solenoid valve (Ref. Aircraft Maintenance Manual).

D. Installation of Torque Limiter

(1) If replacement PS/PSM is being installed, install new preformed packing (6, Fig. 201) on universal adapter (5) and install in torque transmitter boss on front case of RGB. Tighten adapter 375 to 425 lb.in.

(2) Install new preformed packing (4) on front face of universal adapter (5).

(3) Install torque limiter (3), in universal adapter at same position noted at removal. Tighten bolts 32 to 36 lb.in.

(4) Install new preformed packing (2) on universal retainer (1), and insert retainer into universal adapter. Tighten retainer 175 to 200 lb.in., and lockwire.

(5) Remove protective covers/caps, and connect Py tube (7) to torque limiter. Tighten nut 90 to 100 lb.in.

(6) Install torque transmitter and electrical connection (Ref. Aircraft Maintenance Manual).

(7) Pressure test pneumatic system (Ref. 73-10-07, Adjustment/Test).

(8) Check function of torque limiter (Ref. Adjustment/Test).

6. Cleaning/Painting

A. Cleaning of Air Tube(s)

(1) Clean air tube(s) (Ref. 73-10-07, Cleaning/Painting).

B. Cleaning of Torque Limiter

(1) Clean exterior with solvent (PWC11-027) or (PWC11-031) with a soft bristle brush or spray as necessary. Do not allow solvent to enter limiter. Dry using clean, dry compressed air.

6. Cleaning/Painting

   A. Cleaning of Air Tube(s)

      (1) Clean air tube(s) (Ref. 73-10-07, Cleaning/Painting).

   B. Cleaning of Torque Limiter

      (1) Clean exterior with solvent (PWC11-027) or (PWC11-031) with a soft bristle brush or spray as necessary. Do not allow solvent to enter limiter. Dry using clean, dry compressed air.

7. Inspection/Check

   A. Inspection of Air Tubes

      (1) Examine air tube (Ref. 73-10-08, Inspection/Check).

8. Approved Repairs

   A. Repair of Air Tube

      (1) Smooth out small nicks with abrasive cloth (PWC05-101).

      (2) Remove corrosion by polishing with abrasive cloth (PWC05-061) and oil (PWC03-001).

9. Adjustment/Test

   A. Procedure

      (1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and do checks associated with Installation/Replacement of Torque Limiter (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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Figure 201 Torque Limiter

Figure 202 Removal/Installation of Solenoid Valve

73-11-05
DUPLEX FUEL MANIFOLD - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

A. Fuel Manifold

The fuel manifold installation delivers metered fuel from the flow divider to the fuel manifold installation. The fuel manifold installation consists of 14 adapter assemblies, interconnected by pairs of transfer tubes attached to their respective bosses on the gas generator case by bolts. Locking plates, fastened by the same two bolts, maintain the tubes in position. The adapters and transfer tubes are sealed with gaskets and preformed packings.

B. Fuel Manifold Adapter Assemblies

Each fuel manifold adapter assembly incorporates primary and secondary flow, strainer elements and a fuel nozzle with swirl-type tip and a sheath. The swirl-type tips provide a fine atomized fuel spray in the annular combustion chamber. The sheath fits over the fuel nozzle and internal section of the manifold adapter. Each fuel nozzle assembly is threaded into the internal section of the adapter.

Each sheath and nozzle extends through the gas generator case into the combustion chamber outer liner. They are positioned to produce a tangential spray from one nozzle to the next in the combustion chamber. A slotted hole in each sheath allows cooling air from the space between the gas generator case and outer liner to pass within the sheath and out through the nozzle aperture; this air, in addition to cooling the tip of the nozzle, also assists in fuel atomization.

The forward end of the assembled combustion chamber is located and supported within the gas generator case by the fuel nozzle sheaths. The sheaths act as spigots and pass through suspension brackets/collars welded to the wall of the outer liner.

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Figure 1 Fuel Manifold Assembly

DUPLEX FUEL MANIFOLD - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire unless otherwise specified shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Fuel, Engine
PWC03-001	Oil, Engine
PWC03-002	Fluid, Calibrating
PWC05-007	Fluid, Check
PWC05-019	Compound, Lapping
PWC05-027	Ink, Marking
PWC05-046	Marker, Ink
PWC05-061	Cloth, Abrasive Coated Crocus
PWC06-004	Compound, Antiseize

PWC11-013	Compound
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-049	Remover, Rust

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC30128-14	Transfer Tube Puller	
PWC30506	Flow Test Rig	
PWC30530	Blanking Plug	
PWC32366	Pusher	
PWC32811	Flow Test Fixture	
PWC34405	Leak Test Fixture	
PWC34416	Nozzle Sheath Puller	
PWC54246	Puller	Alternative to PWC32366
PWC90086	Spray Chamber	

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name

Container, Stainless Steel Perforated

Cleaner, Ultrasonic

5. Removal/Installation

A. General

To ease accessibility to the transfer tubes and manifold adapters adjacent to spark igniters, disconnect ignition cables from igniters (Ref. 74-20-00, Removal/Installation). Release ignition cable loop clamps from support brackets at center mount ring lower attachment brackets and move clear. Install blanking caps on igniters and cable connectors.

Disconnect fuel delivery lines from elbow on flow divider. Install blanking caps on elbow and coupling nut.

DELETED.

B. Removal of Fuel Manifold Adapters (Ref. Fig. 201)

CAUTION: IF THE ENGINE IS NOT SEPARATED AT FLANGE C AND IT IS NECESSARY TO REMOVE ALL THE FUEL MANIFOLD ADAPTERS, THEN MAKE SURE THAT THE SPARK IGNITERS STAY INSTALLED. IF NOT, THERE COULD BE ALIGNMENT PROBLEMS WITH THE COMBUSTION CHAMBER OUTER LINER WHEN YOU INSTALL THE FUEL MANIFOLD ADAPTERS AGAIN.

NOTE: The following procedure itemizes a removal sequence, commencing with the No. 8 fuel manifold inlet adapter, that is best achieved by considering Nos. 7, 8 and 9 adapters as a group. The procedure may be modified by the operator as convenient for adapters at other locations.

(1) Using suitable ink marker (PWC05-027) or (PWC05-046), number position of each manifold adapter to identify original location for reinstallation.

(2) Remove bolts (3), fastening locking plate (4) to manifold inlet adapter (2) to gas generator case. Remove locking plate (4).

(3) Remove bolts (3), fastening locking plates (4) to the manifold adapters (5) adjacent to inlet manifold adapter (2). Remove locking plates (4).

WARNING: PUT ON CLEAN PROTECTIVE GLOVES WHEN YOU USE THE PUSHER (PWC32366) TO PREVENT INJURY TO YOUR FINGERS.

CAUTION: MOVE THE TRANSFER TUBES AWAY TO PREVENT DAMAGE TO THE STRAINER ELEMENTS WHICH YOU CAN FIND IN THE BORE OF THE DIAMETER.

(4) Hold all three adapters, then move the interconnecting fuel transfer tubes (6) into the adapter bores. Use the pusher (PWC32366) or puller (PWC54246) to move fuel transfer tubes in a clockwise direction, away from inlet manifold adapter bores as shown in Figure 201.

(5) Remove the inlet manifold adapter (2) with attached flow divider and dump valve (1). Use the pusher (PWC32366) or puller (PWC54246) to remove the fuel transfer tubes (6) adjacent to adapters (5). Remove and discard preformed packings (7) from fuel transfer tubes.

NOTE: Do not remove flow divider from inlet manifold adapter unless cleaning is necessary (Ref. Cleaning/Painting). Keep the parts attached as an assembly and you can do the inspection and testing procedures below (Ref. Para. 7. and 9.B.).

(6) Remove and discard metal O-ring (12) from the sheath (8) on inlet manifold adapter.

(7) Remove remaining manifold adapters (5) progressively from the gas generator case by removing bolts, (3) and locking plates (4). As each adapter is removed, withdraw interconnecting fuel transfer tubes (6). Remove and discard preformed packings (7). Remove and discard metal O-rings (12).

CAUTION: HANDLE FUEL NOZZLE ASSEMBLIES WITH EXTREME CARE SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERNS. WEAR CLEAN, LINT FREE GLOVES AT ALL TIMES WHEN PARTS ARE HANDLED.

CAUTION: MAKE SURE WRENCH IS CORRECTLY ENGAGED ON NOZZLE DURING REMOVAL. FUEL NOZZLE ORIFICE MAY BE DAMAGED IF NOZZLE SLIPS. HOLD STEM WHEN NOZZLE IS REMOVED TO PREVENT BENDING.

CAUTION: DO NOT PRY SHEATHS OFF.

(8) Visually inspect all fuel nozzle tips for concentricity with fuel exit hole of sheath (Ref. Fig. 202).

NOTE: Fuel nozzle tip should be centered with fuel exit hole of sheath.

(9) If concentricity is acceptable, remove sheath (8, Fig. 201) from inlet adapter (2) and manifold adapters (5) using puller (PWC34416) and proceed to step (11).

(10) If concentricity is not acceptable, replace fuel manifold adapter assembly with new or serviceable fuel manifold adapter assembly.

(11) Test the nozzle tip assembly (Ref. Testing). If unsatisfactory, unlock the keywashers (10) and remove the nozzle tip assembly (11) (comprised of items 16, 17 and 18) and the gasket (15) from the adapters (2) and (5). Discard the keywashers and the gaskets.

NOTE: 1. If nozzle tip assembly (11) is removed, it must be replaced by a new or overhauled nozzle tip assembly.

NOTE: 2. If new nozzle tip assembly is installed and does not pass the leakage test or the functional test, it should be removed and installed again.

NOTE: 3. If you remove the fuel nozzles for unscheduled borescope inspection, the test or replacement of the nozzle tip is not necessary. Make sure that you do not move the fuel nozzle tip assembly.

(12) Remove strainer elements (13) with puller (PWC30128-14). Remove and discard preformed packings (16).

(13) To prevent exposure to dust and dirt, place manifold components in clean, covered containers or plastic bags until required for use.

(14) Send rejected assemblies for repair or overhaul in original packaging to prevent parts contacting each other during shipment.

C. Installation of Fuel Manifold Adapters (Ref. Figs. 201, 203 and 204)

CAUTION: HANDLE FUEL NOZZLE ASSEMBLIES WITH EXTREME CARE SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERNS. WEAR CLEAN, LINT FREE GLOVES AT ALL TIMES WHEN PARTS ARE HANDLED

CAUTION: MAKE SURE WRENCH SOCKET IS CORRECTLY ENGAGED ON NOZZLE DURING INSTALLATION. FUEL NOZZLE OUTLET MAY BE DAMAGED IF NOZZLE SLIPS. HOLD STEM WHEN NOZZLE IS INSTALLED TO PREVENT BENDING.

(1) With a 10X magnifying glass verify that each manifold adapter assembly has the correct detail fuel nozzle assembly tip part number (Ref. IPC).

CAUTION: A MISSING OR IMPROPERLY INSTALLED GASKET (REF. FIG. 203) MAY RESULT IN PRIMARY FUEL FLOW LEAKING INTO SECONDARY FUEL FLOW CIRCUIT DURING ENGINE START. THIS SITUATION MAY DELAY OR PREVENT ENGINE STARTING AND CAUSE EXCESSIVE STARTING TEMPERATURE.

CAUTION: TO PREVENT STEM FROM BENDING, HOLD STEM DURING TIGHTENING AND DO NOT EXCEED TORQUE LIMIT.

CAUTION: USE OF ENGINE OIL (PWC03-001) IS ONLY ACCEPTABLE AS A LUBRICANT FOR INSTALLATION OF THE FUEL NOZZLE TIP ASSEMBLIES. DO NOT USE CALIBRATION FLUID OR OTHER LUBRICANTS.

CAUTION: DO NOT TORQUE MORE THAN THE LIMIT TO ALIGN FLAT ON TIP WITH KEYWASHER.

(2) Install the nozzle tip assembly (11) in the manifold adapters (2 and 5, Fig. 201) with the new gasket (15) and the new keywashers (10) at each location. Use engine oil (PWC03-001) as a lubricant and torque the nozzle tip assembly 55 to 65 lbf.in. (6.3 - 7.3 Nm). Do not lock keywashers until leakage test is completed.

NOTE: When you install the new nozzle tip assembly (11), make sure that the cone (18) and the distributor (17) are installed in the nozzle body (16).

(3) Lubricate and install new preformed packings (14) on strainer elements (13) using a thin layer of engine oil (PWC03-001).

CAUTION: MAKE SURE THE STRAINER ELEMENT IS INSTALLED WITH THE PREFORMED PACKING TOWARD THE OUTSIDE.

(4) Insert the strainer elements into the manifold adapters.

(5) Do a leakage test for each nozzle and adapter assembly (Ref. Adjustment/Test). If leaks are found, repair or replace the nozzle tip assembly (Ref. Repair).

(6) Functional test each nozzle adapter assembly (Ref. Adjustment/Test).

CAUTION: DO NOT USE SHARP EDGED TOOLS TO BEND OR SET KEYWASHER TABS. TAB DETACHMENT MAY OCCUR WITH SUBSEQUENT DAMAGE TO THE NOZZLE TIP.

(7) On completion of satisfactory tests, lock each keywasher (10) on respective nozzle tip assembly (11).

(8) Do an external leak test of each fuel nozzle and adapter assembly (Ref. Adjustment/Test). If leaks are found, remove nozzle tip assembly (11) and do Steps (2) thru (6) again.

(9) Install manifold adapters and fuel transfer tubes:

(a) Assemble sheaths (8) on manifold adapters (2 and 5). Make sure locating pins (9) engages holes in sheaths.

(b) Using feeler gage check between fuel nozzle adapters and sheaths flanges. Maximum gap allowed is 0.003 inch (Ref. Fig. 204). Larger gap suggests either or both parts are distorted. Send parts to P&WC (Ref. INTRODUCTION, Customer Support) for repair.

NOTE: If fit is too tight for hand installation, remove and heat sheath slightly with heat gun. Re-install sheath on nozzle adapter. Check clearance.

(c) Verify concentricity of fuel nozzle tip with fuel exit hole of sheath (Ref. Fig. 202).

WARNING: PUT ON CLEAN PROTECTIVE GLOVES WHEN YOU USE THE PUSHER (PWC32366) TO PREVENT INJURY TO YOUR FINGERS.

(d) Lubricate the preformed packings (7, Fig. 201) with engine oil (PWC03-001) and install them on the fuel transfer tubes (6). Install the fuel transfer tubes into the ports on one side of manifold adapters (2) and (5), then push the fuel transfer tubes into full depth of bore in manifold adapters ports with pusher (PWC32366) or puller (PWC54246).

(e) Position each metal O-ring (12) in recess of adapter bosses on gas generator case and retain using compound (PWC06-004) or (PWC06-005).

(10) Insert inlet manifold adapter (2) into boss at 6 o'clock position on gas generator case studs and install nuts. Do not tighten.

WARNING: PUT ON CLEAN PROTECTIVE GLOVES WHEN YOU USE THE PUSHER (PWC32366) TO PREVENT INJURY TO YOUR FINGERS.

(11) Start with each side of the inlet manifold adapter, install the remaining manifold adapters (4) on the gas generator case at the locations specified before.

NOTE: 1. Make sure that the metal O-ring is in position when you install the nozzle.

NOTE: 2. To find the hot section damage easily, install the replacement nozzle at the initial locations from which unserviceable item was removed. If the cleaning of the nozzles after the flow test is not necessary, then install the nozzles at the initial locations.

(12) Use pusher (PWC32366) or puller (PWC54246) to engage fuel transfer tubes (6) to interconnect with adjacent adapter.

(13) Install locking plate (4) and secure to gas generator case with nuts. Do not tighten.

(14) When manifold adapters (5) are positioned, remove bolts (3) from inlet manifold adapter (2), install locking plate (4), and bolts.

CAUTION: MAKE SURE THAT ALL 14 MANIFOLD ADAPTER LOCKING PLATES ARE CORRECTLY INSTALLED.

CAUTION: CHECK SEATING OF METAL O-RING RELATIVE TO SHEATH AND BOSS BEFORE BOLTS ARE TIGHTENED. TIGHTENING SHOULD BE DONE EVENLY ON EACH ADAPTER TO PROVIDE FULL SEALING POTENTIAL OF O-RING.

(15) Tighten all bolts initially, 15 to 20 lb.in., then 32 to 36 lb.in.

NOTE: After tightening, a 0.001 inch maximum gap is allowed between adapter and sheath flanges.

(16) Connect lines to elbow. Tighten self locking coupling nuts 90 to 100 lb. in.

(17) Connect the ignition leads to igniters. Tighten the connections with your fingers, then turn the nut plus 45 degrees. Install the safetywire. Attach the ignition lead loop clamps to hold brackets at center mount ring lower mounts. Torque the nuts 32 to 36 lbf.in. (Ref. 74-20-00, CABLES & SPARK IGNITERS - MAINTENANCE PRACTICES).

(18) Check function of fuel manifold installation (Ref. Adjustment/Test).

6. Cleaning/Painting

WARNING: CARBON REMOVING COMPOUND IS TOXIC AND CAUSTIC, AND MUST BE HANDLED WITH EXTREME CARE. AVOID ALL DIRECT CONTACT WITH SKIN OR CLOTHING. PREVENT CONTACT WITH EYES AND AVOID INHALATION OF VAPORS. COMPOUNDS CAN BE FATAL IF SWALLOWED. IF CONTACT WITH EYES OR SKIN IS MADE, WASH AFFECTED AREAS THOROUGHLY FOR 15 MINUTES WITH WATER AND RINSE WITH SATURATED BORIC ACID SOLUTION. IF ACCIDENTALLY SWALLOWED, GET MEDICAL ATTENTION IMMEDIATELY. CONSULT WITH PHYSICIAN AS RAPIDLY AS POSSIBLE FOR ALL CONTACT CASES.

CAUTION: ONLY USE RECOMMENDED (ALKALINE) CLEANING SOLUTION (PH>7). SOLUTIONS WITH A PH VALUE LOWER THAN 7 MAY CAUSE FUEL NOZZLE DAMAGE.

CAUTION: OBSERVE SAFETY PRECAUTIONS AT ALL TIMES WHEN FUELS OR SIMILAR COMBUSTIBLES ARE USED.

A. Cleaning of Fuel Manifold Adapter Assemblies (Ref. Fig. 205)

(1) Remove fuel flow divider from inlet adapter (Ref. 73-10-04, Removal/Installation).

(2) Remove fuel manifold sheaths from adapter assemblies.

CAUTION: MAKE SURE ADAPTERS ARE SEPARATED FROM EACH OTHER TO PREVENT DAMAGE DURING CLEANING.

(3) Place as many manifold adapter assemblies as possible in perforated stainless steel container constructed to prevent contact between parts.

NOTE: Wires may be used to suspend parts in cleaning solution to prevent contact during cleaning.

(4) Prepare caustic solution by diluting 2 to 3 pounds of carbon removing compound (PWC11-013) or (PWC11-049) in one (1) US gallon of water (3.8 liters), and heat to approximately 90°C (200°F). Pour caustic solution/cleaner into tank of ultrasonic cleaner.

NOTE: 2 to 3 lbs. of carbon removing compound (PWC11-013) or (PWC11-049) per US gallon produces 24 to 36% solution.

(5) Suspend the perforated stainless steel container containing the manifold adapter assemblies in cleaner tank solution. Make sure that all manifold adapters are completely immersed.

(6) Cover tank and activate ultrasonic cleaner for approximately one hour.

WARNING: PUT ON PROTECTIVE GLOVES WHEN HANDLING HOT PARTS TO PREVENT PERSONAL INJURY.

(7) After you clean the assemblies, immediately flush the assemblies fully in very hot water at 82 °C (180 °F) for two to three minutes.

WARNING: PUT ON PROTECTIVE GLOVES WHEN HANDLING HOT PARTS TO PREVENT PERSONAL INJURY.

CAUTION: FLUSH THE ASSEMBLIES IMMEDIATELY AFTER THE CLEANING TO PREVENT DAMAGE TO THE ASSEMBLIES BY THE REMAINING CARBON REMOVER SOLUTION.

(8) Flush the parts again in very hot water at 82 °C (180 °F) for two to three minutes.

(9) Install blanking plate (Ref. Fig. 205) and preformed packings on mounting face of inlet adapter to block flow through diverter valve transfer ports at base of adapter.

(10) To remove residual cleaning solution from inside adapter assemblies, install adapters in fixture (PWC32811). Using appropriate blanking tubes, flow clean, very hot water at normal tap pressure, 30 psig max., for at least one minute through primary and secondary passageways of adapters.

(11) Remove blanking plate from inlet manifold adapter.

(12) Immediately dry assemblies thoroughly using clean, filtered compressed air or nitrogen.

(13) Do leak and function test (Ref. Adjustment/Test).

NOTE: Before commencing test as described, allow fuel to flow through nozzle and manifold adapter assembly for at least one minute at 30 psig.

B. Cleaning of Fuel Manifold Adapter (Nozzles Removed) and Adapter Sheaths

NOTE: SPOP 218 can be used as an optional cleaning procedure for fuel manifold adapter sheath only.

(1) Place fuel manifold adapters and sheaths in perforated stainless steel container, and proceed as described (Ref. Para A., steps (4) thru (7)). Reduce cleaning time to 30 minutes.

CAUTION: PRESSURE WASH IMMEDIATELY AFTER CLEANING.

(2) Pressure wash parts thoroughly to remove residual compound under very hot, running water for at least one minute. Make sure adequate water flow is maintained through internal bores of adapters. Remove remaining loose carbon build-up on sheaths by scrubbing with a non-metallic bristle brush.

(3) Immediately dry parts thoroughly using clean, filtered compressed air.

(4) Install the fuel nozzles in manifold adapter (Ref. Removal/Installation) and test (Ref. Adjustment/Test).

7. Inspection/Check

CAUTION: HANDLE FUEL NOZZLE ASSEMBLIES WITH EXTREME CARE SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERNS. WEAR CLEAN, LINT FREE GLOVES AT ALL TIMES WHEN PARTS ARE HANDLED.

A. Fuel Nozzle Assembly

(1) Check the nozzle assembly for burrs and similar defects. Threads and hexagon may be lightly stoned to remove nicks and burrs.

B. Fuel Nozzle Sheath (Ref. Fig. 206)

(1) Erosion, any loss of coating is acceptable provided any loose coating is removed by light buffing and 0.040 inch minimum dome thickness is retained.

B. Fuel Nozzle Sheath (Ref. Fig. 206)

(1) Erosion, any loss of coating is acceptable provided any loose coating is removed by light buffing and 0.040 inch minimum dome thickness is retained.

(2) Fretting wear, maximum permissible depth is 0.010 inch; deburr raised material.

C. Manifold Adapter

(1) Check the locating pin for security in the adapter and for burrs and similar defects. Check threads for damage.

D. Transfer Tubes (Ref. Fig. 207)

(1) Examine for general condition and check preformed packing grooves and lands for damage. Minor surface damage in the form of burrs and scratches, may be removed by blending.

(2) Inspect for bent transfer tubes (1) as follows:

(a) Put the transfer tube on flat surface and roll the transfer tube. If an elliptical motion is produced at any point along the tube, reject the tube.

(3) Inspect condition of external anodic finish.

(4) Examine the bore of each tube is free from blockage. Install the cap on the transfer tube (1) after inspection.

E. Strainer Element

(1) Inspect strainer element for cleanliness, damage, and weld for integrity. Recleaning is permissible (Ref. Cleaning/Painting). No other damage is permissible.

8. Approved Repairs

A. Procedure (Ref. Fig. 208)

CAUTION: REPAIRS ARE NOT PERMITTED ON NOZZLE ORIFICE FACE.

CAUTION: DAMAGE MAY OCCUR TO THE ADAPTER SEALING FACE IF USING TOO COARSE A GRIT OF ABRASIVE CLOTH OR APPLICATION OF UNEQUAL PRESSURE ON ADAPTER FACE DURING LAPPING. THIS PROCEDURE IS ONLY RECOMMENDED FOR ADAPTERS THAT ARE FOUND TO BE LEAKING AFTER INSTALLATION OF A NOZZLE TIP.

CAUTION: IF LEAKAGE CANNOT BE STOPPED BY LAPPING OF THE ADAPTER SEALING FACE, DO NOT OVERTORQUE NOZZLE TIP TO ACHIEVE CORRECT SEALING. RETURN DEFECTIVE NOZZLE ASSEMBLY TO AN AUTHORIZED OVERHAUL SHOP FOR REPAIR.

NOTE: Repair of adapters, sheaths and nozzle assemblies is limited to removing minor defects such as scores, nicks, scratches and gouges on exterior surfaces.

(1) Clean up minor defects with a fine stone or file and/or by polishing/lapping with abrasive cloth (PWC05-061). Thread damage on adapters may be repaired with a suitable Swiss file, thread chaser or appropriate die.

(2) Remove all sharp edges and high spots. Lap adapter sealing surfaces (Ref. Fig. 208) against a flat base (± 0.0002 inch flatness). Use lapping compound (PWC05-019) or an abrasive cloth (PWC05-061) lubricated with a drop of fuel.

(3) Clean all parts after repair by pressure washing in solvent (PWC11-027) or (PWC11-031).

9. Adjustment/Test

CAUTION: OBSERVE SAFETY PRECAUTIONS AT ALL TIMES WHEN FUELS OR SIMILAR COMBUSTIBLES ARE USED.

CAUTION: DAMAGE TO THE HOT SECTION MAY BE CAUSED BY DEFECTIVE FUEL NOZZLES. REGULAR NOZZLE INSPECTION AND CLEANING IS RECOMMENDED TO EXTEND HOT SECTION LIFE.

A. General (Ref. Fig. 209)

(1) Definitions of terms used in the text to describe specified test conditions for nozzles:

(a) "Streakiness" is defined as variation in spray quantity between different parts of spray cone and appearing as lighter or darker streaks in spray.

1 A total of 20% of fuel spray may show light streaks.

2 Caused by carbon deposit at nozzle face.

3 Brush nozzle surface during flow test.

(b) "Spitting" is a condition which exists when large drops of unatomized fuel occur intermittently and usually on outside of spray cone.

1 No spitting allowed.

2 Caused by carbon deposit at nozzle face.

3 Brush nozzle during flow test.

(c) "Drooling" is a condition which occurs when large drops of unatomized fuel form on nozzle face.

1 No drooling allowed.

2 Caused by carbon deposit at nozzle orifice or by partial obstruction of fuel nozzle distributor.

3 Brush nozzle surface during flow test and ultrasonically clean.

(d) "Void" area of fuel spray showing discontinuity in fuel flow (air gap).

1 No void allowed.

2 Caused by obstruction on internal fuel passage.

3 Ultrasonically clean.

(e) "Skewness" describes a spray condition that is not centered.

1 No skewness allowed.

2 Caused by damage to nozzle orifice.

3 Not repairable at field level.

B. Leakage Test of Fuel Manifold Adapters (Ref. Figs. 210 and 211)

CAUTION: USE EXTREME CARE WHEN HANDLING FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERNS. WEAR CLEAN, LINT FREE COTTON GLOVES OR SURGICAL GLOVES AT ALL TIMES WHEN PARTS ARE HANDLED.

(1) Loosen screws (8, 6 and 4, Fig. 210) of leak test fixture (2, PWC34405) and remove pivot block (7).

(2) Insert nozzle assembly in plugs of leak test fixture (2, PWC34405).

(3) Insert plugs of pivot block (7) in the nozzle assembly. Make sure the preformed packings are not damaged during nozzle installation.

(4) With plugs fully inserted into adapter ports, hold parts firmly and tighten pivot screw (8).

(5) Blank off nozzle orifice:

(a) Turn setscrew (4) until it just makes contact with rear of adapter behind nozzle.

(b) Turn torque screw (6) until preformed packing pad (5) seats on nozzle face.

(c) Tighten setscrew (4) and torque screw (6), simultaneously, to ensure that preformed packing pad (5) closes nozzle orifice without distortion of adapter.

(d) Tighten locknut on setscrew (4).

(6) When inlet manifold adapter and nozzle assembly (9) with attached flow divider (10) is to be tested, do the following additional steps:

(a) Blank off elbow on flow divider (10) with caps (11). Tighten caps 40 to 45 lb.in. (Ref. View A).

(b) If elbows are not installed, blank off ports in flow divider (10) with plugs (12, PWC30530) (Ref. View B).

(7) Check for external leaks between fuel nozzle and manifold adapter using one of the following methods:

(a) Method A: Connect hose assembly (1) to a supply of clean, dry compressed air or nitrogen and apply 200 psig to leak test fixture (2, PWC34405). Check for leaks using leak check fluid (PWC05-007) or by immersing in solvent (PWC11-027) or (PWC11-031). No leaks are permitted. If leakage occurs go to step (c).

(b) Method B: Fill the hose assembly (1) with the fuel (PWC01-001) or calibrating fluid (PWC03-002). Apply 500 psig of compressed air or nitrogen to the hose assembly (1) to pressurize the fuel. Hold the hose assembly (1) vertical and examine the fuel nozzle for leakage. No leaks are permitted. If leakage occurs go to Step (c).

(c) If there are any external leaks between the fuel nozzle tip assembly and the manifold adapter, remove the fuel nozzle tip assembly (Ref. Para. 5.B., step (11)).

(8) Check for internal leaks of manifold adapter:

CAUTION: CONNECT GROUND CABLE ON TEST RIG TO ELIMINATE DANGER OF ELECTROSTATIC DISCHARGE.

(a) Partially fill reservoir (5, Fig. 212) of flow test rig (1, PWC30506) with clean fuel (PWC01-001).

(b) Insert one blanking tube assembly (17) and connecting tube assembly (9) of fixture (10) into primary passageway of manifold adapter (Ref. Fig. 211). The two remaining blanking tube assemblies (17, Fig. 212) are not required.

(c) Place manifold adapter (11, Fig. 212) in fixture (10) and put collars of tube assemblies (17) inside of fixture flanges with tubes in appropriate slots. Fasten adapter to fixture with screws and nuts.

(d) Connect tube assembly (9) to hose assembly (8) and tighten coupling nuts to prevent leakage.

(e) Connect air supply line (2) with 100 psig maximum to pressure regulator (3) on flow test rig (1, PWC30506).

(f) Adjust pressure regulator (3) to increase pressure to 100 psig as indicated on gage (7).

CAUTION: LEAKAGE FROM PRIMARY TO SECONDARY MANIFOLD MAY CAUSE FAILURE TO START OR POSSIBLE HOT START.

(g) Check for leaks at secondary manifold (Ref. Fig. 211). Use shop air to dry the manifold passage which is open to atmosphere during visual inspection for fuel leakage. Leakage of 10 drop/minute is acceptable. If leak exceeds limit, disassemble fuel nozzle (Ref. Removal/Installation) and install new gasket and new keywasher (15 and 10, Fig. 201). Repeat leak test procedure.

(h) Reduce pressure to zero, as indicated on gage (7, Fig. 212), by adjusting pressure regulator (3). When fuel flow from nozzle stops, disconnect and blank off hose assembly (8) from connecting tube assembly (9).

(i) Disconnect air supply line (2) from pressure regulator (3) on flow test rig (1, PWC30506).

(j) Remove adapter (11) and nozzle assembly (12) from flow fixture (10) and withdraw connecting tube assembly (9) and blanking tube assembly (17) from ports in adapter.

(k) Repeat procedure for inlet manifold adapter and flow divider.

C. Functional Test of Fuel Manifold Adapters with Test Rig (PWC30506) (Ref. Fig. 212)

CAUTION: USE EXTREME CARE WHEN HANDLING FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERNS. WEAR CLEAN, LINT FREE COTTON GLOVES OR SURGICAL GLOVES AT ALL TIMES WHEN PARTS ARE HANDLED.

CAUTION: CONNECT GROUND CABLE ON TEST RIG TO ELIMINATE DANGER OF ELECTROSTATIC DISCHARGE.

CAUTION: DO NOT BREATH FUEL DURING FUNCTIONAL TEST. MAKE SURE THAT THERE IS ADEQUATE VENTILATION. USE AN EXPLOSIVE PROOF VENTILATION HOOD.

NOTE: Nozzle can be reinstalled without cleaning provided the function test is within limits.

(1) Fill the reservoir (5) of the flow test rig (PWC30506) (1) with clean fuel (PWC01-001) or calibrating fluid (PWC03-002). Make sure that you do not fully fill the reservoir.

(2) Insert one blanking tube assembly (17) and connecting tube assembly (9) of fixture (10) into manifold adapter (11) as shown. The two remaining blanking tube assemblies (17) are not required.

(3) Place manifold adapter (11) in fixture (10) and put collars of tube assemblies (17) inside of fixture flanges with tubes in appropriate slots. Fasten adapter to fixture with screws and nuts.

(4) Connect tube assembly (10) to hose assembly (8) and tighten coupling nuts to prevent leakage.

(5) Connect air supply line (2) with 100 psig maximum to pressure regulator (3) on flow test rig (1, PWC30506).

(6) PRIMARY FUEL NOZZLES - Adjust pressure regulator (3) gradually until 20.0 psig is indicated on pressure gage (7). A full conical spray, free from spitting or drooling, must appear from nozzle at 20.0 psig.

(7) If spitting or drooling occurs at 20.0 psig, clean (Ref. Cleaning/Painting) and retest nozzle. If satisfactory spray quality cannot be achieved after repeated cleaning, return unserviceable nozzles to an authorized accessories overhaul shop.

(8) Adjust pressure regulator (3) to increase pressure to 60 psig as indicated on gage (7). Volume of spray should increase and be spread evenly about the center axis of nozzle orifice. If total streakiness exceeds 20% of spray area, repeat cleaning or reject nozzle (Ref. Fig. 209).

NOTE: Spitting, drooling and streakiness may be caused by external carbon deposits around nozzle orifice. Remove deposits by lightly brushing nozzle face with cotton swab or non-metallic bristle brush while fuel is flowing through orifice.

(9) Transfer blanking tube assembly (17) and connecting tube assembly (9) of fixture (10) into the secondary manifold adapter (11).

(10) SECONDARY FUEL NOZZLES - Adjust the pressure regulator (3) gradually until 30.0 psig is indicated on the pressure gage (7). A full conical spray, free from spitting and drooling, must appear from the nozzle at 30.0 psig.

(11) If spitting or drooling occurs at 30.0 psig, clean (Ref. Cleaning/Painting) and retest the nozzle. If satisfactory spray quality cannot be achieved after repeated cleaning, return unserviceable nozzles to an authorized accessories overhaul facility.

(12) Adjust the pressure regulator (3) to increase the pressure to 60 psig, as indicated on the gage.

(13) The volume of spray should increase and be spread evenly about the center axis of the nozzle orifice. If total streakiness exceeds 20% of spray area, repeat cleaning or reject the nozzle (Ref. Fig. 209).

(14) Reduce pressure to zero, as indicated on gage (7, Fig. 212), by adjusting pressure regulator (3). When fuel flow from nozzle stops, disconnect and blank off hose assembly (8) from connecting tube assembly (9).

(15) Disconnect air supply line (2) from pressure regulator (3) on flow test rig (1, PWC30506).

(16) Remove adapter (11) and nozzle assembly (12) from flow fixture (10) and withdraw connecting tube assembly (9) and blanking tube assembly (17) from ports in adapter.

(17) Place adapter and nozzle assembly in a clean, dust-proof container until required for installation on engine.

(18) Function test inlet adapter (13) and nozzle assembly (12):

(a) Blank off elbow connection on flow divider (14) with caps (15). Tighten caps 40 to 45 lb.in. (Ref. View A). Alternatively, if elbow connections are not installed, use plugs (16) to blank off ports (Ref. View B).

(b) Insert connecting tube assembly (9) of fixture (10) into port of inlet adapter (13) at same location as that used on adapter (11).

(c) Insert three blanking tube assemblies (17) into remaining ports of adapter (13).

(d) Install adapter (13) in fixture (10) and function test (Ref. steps (2) thru (16)).

(e) Remove plugs (16) or blanking caps (15) from flow divider (15) and place adapter and nozzle assembly with attached flow divider in a clean, dust-proof container until required for installation.

NOTE: Return unserviceable nozzles to an authorized accessories overhaul shop for repair.

D. Functional Test of Fuel Manifold Adapters with Spray Chamber (PWC90086) (Ref. Fig. 213)

CAUTION: TAKE EXTREME CARE WHEN HANDLING FUEL NOZZLE ASSEMBLIES SINCE EVEN FINGERPRINTS ON THE ORIFICE MAY PRODUCE POOR SPRAY PATTERN. CLEAN, LINT FREE GLOVES MUST BE USED AT ALL TIMES WHEN HANDLING PARTS.

NOTE: Although cleaning is recommended, nozzles can be reinstalled without cleaning provided that function test is within limits.

(1) Fill the reservoir of the spray chamber (PWC90086) with clean fuel (PWC01-001) or calibrating fluid (PWC03-002). Make sure that you do not fully fill the reservoir.

CAUTION: CONNECT GROUND CABLE ON SPRAY CHAMBER (PWC90086) TO PREVENT DANGER OF ELECTROSTATIC DISCHARGE.

(2) Attach ground strap clip to a suitable ground.

(3) Connect air supply line with 100 psig maximum to air inlet (1).

(4) Put fuel nozzle assembly on positioning fixture.

(5) Connect nozzle inlet connector to fuel nozzle assembly.

(6) Position locking mechanism over fuel nozzle inlet connection to make sure that the fuel nozzle is positioned over light source.

(7) Install rubber boot (2) over the fuel nozzle and spry chamber (3) to reduce any possible calibration fluid vapor escaping from the chamber.

(8) Turn on light source at the switch on the battery pack (4) mounted on the top lid.

(9) Set initial air pressure to 20 psig.

(10) Set selector valve (5) in "Pressure" position.

(11) Inspect fuel spray cone at 20 psi for drips and voids.

(12) Adjust pressure regulator valve to increase pressure to 60 psig and inspect fuel nozzle spray cone for drips and voids.

NOTE: Spitting, drooling and streakiness may be caused by external carbon deposits around nozzle orifice. Remove deposits by lightly brushing nozzle face with cotton swab or non-metallic bristle brush while fuel is flowing through orifice.

(13) Return fuel nozzles to an authorized accessories overhaul shop if satisfactory spray cannot be achieved after repeated cleaning.

(14) After completion of testing, move selector valve (5) to "Vacuum" position to remove the accumulated calibration fuel from the spray chamber (3).

NOTE: The calibration fuel is filtered and returned to the reservoir.

(15) Reduce pressure to zero, as indicated on gage by adjusting pressure regulating valve.

(16) Disconnect air supply line from spray chamber (PWC90086).

(17) Remove fuel nozzle from spray chamber (PWC90086).

(18) Put nozzle assemblies in a clean, dust proof container until ready for installation on engine.

(19) If one or more nozzles are found unacceptable during the test, examine the hot section for evidence of heat damage by direct visual or borescope inspection.

NOTE: Return unserviceable nozzles to an authorized accessories overhaul shop for repair.

E. Functional Check of Fuel Manifold Installation

(1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and do checks associated with Installation/Replacement of Fuel Manifold/Nozzles (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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Figure 213 Spray Chamber (PWC90086)

73-20-00
FUEL CONTROL UNIT - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The fuel control unit (FCU) installation, comprising FCU and related parts, is mounted on the rear face of the fuel pump. An integral splined coupling in the pump transmits a speed signal, proportional to compressor rotor and turbine speed (Ng), to the governing section in the FCU. The FCU determines the fuel schedule for the engine to provide the power required by controlling the speed of the gas generator. Engine power output is directly dependent upon Ng. Control of Ng is accomplished by regulating the amount of fuel to the combustion section of the engine. Compressor discharge pressure (P3) is sensed by the fuel control unit and is used to establish acceleration fuel flow limits. This fuel limiting function is used to prevent overtemperature conditions in the engine during starting and acceleration.

The fuel control unit consists of the following major components:

Fuel condition lever that selects the start, ground-idle and flight-idle functions.

Power lever that selects gas generator speed between flight-idle and maximum through the 3D cam, cam follower lever and fuel valve.

Flyweight governor that controls fuel flow to maintain selected speed.

Pneumatic bellows that controls the acceleration schedule and reduces gas generator speed in the event of propeller overspeed.

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Figure 1 Fuel Control Unit

FUEL CONTROL UNIT - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Fuel, Engine
PWC03-002	Fluid, Calibrating, Aircraft
PWC05-061	Cloth, Coated Abrasive
PWC05-077	Oil, Preservative
PWC05-101	Cloth, Abrasive
PWC05-166	Solution, Chemical Treatment
PWC05-167	Grit, Abrasive
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-038	Solvent, Cleaning

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC50745	Rigging Pin, Propeller Reversing Lever

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of FCU

> CAUTION: VARIOUS COMPONENTS OF THE FUEL CONTROL UNIT ARE LOCKED AND SEALED. MAKE SURE ALL SUCH SEALS ARE INTACT AND ARE NOT TAMPERED WITH.

(1) Disconnect airframe linkages from FCU (Ref. Aircraft Maintenance Manual).

(2) Note position of FCU interconnect rod (11, Fig. 201) and remove cotterpin, nut (9), washer (10) and bolt (15) fastening interconnect rod (11) to fuel control arm (13). Raise and fasten end of rod clear of FCU. Discard cotterpin.

NOTE: To prevent contamination of work areas, use a container to catch spillage when disconnecting fuel lines.

(3) Disconnect fuel interconnect hose, fuel outlet line, Py tube, and P3 tube from fuel control unit. Suitably cap/cover fittings on FCU and disconnected lines.

(4) Support fuel control unit (3), remove nuts (1) and washers (2) and withdraw unit from studs on mounting face of fuel pump. Remove and discard preformed packing (8).

(5) If fuel control unit is being replaced, proceed as follows:

(a) Note angular positions of Py line elbow (7), fuel outlet line elbow (19), fuel interconnect hose elbow (24), P3 line elbow (23), to ensure correct alignment of these items during assembly on replacement fuel control unit.

(b) Loosen nuts (6, 18, 22 and 25) , and remove elbows (7, 19, 23 and 24). Remove and discard preformed packings (4, 16, 20, and 27) and backup rings (5, 17, 21, and 26).

(c) Remove FCU extension (14), arm (13) and serrated spacer (12)

B. Installation of FCU

CAUTION: VARIOUS COMPONENTS OF THE FUEL CONTROL UNIT ARE SAFETY WIRED AND SEALED. CHECK THAT ALL SUCH SEALS ARE INTACT AND HAVE NOT BEEN TAMPERED WITH.

(1) When a replacement fuel control unit (3, Fig. 201) is being installed, carry out depreservation and install fittings prior to installation as follows:

NOTE: Depreservation is not required when original fuel control unit is being installed.

(a) Remove plugs from inlet and outlet ports. Make sure air section of unit is sealed off with shipping plugs.

(b) Drain as much residual preservation fluid as possible from fuel section of unit.

(c) Flush fuel section of unit with fuel (PWC01-001) that has been passed through a 10-micron (nominal) filter.

(2) Install nuts (6, 18, 22), new backup rings (5, 17, 21), and preformed packings (4, 16, 20) on elbows (7, 19, 23), and install elbows (Ref. 70-00-00, MAINTENANCE PRACTICES) in FCU at same position noted during removal. Tighten nuts (6, 18, 22) 38 to 42 lb.in., and install suitable caps until FCU is ready for installation.

(3) Install nut (25), new backup ring (26), and new preformed packing (27) on elbow (24), and install elbow (Ref. 70-00-00, MAINTENANCE PRACTICES) in FCU at same position noted during removal. Tighten nut (25) 70 to 80 lb.in., and install suitable cap until FCU is ready for installation.

(4) Install new lubricated preformed packing (8) in recess in mounting face of fuel pump.

(5) Position fuel control unit (3) on studs of fuel pump and push in, without forcing, to engage splines of FCU driveshaft with corresponding splines of pump driveshaft. As mounting faces meet, make sure preformed packing (8) is not displaced. Install washers (2) and self-locking nuts (1). Tighten nuts 75 to 85 lb.in.

(6) When a replacement fuel control unit is being installed, install associated parts as follows:

(a) Remove shipping protector nut and spacer from condition lever shaft on fuel control unit.

(b) Engage serrations on spacer (12) with those on arm (13) and place both parts on condition lever shaft on fuel control unit.

(c) Install arm extension (14) on condition lever shaft of fuel control unit (3), fingertight only.

(d) Install rigging pins (PWC50745) in fuel control and reversing linkage cambox. Align outer hole in arm (13) with FCU interconnect rod (11) by rotating arm and spacer (12). Alignment is achieved when bolt (15) can be inserted freely through hole in arm and rod-end, and serrations on arm, spacer and lever on FCU are engaged.

(e) Tighten arm extension (14) 25 to 35 lb.in., and lockwire.

(7) Install bolt (15) from left-hand side through arm (13), FCU interconnect rod (11), washer (10) and nut (9). Torque nut 24 to 36 lb.in. Align slots of nut with cotterpin hole of lever shaft within torque limits. Install cotterpin.

(8) Remove blanking caps from elbows (7 and 23) and plugs from Py tube and P3 air tube. Connect lines to respective elbows, and tighten tube coupling nuts 90 to 100 lb.in.

(9) Remove blanking cap from elbow (19) and plug from fuel pressure line. Connect line to respective elbow, and tighten tube coupling nut 270 to 300 lb.in.

(10) Remove blanking cap from elbow (24) and plug from fuel interconnect hose. Connect hose to elbow, and tighten coupling nut 170 to 200 lb.in.

(11) Connect airframe linkages to fuel control unit (Ref. Aircraft Maintenance Manual).

(12) Install lockwire at all elbow jam nuts and coupling nuts.

(13) Check function of FCU (Ref. Adjustment/Test).

6. Cleaning/Painting

A. Cleaning of FCU

(1) Clean exterior surfaces with solvent (PWC11-027) or (PWC11-031). To prevent cleaning agent from entering unit, do not remove blanking caps and plugs.

(2) Wipe surfaces dry with clean, lint-free cloth to remove all residual solvent and contamination.

7. Inspection/Check

A. General

(1) Examine mounting flange, housing and components of lever mechanism for cracks and other surface defects. Cracks are not permissible; minor defects may be repaired.

(2) Examine ports for damage to internal threads and, if evident, send unit for rectification at an overhaul facility.

(3) Examine elbow fittings for damage to threads.

(4) Check for signs of external leakage and, if leakage is evident, send unit for rectification at an overhaul facility.

(5) Examine external surfaces for corrosion and for general condition of anodic treatment.

B. Inspection of Seals

(1) Examine for integrity and damage. If any seal indicates tampering or if wire is broken, send unit to an overhaul facility for recalibration.

CAUTION: TO MAKE SURE CALIBRATION AND OPERATION HAVE NOT BEEN AFFECTED, DO NOT REPLACE A LOCKED SEAL UNTIL UNIT HAS BEEN CHECKED.

(2) Examine remainder of lockwire and replace if damaged or broken.

8. Approved Repairs

A. General

(1) Clean all areas and apply corrosion preventive treatment to aluminum surfaces after minor repairs. Do not allow filings and dirt to enter fuel control unit during repair.

(2) Minor surface damage such as burrs, nicks, scores, scratches, and similar defects may be repaired with a fine stone or abrasive cloth (PWC05-061). Remove all high spots and sharp edges.

(3) Clean up minor thread damage on elbow fittings with a suitable Swiss file, or chase with appropriate size die. Replace fittings if thread damage is severe.

B. Removal of Corrosion

NOTE: Only light surface corrosion may be removed from housing. Severe corrosion, indicated by surface etching and/or heavy pitting is cause for rejection of unit.

(1) Remove corrosion using one of the following methods:

(a) Mask off areas around corrosion and vapor blast to remove corrosion using abrasive grit (PWC05-167) or finer.

(b) Carefully polish with abrasive cloth (PWC05-101) followed by (PWC05-061)and smooth into surrounding area.

(2) Apply anti-corrosion treatment, (Ref. Para. C. following) , to all repair areas.

C. Application of Surface Treatment

(1) The anodic anti-corrosion finish on surfaces of housings may be repaired by local application of chemical treatment solution. This treatment must be used on areas where minor repairs have been done. To apply treatment, proceed as follows:

(a) Prepare surface by swabbing with solvent (PWC11-038). Keep surface wetted with cleaning agent for one to five minutes.

(b) Rinse with clean water to remove all traces of cleaning agent.

WARNING: ALODINE SOLUTION IS EXTREMELY DANGEROUS. IT CONTAINS AN OXIDIZING INGREDIENT WHICH CAN CAUSE AN EXPLOSION IF IT COMES IN CONTACT WITH COMBUSTIBLE MATERIALS SUCH AS PAINTS AND SOLVENTS.

(c) Apply chemical treatment solution (PWC05-166) to prepared surface by brush, swab or spray method and allow three to five minutes setting time.

(d) Rinse with clean water to remove all excess chemical treatment solution and allow surface to air dry.

(e) Examine coating and make sure repair area is completely covered. Reapply treatment as necessary.

9. Adjustment/Test

Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and do checks associated with Installation/Replacement of FCU (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

10. Storage

A. Preservation of Fuel Control Unit

(1) Storage:

(a) Drain all fuel or calibrating fluid (PWC03-002) from the fuel control unit.

(b) Flush with preservative oil (PWC05-077) by filling P1 and Pn ports.

(c) Fill the fuel control unit with preservative oil (PWC05-077) filtered through a 10 micron filter.

NOTE: Tilt the fuel control unit as necessary to make sure that a complete film of oil goes into all ports and passages of the fuel section of the unit.

(d) Drain the excess oil as required and install caps and plugs in all ports of the fuel section of the unit.

(e) Check the security of all caps and plugs in all openings of the air section of the fuel control unit to prevent the entrance of dirt or other contaminates.

(f) Put a tag on the unit indicating date of storage.

(g) For protection from dirt and other contaminants refer Para. 10. C.

B. Depreservation of Fuel Control Unit - Reconditioning after Storage before Installing the Engine

CAUTION: DO NOT TRY TO REPLACE ANY LOCKWIRE SEAL UNTIL THE FUEL CONTROL UNIT HAS BEEN CHECKED TO BE CERTAIN THAT CALIBRATION OR OPERATION HAS NOT BEEN AFFECTED.

(1) Inspect all lockwire and lockwire seals. Return the unit for recalibration if any lockwire seal indicates tampering or if the lockwire is broken.

(2) Check the external surface for corrosion or damage.

NOTE: Make sure plugs and covers are correctly installed.

NOTE: Make sure plugs and covers are correctly installed.

(3) Remove all storage and shipping parts when fuel control unit is to be used.

(4) Drain the preservative oil (PWC05-077) from the fuel control unit ports.

(5) Assemble the fuel control unit on the engine and connect the inlet port to the fuel system.

(6) Install a correct drain tube to the outlet port.

(7) Do a wet motoring for 30 seconds.

(8) Collect the fluid mixed with preservative oil in a suitable container.

(9) Remove the drain tube and connect the outlet to the engine fuel system.

C. Packaging and Shipping of Fuel Control Unit (Ref. Fig. 202)

(1) When the fuel control unit is to be shipped or stored, prepare the unit as follows:

NOTE: Make sure that all shipping plugs and caps are attached.

(a) Put the fuel control unit into a moisture and fume proof container or plastic bag and seal the opening. Attach a tag to the unit indicating the date of storage.

(b) Store the unit in approved reinforced cardboard container.

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Figure 201 Removal/Installation of Fuel Control Unit

Figure 202 Fuel Control Unit – Storage

74-00-00
IGNITION SYSTEM- DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

The spark ignition system has been developed to provide the engine with an ignition system capable of quick light-ups over a wide temperature range. The system consists of a usually airframe-mounted ignition exciter, individual high tension cable assemblies and spark igniters. The system is energized from the aircraft nominal 28 VDC supply and will operate in the 9 to 30 volt range.

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Figure 1 Ignition System - Components

74-00-00
IGNITION SYSTEM - MAINTENANCE PRACTICES

1. General

   A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00, STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

   B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

   C. Lockwire used , unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be called out in instructions.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Adjustment/Test

A. General

The ignition system may be tested for correct operation while the engine is installed in the airframe or with the engine installed in the maintenance stand.

B. Operational Check

WARNING: RESIDUAL VOLTAGE IN IGNITION EXCITER MAY BE DANGEROUSLY HIGH. MAKE SURE THAT IGNITION IS SWITCHED OFF AND SYSTEM HAS BEEN INOPERATIVE FOR AT LEAST SIX MINUTES BEFORE REMOVING ANY IGNITION COMPONENTS. ALWAYS DISCONNECT COUPLING NUTS AT IGNITION EXCITER END FIRST. ALWAYS USE INSULATED TOOLS TO REMOVE CABLE COUPLING NUTS. DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

(1) Switch ignition system OFF.

CAUTION: WHEN LOOSENING/TIGHTENING COUPLING NUTS DO NOT LET IGNITION CABLE BRAIDING OR FERRULES TURN AT THE SAME TIME.

(2) Disconnect coupling nut of one ignition cable from output connector on ignition exciter.

CAUTION: BEFORE SWITCHING ON IGNITION TO DO OPERATIONAL CHECK, DO A DRY MOTORING RUN (Ref. 71-00-00, ADJUSTMENT/TEST, Dry Motoring Run) TO REMOVE ANY FUEL THAT MAY BE IN GAS GENERATOR CASE.

(3) Switch ignition ON.

(4) Listen at gas generator case for snapping sound with frequency of approximately one snap per second. Switch ignition OFF.

(5) Reconnect coupling nut of ignition cable to ignition exciter and remove other cable coupling nut. Repeat steps (3) and (4).

(6) If snapping sound is not heard on either check, replace ignition exciter (Ref. 74-10-00, Removal/Installation) and repeat steps (1) through (5).

(7) If snapping sound is not heard on one check only, replace respective spark igniter and/or ignition cable (Ref. 74-20-00, Removal/Installation) and repeat operational check. If spark igniter still fails, replace ignition exciter.

6. Fault Isolation

For detailed fault isolation of ignition system, refer to Chapter 72-00-00, FAULT ISOLATION.

74-10-00
IGNITION EXCITER - DESCRIPTION AND OPERATION

1. Description and Operation

The ignition exciter comprises a sealed unit containing electronic components encased in an epoxy resin. The unit is energized only during the engine starting sequence to initiate combustion in the combustion chamber. The exciter transforms the DC input to a pulsed high voltage output through solid state circuitry, a transformer and diodes.

When the unit is energized, a capacitor on the high voltage side of the output transformer is progressively charged until the energy stored, approximately four joules, is sufficient to ionize a spark gap in the unit and discharge the capacitor across the two spark igniters through a dividing and step-up transformer network. The network is designed so that if one igniter is open or shorted, the remaining igniter will continue to function. The network also enables the capacitor to discharge automatically in the event of either or both igniters becoming inoperative or input voltage is switched off.

The ignition exciter is usually remotely installed by the airframe manufacturer as the engine mount structure tends to prevent direct mounting on the engine. Refer to applicable airframe manufacturer's manual for details of off-engine mounted exciter attachments.

74-10-00
IGNITION EXCITER - MAINTENANCE PRACTICES

1. General

   A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

   B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

   C. Lockwire used, unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC06-005	DELETED
PWC11-012	Acetone
PWC11-014	Alcohol, Isopropyl
PWC11-023	Solvent, Cleaning
PWC11-025	Solvent, Cleaning

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

WARNING: RESIDUAL VOLTAGE IN IGNITION EXCITER MAY BE DANGEROUSLY HIGH. TURN IGNITION OFF. ALWAYS DISCONNECT COUPLING NUTS AT IGNITION EXCITER END FIRST. ALWAYS USE INSULATED TOOLS TO REMOVE CABLE COUPLING NUTS. DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

A. Removal of Ignition Exciter

(1) Isolate power from ignition system.

(2) Remove supply cable (1 , Fig. 201) from input connector (2) on ignition exciter (3).

CAUTION: WHEN LOOSENING/TIGHTENING COUPLING NUTS DO NOT LET IGNITION CABLE BRAIDING OR FERRULES TURN AT SAME TIME.

(3) Remove ignition cable couplings (6) from output connectors (5) on ignition exciter.

(4) Remove bolts, washers (4) and ignition exciter from the airframe.

B. Installation of Ignition Exciter

NOTE: For installation of units refer to relevant airframe manufacturer's manual.

(1) Install ignition exciter.

(2) DELETED.

CAUTION: DO NOT LUBRICATE THE IGNITION EXCITER THREADS.

CAUTION: WHEN LOOSENING/TIGHTENING COUPLING NUTS DO NOT LET IGNITION CABLE BRAIDING OR FERRULES TURN AT SAME TIME.

(3) Connect coupling nuts of supply cable (1, Fig. 201) and two high tension ignition cable couplings (6) to respective connectors (2) and (5) on ignition exciter. Tighten nuts fingertight plus 45 degrees and lockwire.

(4) Reconnect coupling nuts at other end of ignition cables to spark igniters. Tighten nuts fingertight plus 45 degrees.

6. Cleaning/Painting

A. Cleaning of Ignition Exciter

(1) Remove all corrosion residue using a stainless steel wire brush.

(2) Clean affected surfaces thoroughly using a clean lint free cloth moistened with acetone (PWC11-012), isopropyl alcohol (PWC11-014), solvent (PWC11-023) or (PWC11-025).

(3) Apply a thin layer of engine oil (PWC03-001) on the threads of the ignition exciter.

7. Inspection/Check

A. Inspection of Ignition exciter

(1) Examine ignition exciter for damage and general condition.

(2) Examine input and output connectors for damage, paying particular attention to connector threads for corrosion.

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Figure 201 Removal/Installation of Ignition Exciter

74-20-00
IGNITION CABLES AND SPARK IGNITERS - DESCRIPTION AND OPERATION

1. General

A. Ignition Cables

Two individual ignition cables carry the electrical energy output from the ignition exciter to the engine mounted spark igniters. Each cable assembly consists of an electrical lead contained in a flexible metal braiding. Coupling nuts at each end facilitate connection to respective connectors on ignition exciter and spark igniter. Mounting flanges for attachment to the engine fireseal mount rings are free to move on the flexible braiding.

B. Spark Igniters (Ref. Fig. 1)

The air-cooled spark igniters, located at the 4 and 9 o'clock positions on the gas generator case adjacent to the fuel manifold, are in the form of a double-ended, threaded plug with a central positive electrode, enclosed in an annular semi-conducting material. The electrical potential developed by the ignition exciter is applied across the gap between the central conductor and the igniter shell (ground). As this potential increases, a small current passes across the semi-conducting material. This current increases until the air between the central conductor and the shell ionizes. When ionization occurs, high energy discharges between the electrodes. The spark always occurs somewhere in the annular space between the central conductor and shell.

Spark igniters are procured under a single part number which covers several parts obtained from different sources. Although individual parts may thus differ in detail appearance, the function is identical and they are fully interchangeable.

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Figure 1 Spark Igniter Installation

CABLES & SPARK IGNITERS - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-058	Solder, Tin-Alloy
PWC06-005B	DELETED
PWC06-023	DELETED
PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-032	Solvent, Degreaser
PWC06-036	DELETED
PWC06-036A	DELETED

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

WARNING: MAKE SURE IGNITION IS SWITCHED OFF AND SYSTEM HAS BEEN INOPERATIVE FOR AT LEAST SIX MINUTES BEFORE REMOVING ANY IGNITION COMPONENTS.

A. Removal of Ignition Cables

(1) Isolate power from ignition system.

WARNING: DISCONNECT COUPLING NUTS AT IGNITION EXCITER FIRST. USE INSULATED TOOLS TO REMOVE CABLE COUPLING NUTS. DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

CAUTION: WHEN LOOSENING/TIGHTENING COUPLING NUTS, DO NOT LET BRAIDING, FERRULES OR IGNITER PLUGS TURN.

(2) Remove left and right ignition cables (2 and 3, Fig. 201) from ignition exciter and respective spark igniters (1 and 4). Cap/cover cable connections.

(3) To gain access for removal of cables, loosen coupling nuts of diverter valve outlet tube at tee adapter and diverter valve. Allow residual oil to drain into suitable container. Cap/cover end fittings and tube.

(4) Remove self-locking nut and bolt fastening ignition cable loop clamps to loop clamp on No. 2 bearing scavenge oil tube or center fuel tube as applicable.

NOTE: Routing of engine ignition cables from rear fireseal to ignition exciter is dependent on left or right airframe installation. Refer to Aircraft Maintenance Manual for location of ignition exciter.

(5) Remove self-locking nuts and bolts fastening cable flanges (5) and support bracket (6) to rear mount ring (Detail G).

(6) Remove self-locking nut and bolt fastening loop clamp (18) to No. 2 bearing scavenge oil tube loop clamp (17). Remove loop clamp (18) (Detail C).

(7) Remove bolt fastening loop clamp (7) to No. 2 bearing scavenge tube flange. Remove loop clamp as required (Detail B).

(8) Remove self-locking nut and bolt fastening loop clamps (9 and 11) to brackets (10 and 12) at center mount ring. Remove loop clamps (Detail A).

(9) Remove self-locking nuts and bolts fastening left cable flange (8) to center mount ring (Detail A).

(10) Remove left ignition cable (2) through respective mount rings.

(11) Remove self-locking nut and bolt fastening loop clamp (19) to fuel tube loop clamp (20). Remove loop clamp (19) (Detail F).

(12) Remove bolt fastening loop clamp (13) to P3 air tube flange. Remove loop clamp (Detail E).

(13) Remove self-locking nuts and bolts fastening right cable flange (14) to center mount ring (Detail D).

(14) Remove self-locking nut and bolt fastening loop clamp (15) to bracket (16) at center mount ring. Remove loop clamp (Detail D).

(15) Remove right ignition cable (3) through respective mount rings.

B. Removal of Spark Igniters

(1) Isolate power from ignition system.

CAUTION: WHEN LOOSENING/TIGHTENING COUPLING NUTS, DO NOT LET BRAIDING, FERRULES OR IGNITER PLUGS TURN.

(2) Remove coupling nut of ignition cable from respective spark igniter (Ref. 74-20-00, Removal/Installation).

(3) Remove spark igniters (2, Fig. 202) from gas generator case.

(4) Remove copper gasket (1) from each spark igniter.

C. Installation of Ignition Cables

(1) Install ignition cables (2 and 3, Fig. 201) between center and rear mount rings passing cable ends through respective holes.

CAUTION: BOLTS MUST BE INSTALLED WITH HEADS ON AIR INLET SIDE OF MOUNT RINGS.

(2) Install cable flanges (5) on rear fireseal mount ring with bolts and self-locking nuts. Upper bolts also fasten support bracket (6). Tighten nuts 36 to 40 lb.in. (Detail G).

(3) Install cable flanges (8 and 14) on center mount ring, with bolts and self-locking nuts. Tighten nuts 36 to 40 lb.in. (Details A and D).

(4) DELETED.

CAUTION: WHEN LOOSENING/TIGHTENING COUPLING NUTS, DO NOT LET BRAIDING, FERRULES OR IGNITER PLUGS TURN.

(5) Connect ignition cables (2 and 3) to respective spark igniters (1 and 4) and connectors on ignition exciter. Screw couplings into mating threads by hand. Check there is no binding between coupling nut and cable. Tighten coupling nuts fingertight plus 45 degrees. Lockwire coupling nuts at ignition exciter.

(6) Install loop clamps on rear of ignition cables (2 and 3) and position adjacent to loop clamp on No. 2 bearing scavenge oil tube or center fuel tube as applicable with bolt and self-locking nut. Tighten nut 36 to 40 lb.in.

(7) Install loop clamp (18) on left ignition cable (2) to loop clamp (17) on No. 2 bearing scavenge oil tube with bolt and self-locking nut. Tighten nut 36 to 40 lb.in. (Detail C).

(8) Install loop clamp (7) on left ignition cable (2) to No. 2 bearing flange with bolt. Tighten bolt 36 to 40 lb.in. and lockwire (Detail B).

(9) Install left ignition cable loop clamps (9 and 11) and fasten to brackets (10 and 12) with bolts and self-locking nuts. Tighten nuts 36 to 40 lb.in. (Detail A).

(10) Install right ignition cable loop clamp (15) and loop clamp to bracket (16) at center mount ring with bolt and self-locking nut. Tighten nut 36 to 40 lb.in. (Detail D).

(11) Install loop clamp (13) on right ignition cable (3) and fasten loop clamp to P3 air tube flange with bolt. Tighten bolt 36 to 40 lb.in., and lockwire (Detail E).

(12) Install right ignition cable loop clamp (19) to loop clamp (20) on fuel tube with bolt and self-locking nut. Tighten nut 36 to 40 lb.in. (Detail G).

(13) Install thermostatic bypass and check valve outlet tube and connect coupling nuts to valve and scavenge oil pump tee adapter. Tighten coupling nuts 450 to 500 lb.in., and lockwire.

D. Installation of Spark Igniters

(1) Install new copper gasket (1, Fig. 202) on each spark igniter (2).

(2) If necessary, chase igniter boss threads (Ref. 72-30-04, Approved Repairs).

(3) DELETED.

CAUTION: DO NOT LUBRICATE THE IGNITER THREADS OR IGNITER BOSS THREADS.

(4) Install the spark igniters (2) in bosses at 4 o'clock and 9 o'clock positions on the gas generator case. Torque the spark igniters 200 to 240 lbf.in.

(5) Insert central conductor of ignition cable into respective spark igniter (Ref. Para. 5.C.).

6. Cleaning/Painting

A. Spark Igniters

CAUTION: DO NOT CLEAN THE NOSE (FIRING) END OF THE IGNITERS. DO NOT REMOVE CARBON FROM THE ELECTRODES OR FROM ANNULAR GAP AREAS. CARBON DEPOSITS IN THE GAP AREA ACT AS AN AID IN IGNITER OPERATION.

(1) Use a felt swab soaked in alcohol (PWC11-014) or (PWC11-031) to clean the inside surface of the terminal well and contact pin.

(2) Dry using clean, dry compressed air.

B. Ignition Cables

CAUTION: ISOPROPYL ALCOHOL (PWC11-014) IS FLAMMABLE AND HARMFUL TO EYES AND BREATHING PASSAGES. KEEP AWAY FROM IGNITION SOURCE. WEAR PROTECTIVE CLOTHING AND USE IN PROPERLY VENTILATED AREA.

CAUTION: DO NOT IMMERSE CABLE IN ALCOHOL.

(1) Clean inside of cable terminal with a wood stick (0.050 to 0.060 in.dia.) dampened with alcohol (PWC11-014).

(2) Spray alcohol (PWC11-014) in terminal to remove any dirt or foreign material.

(3) Dry using clean, dry compressor air.

7. Inspection/Check

A. Spark Igniters

(1) Examine exterior cylindrical area of firing end of igniter shell for chafing wear.

NOTE: Wear is acceptable to a depth of 0.015 inch.

(2) Inspect igniter shell and electrode for erosion (Ref. Fig. 203 and Table 201). If erosion equals or exceeds amount shown, reject spark igniter.

(3) Check air cooling holes are clear and unobstructed.

(4) Inspect igniter plug contact pin for erosion/burning. Replace plug if such condition is apparent.

(5) Positive retention must exist between the igniter pin and the ignition cable terminal.

(6) Test spark igniters (Ref. 74-00-00, Adjustment/Test).

Table 201 Spark Igniter Erosion Limits (Ref. Fig. 203)

B. Ignition Cables

(1) Inspect cables for signs of damage to braiding and general condition.

(2) Inspect cable coupling nuts for corrosion.

(3) Inspect central conductor and insulation for contamination and burning.

(4) Do retention test on igniter end of cable only:

(a) Mate an igniter plug to the end of the cable, but do not attach it.

CAUTION: DO NOT LET THE IGNITER PLUG DROP TO THE GROUND WHEN PERFORMING THE NEXT STEP.

(b) The igniter plug must remain in place when pointed toward the ground.

(c) Positive retention must exist between the ignition cable terminal and the igniter plug. Do retention test again with new igniter plug if necessary. Replace ignition cable if not successful.

8. Approved Repairs

A. Cable Braiding Minor Damage

(1) Examine damaged area. Make sure damage does not exceed 0.375 inch long, edge of damage is at least 0.500 inch from nearest connector or flange and there is no damage to underlying insulation.

WARNING: CLEAN CABLE ASSEMBLY IN A WELL-VENTILATED AREA. AVOID PROLONGED INHALATION OF FUMES. WEAR PROTECTIVE (RUBBER) GLOVES AND WASH HANDS AFTER EXPOSURE TO CLEANER.

WARNING: WEAR PROTECTIVE EQUIPMENT FOR EYES AND FACE WHEN USING COMPRESSED AIR. AIR PRESSURE MUST NOT EXCEED 30 PSI.

(2) Clean damaged area of braiding with clean cloth dampened with solvent (PWC11-014) or (PWC11-032), to remove all contaminants from ignition cable.

CAUTION: SOLDERING IRON MUST NOT EXCEED 250 WATTS. APPLY ONLY ENOUGH HEAT TO FLOW SOLDER.

(3) Use a solder (PWC05-058) with suitable flux to solder damaged area. Overlap damaged area by approximately 0.125 inch.

(4) Clean braiding with solvent (PWC11-014) or (PWC11-032), then dry repaired area with filtered, compressed air not exceeding 30 psi.

(5) Smooth repaired area with abrasive cloth to blend with braided surface. Repeat Step (4), as required.

(6) Check cable assembly for continuity and insulation resistance prior to installation (Ref. Adjustment/Test).

B. Cable Braiding Major Damage (Ref. Fig. 204)

(1) Examine damaged area. Make sure damage, (Ref. Subpara. A.), does not exceed 1.00 inch long and is at least 0.500 inch from nearest connector, flange or existing repair. Replace ignition cable assembly if damage exceeds these limits.

(2) Remove loose strands of braiding around damaged area.

(3) Wrap tape (PWC05-066A) around cable braiding, covering all of damaged area as shown.

(4) Wrap repaired area with stainless steel wire as shown. Hold wrapping wire supply along length of cable braid beginning from the left. Starting at opposite end, wrap wire tightly and uniformly over cable braiding and repaired area.

NOTE: Make sure wire overlaps tape and contacts cable braiding at each end of repair.

(5) When approximately two-thirds of wrapping is completed, allow short end of loop to remain exposed. Continue wrapping wire to complete remaining distance, shown as "1/3X".

(6) After final turn of wrapping, insert wire "A" through loop as shown. Cut off surplus end "B" of wire so that length is approximately one-third of repair length. Pull loop and "C" until wire at "A" is snug and end "B" of wire has just disappeared underneath final turn of wrapping. Cut wire and "C" flush.

(7) Test cable assembly for continuity and insulation resistance prior to usage (Ref. Adjustment/Test).

9. Adjustment/Test

A. Ignition Cables

(1) Check for continuity using an ohmmeter Model 260, or other low voltage continuity device. Resistance from terminal to terminal must be 0.5 Ω max.

(2) Insulation resistance between metal braiding and inner cable must be 100 KΩ min.

NOTE: Return defective cables to authorized repair shop for inner cable replacement.

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Figure 201 Removal/Installation of Ignition Cables

Figure 202 Removal/Installation of Spark Igniters

Figure 203 Spark Igniter Inspection

Figure 204 Repair of Ignition Cable - Major Damage

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201 Spark Igniter Erosion Limits (Ref. Fig. 203)

AIR - DESCRIPTION AND OPERATION

1. General

Three separate air systems are provided for the engine; one system for bearing compartment sealing, a second for cooling air, and the third for compressor bleed valve and airframe services. Compressor discharge air involved with engine control is dealt with in chapter 73-10-07.

2. Description and Operation (Ref. Fig. 1)

A. General

Air is utilized to seal the Nos. 1, 2 and 3 bearing compartments and to cool the compressor and power turbine disks, and the compressor turbine stator. Pressure air is used in conjunction with labyrinth seals to establish and control the required pressure gradients. The labyrinth seals consist of two separate parts, one rotating within the other. One part has a smooth surface, the other has annular knife edges. The knife edges may either be stationary or rotating, as well as internal or external, depending on the location within the engine. These parts together form an air seal when matched. The running clearance between each pair of rotating and stationary parts is kept to a minimum.

Compressor interstage air (P2.5) is utilized to provide a pressure differential across the labyrinth seal located in front of the No. 1 bearing. The air is bled through slots in the hub of the fourth-stage compressor disk and into the center of the rotor assembly. Air then flows rearward through passages in the compressor disks and out to an annulus in the center of the labyrinth seal through passages in the compressor rear hub. The air is metered through the labyrinth to form the pressure seal. Air flowing forward through the seal feeds into the inlet air stream while air flowing to the rear vents into the accessory gearbox together with the scavenged oil; it is then separated by the centrifugal breather impeller and bled overboard.

The No. 2 bearing is protected by a single labyrinth seal at the front end and a double seal at the rear. Pressure air for this area is bled from the labyrinth seal connecting it to the turbine cooling air system. The air flows through passages in the No. 2 bearing support, equalizing pressure at the front and rear of the bearing compartment, and ensures a pressure seal in the front and rear labyrinths. The No. 2 bearing cavity seal air is dumped into the accessory gearbox through the bearing oil scavenge line.

Cooling air from around the combustion chamber liner inner wall passes through ports in the forward wall of the outer liner to internal passages between the compressor turbine vane ring sealing ring and inner support lugs. Air then passes through circulating passages in each vane and vents axially from the vane trailing edge.

The compressor, and first and second-stage power turbine disks are cooled by compressor discharge air from the diffuser exit zone down the rear face of the combustion chamber outer liner. The air is then metered through holes in the compressor turbine stator support flange of the gas generator case into the turbine hub baffles. This air splits into three paths: one metered path directs air to cool the rear face of the compressor turbine disk, the second pressurizes the No. 2 bearing front labyrinth seal while the balance passes through holes in the compressor turbine disk hub and into the centerbore. A portion of this air is metered over the front face of the compressor turbine disk by the interstage baffle. The remaining air passes through a hole in the center of the interstage baffle and into a zone immediately to the rear of the power turbine first-stage disk. Metering seals on the interstage baffle direct some of the air over the rear face of the first-stage disk, while the remainder is directed through holes in the disk hub to an annular space between the power turbine shaft and the centerbore of the first and second-stage power turbine disks. A portion of this air is allowed to bleed out between the first and second-stage disks at the PT rotor labyrinth seal. The balance is passed through holes in the hub of second-stage disk to pressurize the No. 3 bearing double labyrinth seal. Air bleeding forward through the seal is returned to the accessory gearbox via the No. 3 and 4 scavenge oil line, while air bleeding to the rear through the seal is metered over the front face of the second-stage power turbine disk.

Cooling air passing over the front and rear faces of the compressor and power turbine disks is dissipated into the main exhaust gas stream at the blade roots. The Nos. 1, 2 and 3 bearing cavity sealing air is carried with the scavenged oil into the accessory gearbox where it is separated from the oil by the centrifugal breather and vented to atmosphere.

B. Compressor Bleed Valve

The compressor bleed valve, located on the gas generator case at the 3 o'clock position, automatically opens ports in the gas generator case to spill interstage compressor air (P2.5) and prevent compressor stall.

The operation of the bleed valve is controlled by P3 pressure taken from the vicinity of No. 2 bearing air seal.

On starting and at low Ng, the bleed valve is open as P2.5 is greater than P3 but, as Ng increases, P3 becomes greater than P2.5 and the valve becomes closed at high Ng.

Compressor interstage air (P2.5) released by the compressor bleed valve is directed to hollow struts in the compressor air inlet case from where it escapes into the inlet flow of air through a series of tangential openings in the struts. The effect of this escaping air is to create a swirl effect and reduce compressor stall during starting and low power operations.

C. Air Supply for Airframe Services

Two supply pressures, P2.5 and P3, are provided for airframe services. The P2.5 pad, located at the 12 o'clock position, consists of a short flanged tube, secured by countersunk screws and connecting with the compressor rotor axial stages.

The P3 adapter pads are located further forward on the gas generator case at the 3 and 9 o'clock positions. Each pad is connected through internal passages to the diffuser zone in the gas generator case. Depending on airframe installation, the case exit port may include an optional angled adapter.

3. Fault Isolation

For detailed fault isolation of the air system, refer to Chapter 72-00-00, FAULT ISOLATION.

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Figure 1 Engine Airflow and Cooling Air (Typical)

75-30-00
COMPRESSOR BLEED VALVE - DESCRIPTION AND OPERATION

1. Description and Operation

The compressor bleed valve is located at the 3 o'clock position on the gas generator case. It has a piston type valve that operates in a ported housing, the housing vents interstage air acting on the open end of the piston into a closed plenum directly in front of the compressor inlet case. The piston is supported in the housing by a rolling diaphragm and guide pin which permits full travel in each direction, to open or close the housing ports while effectively sealing the air chamber at the top of the piston.

The bleed valve is bolted to the mounting flange on the gas generator case, a hollow spring pin protrudes from the valve mounting flange align the compressor discharge (P3) air hole in the gas generator case and the core passage in the valve housing.

P3 air is taken through a primary metering plug to a convergent-divergent metering orifice which vents to atmosphere. The convergent-divergent orifice is designed to create a choked flow over the necessary engine operating range results in a fixed pressure ratio P3/Px, where Px is the control, pressure between the primary metering plug and the convergent-divergent orifice acts on the top of the piston. The position of the floating piston is dependent on the balance of forces between compressor interstage (P2.5) air and Px. At low engine power, where P2.5 is much greater than Px, the piston will be full open. As power is increased, Px increases and balances P2.5, and the piston starts to close. This results in progressive due to the Px/P2.5 ratio. At high power, the piston completely closed and Px is higher than P2.5. As this is a pressure ratio control, it will maintain constant P3/P2.5 when it is modulating, regardless of Pa and Ta.

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Figure 1 Compressor Bleed Valve Installation

COMPRESSOR BLEED VALVE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC09-003	Compound, Sealing

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Compressor Bleed Valve

(1) Remove bolts (2, Fig. 201), washers (3), center plug and preformed packing from cover of compressor bleed valve (4). Discard packing.

(2) Remove bleed valve.

NOTE: Compressor bleed valve seat (7) is classified (Ref. IPC) and must remain with gas generator assembly.

(3) Remove and retain retaining ring (6) and seal ring (5) from bleed valve. Remove and discard preformed packing (8).

CAUTION: CAREFULLY MOVE THE PISTON OUT OF THE BLEED VALVE WHEN YOU REMOVE THE VALVE SEAT.

(4) Remove the screws (1) that attach the valve seat (7).

(5) Carefully slide and remove the piston (9), metal seal ring (11) and plastic seal ring (10) from the compressor bleed valve (4).

B. Installation of Compressor Bleed Valve

(1) Install the metal seal ring (11) in the groove on the piston (9) and plastic seal ring (10) in the same groove over metal seal ring. Make sure that the ring joints are 180 ± 20 degrees apart.

(2) Compress the seal rings, then install the piston (9) into the compressor bleed valve (4) from the seat end of housing.

(3) Install seat (7, Fig. 201) on replacement bleed valve with screws (1). Tighten screws 5 to 6 lb.in.

(4) Install new lubricated preformed packing (8) on compressor bleed valve. Position seal ring (5) followed by retaining ring (6) on bleed valve.

(5) Align spring pin in bleed valve with hole in gas generator case bleed valve housing. Make sure preformed packing (8) is still in position around pin. Push bleed valve into position.

(6) Apply compound (PWC09-003) to threads of bolts (2). Install bleed valve with bolts and washers (3). Tighten bolts 16 to 20 lb.in., and lockwire.

(7) Install new lubricated preformed packing and center plug in cover of bleed valve if previously removed. Tighten 15 to 20 lb.in., and lockwire.

6. Cleaning/Painting

A. Cleaning of P3 Input Line to Bleed Valve

(1) When a compressor bleed valve is removed from gas generator case following erratic operation, check that P3 input line to bleed valve is free of obstructions. Apply clean, dry compressed air at P3 port of bleed valve mounting boss in gas generator case; free air flow must exist.

7. Inspection/Check

A. Inspection of Valve Housing and Cover

(1) Examine for cracks, dents, nicks and other damage.

(2) Examine sealing and mating surfaces for scratches, galling, scoring and other surface damage, particularly those parts affected by travel of piston (viewable through exit ports).

NOTE: Send compressor bleed valve to an approved overhaul facility for replacement of components. No field repair is permitted.

B. Inspection Of Bleed Valve Seat

(1) Examine for surface damage at piston contact face. Check if classification number is visible. If not, measure Dia. A (Ref. Fig. 202). Refer to IPC P/N 3038323 for class number, and vibropeen same on inner face of valve seat.

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Figure 201 Removal/Installation of Compressor Bleed Valve

Figure 202 Inspection and Identification of Compressor Bleed Valve Classified Seat

76-00-00
ENGINE CONTROLS - DESCRIPTION AND OPERATION

1. General

The engine controls consist of power control, propeller control, fuel control levers, connecting rods and a push/pull control assembly mounted on the top right-hand side running the full length of the engine.

2. Description (Ref. Fig. 1)

The fuel condition lever in the cockpit is connected through airframe linkages to a combined lever and stop mechanism on top of the fuel control unit; this is connected via the FCU linkage to the fuel cut-off lever on the side of the unit. This lever and stop also function as an idle stop for the FCU interconnect rod. With the cockpit fuel condition lever set to GROUND-IDLE, the FCU is set to approximately 55% Ng . With the fuel condition lever set to FLIGHT-IDLE, the FCU is set to approximately 69% Ng.

The power control lever in the cockpit is connected through airframe linkages to the cambox assembly mounted in front of the FCU. The power control lever controls engine power through the full range from maximum takeoff to full reverse. It also selects the propeller pitch (Beta control) from reverse selection up to the constant speed rpm as selected by the cockpit propeller control (propeller speed) lever.

The cambox assembly, mounted on the accessory gearbox (Flange G) at the 2 o'clock position, provides scheduled controlled movements to the FCU and propeller governor. The cam assembly consists of power control lever (input), which is connected directly to propeller control cam/lever, through a cam follower and cam pin, and a lever mounting bracket.

The FCU actuating lever is connected through an adjustable interconnect rod to the FCU control lever. In operation, movement of the power control lever moves the cam follower through the propeller control lever cam slot. During normal propeller operation, from ground-idle through flight-idle to takeoff, the cam follower lever pin moves in the circumferential slot of the cam, but imparts no motion to the propeller control lever. However, on selection of reverse power the lever pin moves into the radial section of the slot, rotating the propeller control lever and transmitting this motion through the push-pull control assembly to the propeller reversing lever. An adjustable interconnect rod, secured to the front of the push-pull control assembly, connects the propeller reversing lever to the propeller governor reset arm. A carbon block attached to the inner end of the propeller reversing lever provides the mechanical link between the engine reversing linkage and the propeller feedback ring.

3. Operation

3. Operation

A. Low Pitch Control Cycle

Assume the cockpit power control (engine power) lever is normally placed in the GROUND-IDLE (GROUND FINE) position prior to engine starting. At this point, the cam follower lever pin is at the intersection of the circumferential and radial sections of the propeller reversing cam slot, the propeller reversing lever, and hence, the propeller feedback ring is at its maximum rearmost position and the Beta control valve allows oil to flow to the propeller.

As the engine starts and propeller rpm increases, the propeller governor senses an underspeed and directs pressure oil to the propeller servo piston to effect a decrease in pitch. At an angle somewhat above the low pitch setting, the propeller servo piston picks up low pitch adjustment stops on the propeller guide rods; this causes the feedback ring to move axially forward.

As the ring moves forward, the propeller reversing lever pivots on the fork end of the reversing linkage, which, in this condition, is static and moves the Beta control valve forward. When this occurs, oil from the propeller servo is returned to the engine reduction gearbox. This process continues until the amount of oil leakage back to the reduction gearbox equals the amount being supplied by the propeller governor. When the two are equal there will be no further change in pitch and the propeller blades will be in low pitch.

B. High Pitch Control Cycle

With the engine operating and the propeller in low pitch (high rpm), the power control lever is advanced from GROUND-IDLE through FLIGHT-IDLE to TAKEOFF. The movement is transmitted to the cam follower lever pin which moves from its GROUND-IDLE position in the cam slot along the circumferential section to the TAKEOFF position. This movement causes no change in relative position of the propeller reversing cam and therefore no movement of the reversing lever. Movement is, however, transmitted via the fuel control actuating lever and interconnecting rod to the FCU arm, which moves to its full power position.

As propeller governing speed is reached the propeller governor commences to dump pressure oil from the propeller servo to increase pitch and maintain speed. The feedback ring moves back to its rearward position, shutting off the Beta control valve and allowing the propeller to operate in a conventional manner. Some airframe installations include a quadrant gate effect at the FLIGHT-IDLE position and may require positive action on the part of the operator, such as resetting of a Ground/Air Selector to Ground position, before the power control lever can be returned to the GROUND-IDLE position.

C. Reverse Pitch Control Cycle

To go into the reverse pitch configuration from the low pitch configuration, the cockpit power control (engine power) lever is pulled back through a gate on the quadrant into the REVERSE position. This action moves the cam follower lever pin from the circumferential section and up the radial section of the cam slot, rotating the propeller reversing cam and transmitting a pulli force on the push-pull wire rope. Movement of the wire rope to the rear causes the propeller reversing lever to pivot on the carbon block and partially open the Beta control valve. This increases pressure oil being supplied by the propeller governor an since this condition is representative of an underspeed, the propeller blades will move through low pitch and into the negative pitch range as long as the propeller reversing lever continues to move. As the propeller moves into low pitch, the feedback rin moves forward in an attempt to close the Beta control valve and prevent any further change in blade pitch. This cannot occur while the propeller reversing lever continues to move toward full reverse.

As the propeller reaches the full reverse pitch position, movement at the fork end of the propeller reversing lever ceases. The reversing lever will then have travelled only far enough to move the Beta control valve to a null position where oil flow into the propeller servo is equal to the return flow. The power turbine governor (Nf) section of the propeller governor is simultaneously reset 5 percent below selected propeller speed by the reset lever and associated lost motion link.

This final setting leads the propeller and is attained before the propeller blades reach full reverse pitch. Selection of reverse pitch also repositions the FCU arm to increase fuel flow and, consequently, power output.

The chosen relationship of engine power to propeller pitch depends on operating requirements. Should the relationship selected be such as to require 86 percent Nf, the power turbine governor section of the propeller governor will limit the engine power according to the ability of the propeller to absorb the power at that speed.

D. Reverse to Low Pitch Control Cycle

The process of returning to low pitch from full reverse is exactly opposite to going into full reverse. That is, as the cockpit pow control (engine power) lever is moved from its full REVERSE position towards the low pitch GROUND-IDLE position, the Beta reversing valve is closed past its null position, dumping more oil from the propeller servo than is being supplied by the propell governor. As propeller pitch moves out of the reverse pitch range, fuel flow is progressively reduced as the cam follower lever moves down the radial section of the cam slot until it reaches the radial and circumferential intersection and the power turbin governor is reset to the lower Nf setting through the reset arm, lost motion link and reversing linkage. Low pitch is obtained when the amount of oil returned to the reduction gearbox is equal to the amount being delivered by the propeller governor.

4. Fault Isolation

For detailed fault isolation of the engine controls refer to Chapter 72-00-00, FAULT ISOLATION.

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Figure 1 Engine Controls and Propeller Reversing Linkage

76-10-00
PROP REVERSE LINKAGE - DESCRIPTION AND OPERATION

1. Description and Operation

The propeller reversing interconnect linkage provides the mechanical link between the power control lever and the propeller reversing lever. The rear of the push/pull control assembly is attached to the propeller control cam (of the cambox assembly at flange G on the accessory gearbox) by a clevis at the rear casing terminal. The front of the push/pull control assembly is attached to the propeller reversing lever by a clevis at the front casing terminal. Both casing terminals incorporate swivel joints to accommodate alignment. The push/pull control assembly comprises a wire rope housed in a self-lubricated stainless steel casing assembly and passes through the engine front lifting bracket and fireseal mounting rings. A removable plate is incorporated at the front lifting bracket to allow the front linkage to be disconnected from the engine without disturbing linkage rigging during, for instance, power section module removal.

PROP REVERSE LINKAGE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-061	Cloth, Abrasive
PWC05-089	Wire, Locking
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC50745	Rigging Pin, Propeller Reversing Lever

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Propeller Reversing Linkage, Rear

(1) Disconnect engine controls (Ref. Aircraft Maintenance Manual).

(2) Note position of push/pull control assembly rear clevis on propeller control cam (7, Fig. 201), and remove cotterpin (21), washer (24) and pin (8) fastening clevis to propeller control cam.

(3) Note position of FCU interconnect rod (13) on power control lever (4), and remove cotterpin, nut (19), washer (22), spacer (10), bolt (18) and rod from power control lever.

(4) Remove bolt (16) and nuts fastening lever mounting bracket (6) to accessory gearbox at Flange G, and angle bracket (15) respectively.

(5) Loosen or remove bolts, as required, fastening angle bracket (15), to allow lever mounting bracket (6) to clear studs at Flange G.

(6) Remove clamping bolt (1) fastening cam follower (2) to grooved pin (14).

(7) Withdraw pin (14), holding cam follower (2) and power control lever (4), between arms of lever mounting bracket (6) and remove power control lever (4) from shouldered pin (3).

(8) Remove cotterpin and washer fastening shouldered pin (3) to propeller control cam (7) and cam follower (2).

(9) Remove cotterpin (21), washer (23) and pin (5) fastening propeller control cam (7), spacer (9) and rigging plate (17) to lever mounting bracket.

B. Removal of Propeller Reversing Linkage, Front (Ref. Fig. 202)

(1) Remove cotterpin, nut (10), bolt (4) fastening propeller reversing lever (7) and sleeve spacer (6) to front clevis (11).

(2) Remove cotterpin, washer and pin (9) fastening sleeve bushing (8) and propeller reversing lever (7) to propeller governor beta valve clevis.

(3) Remove cotterpin, nut (1), washers (14), spacer (3) and bolt (5) fastening governor interconnect rod upper rod end (2) to control terminal.

(4) Remove cotterpin, nut (13), washer (14) and bolt (15) fastening governor interconnect rod internal adjuster (12) to propeller governor reset arm.

C. Removal of Propeller Reversing Linkage, Push/Pull Control Assembly

(1) Note position of rear clevis (1, Fig. 203) on propeller control cam and remove cotterpin, washer and pin fastening clevis to propeller control cam.

(2) Loosen jam nut (2). Remove rear clevis (1) and jam nut from sleeve nut (3).

(3) Hold casing rear terminal (6) and remove sleeve nut (3).

(4) Remove rear ball end (4) from wire rope (5), and casing rear terminal (6) from rear swivel joint (10).

(5) Remove cotterpin, nut (1, Fig. 202), washers, spacer (3) and bolt (5) fastening governor interconnect rod upper end (2) to push/pull control assembly front terminal.

(6) Remove cotterpin, nut (10) and bolt (4) fastening front clevis (11) and sleeve spacer (6) to propeller reversing lever (7).

(7) Loosen front jam nut (22, Fig. 203) and remove front clevis (23) and jam nut from control terminal (20).

(8) Hold casing front terminal (21), and remove control terminal (20).

(9) Remove front ball end (4) from wire rope (5) and casing terminal (21) from front swivel joint (19).

(10) Remove wire rope (5) from casing.

CAUTION: WHEN LOOSENING/TIGHTENING CASING NUTS, DO NOT LET CASING TURN.

(11) Loosen front and rear casing nuts (8).

(12) Remove front jam nut (9) at rear mount ring, and withdraw rear swivel joint (10).

(13) Remove bolts (26), fastening bracket (25), and spacer (24).

(14) Remove bolt and nut fastening trim thermocouple loop clamp and casing loop clamp (7).

(15) Remove bolt and nut fastening casing loop clamp (12) to bracket (13).

(16) Remove bolts (11), nuts (17) fastening bracket (13), seal retaining plates (14), insulations (15) and seals (16) to center mount ring.

(17) Loosen front jam nut (18) and withdraw front swivel (19) from front lifting bracket.

(17) Loosen front jam nut (18) and withdraw front swivel (19) from front lifting bracket.

D. Removal of Guide Pin Bracket Assembly (Ref. Fig. 202)

(1) Remove two nuts (18).

(2) Remove guide pin bracket assembly (17).

E. Installation of Guide Pin Bracket Assembly (Ref. Fig. 202)

(1) Install guide pin bracket assembly (17).

(2) Install nuts (18) and torque 145 to 165 lb.in.

F. Installation of Propeller Reversing Linkage, Rear

CAUTION: THE FOLLOWING ASSEMBLY INSTRUCTIONS ARE GIVEN PRIMARILY TO SATISFY SHIPPING REQUIREMENTS AND THE RESULTANT RIGGING MAY DIFFER QUITE CONSIDERABLY FROM WHAT IT SHOULD BE WHEN THE ENGINE IS INSTALLED IN THE AIRFRAME. AT ENGINE INSTALLATION BY THE AIRFRAME MANUFACTURER THE LINKAGE IS ADJUSTED TO SUIT A PARTICULAR AIRFRAME REQUIREMENT. THIS ADJUSTMENT MAY INCLUDE ALTERING ROD LENGTHS, MOVING CLEVIS PINS TO DIFFERENT HOLES AND, IF NECESSARY, SELECTING A DIFFERENT CAM TO PROVIDE THE REQUIRED POWER RESPONSE CHARACTERISTICS. THE FINAL RIGGING ARRANGEMENT IS PART OF THE AIRCRAFT CERTIFICATION REQUIREMENT AND IS DETAILED IN THE APPROPRIATE AIRCRAFT MAINTENANCE MANUAL. THEREFORE, WHEN AN ENGINE IS REINSTALLED IN AN AIRCRAFT AFTER OVERHAUL OR REPAIR, THE ENGINE SHOULD BE RIGGED IN ACCORDANCE WITH THE RELEVANT AIRCRAFT MAINTENANCE MANUAL AND NOT IN ACCORDANCE WITH THE APPLICABLE P&WC MAINTENANCE OR OVERHAUL MANUAL.

(1) Install propeller control cam (7, Fig. 201), spacer (9) and rigging plate (17) between arms of lever mounting bracket (6). Align front holes, insert pin (5) and install washer (23) and cotterpin (21).

(2) Place arms of cam follower (2) on both sides of propeller control cam (7), install shouldered pin (3) through cam follower arms and engage propeller control cam. Fasten pin (3) with washer (23) and cotterpin (21).

NOTE: Make sure cam follower lockwire tab is aft.

(3) Install power control lever (4) over exposed end of shouldered pin (3), insert power control lever (4), cam follower (2) between arm of lever mounting bracket (6) and rigging plate (17). Align aft holes, and insert grooved pin (14).

(4) Install clamping bolt (1) fastening cam follower (2) to grooved pin. Tighten bolt 32 to 36 lb.in., and lockwire to cam follower.

(5) Install cambox assembly over studs at Flange G, and install nuts Do not tighten.

(6) Install bolt (16) fastening lever mounting bracket (6) to angle bracket (15). Do not tighten.

(7) Install or tighten bolts, as applicable, fastening angle bracket (15) to accessory gearbox.

(8) Tighten bolt (16), and nuts fastening angle bracket (15) to accessory gearbox, 32 to 36 lb.in., and lockwire together.

(9) Tighten nuts 32 to 36 lb.in.

CAUTION: MAKE SURE THAT THE THREADED SECTION OF ROD END CONNECTORS (11) EXTEND MORE THAN SAFETY HOLE IN THE FCU INTERCONNECT ROD (13).

(10) Install FCU interconnect rod (13) to power control lever (4) at previously marked position, with spacer (10), washer (22), and nut (19). Tighten nut 12 to 18 lb.in. and install cotterpin (21).

(11) Install push/pull control assembly rear clevis to propeller control cam (7) at previously marked position, using pin (8), washer (23) and cotterpin (21).

(12) Check system rigging (Ref. Aircraft Maintenance Manual).

(13) Check reversing linkage installation (Ref. Adjustment/Test).

G. Installation of Propeller Reversing Linkage, Front (Ref. Fig. 202)

CAUTION: THE LOWER END OF THE PROPELLER REVERSING LEVER (7) IS MACHINED WITH A STEPPED NOTCH. MAKE SURE THE STEPPED NOTCH AT THE END OF THE PROPELLER REVERSING LEVER (7) IS UNDER THE PIN IN THE REVERSING LEVER GUIDE PIN BRACKET ASSEMBLY (17) (REF. FIG. 202, DETAIL E).

(1) Install pin (9), washer, and cotterpin, bushing (8) and propeller reversing lever (7) as applicable, to governor beta valve clevis.

(2) Install rigging pin (PWC50745) in cambox.

(3) Push propeller reversing lever rearward to bottom beta valve, and fit push/pull control assembly front clevis (11) to propeller reversing lever (7). Adjust clevis as necessary and install bolt (4), spacer (6) and nut (10). Tighten nut 12 to 18 lb.in., and install cotterpin. Make sure clevis (11) is in safety, tighten jam nut 14 to 16 lb.in. and lockwire.

(4) Install governor interconnect rod (12) to governor reset arm using bolt (15), washer (14) and nut (13). Tighten nut 12 to 18 lb.in., and install cotterpin.

(5) Install governor interconnect rod upper rod end (2) to push/pull control assembly terminal using bolt (5), spacer (3), washers (14) and nut (1). Tighten nut 12 to 18 lb.in. and install cotterpin.

(6) Remove rigging pin (PWC50745) from cambox.

(7) Check system rigging (Ref. Aircraft Maintenance Manual).

(8) Check reversing linkage installation (Ref. Adjustment/Test).

H. Installation of Propeller Reversing Linkage, Push/Pull Control Assembly

(1) Install bracket (25, Fig. 203) spacer (24), and bolts (26). DO NOT tighten bolts.

(2) Install one jam nut (9), on rear swivel joint (10), insert through center mount ring, and install second jam nut (9). Snug nuts (9) only, DO NOT tighten.

(3) Insert front swivel joint (19) through front lifting bracket and install jam nut (18). Tighten nut 95 to 105 lb.in., and lockwire.

(4) Insert wire rope casing through center and rear mount rings and install one seal retaining plate (14) and one insulation (15), on each side of center mount ring.

CAUTION: WHEN LOOSENING/TIGHTENING CASING NUTS, DO NOT LET CASING TURN.

(5) Loosen rear jam nut (9) at rear swivel joint, as required, and alternately tighten front and rear casing nuts (8) 40 to 60 lb.in., until casing is centered between front and rear swivel joints (10 and 19). Lockwire casing nuts.

(6) Tighten rear swivel joint jam nuts (9) 95 to 105 lb.in., and lockwire.

(7) Install seals (16) one each side and adjacent to center mount ring, and fasten seals (16), insulations (15), retaining plates (14) and bracket (13) with bolts (11) and nuts (17). Tighten nuts until firm contact is made, plus one-half turn.

(8) Install loop clamp (7) on casing and fasten to trim thermocouple loop clamp with bolt and nut. Tighten 36 to 40 lb.in.

(9) Install loop clamp (12) on casing to bracket (13) at center mount ring with nut and bolt. Tighten 36 to 40 lb.in.

(10) Install casing rear (short) terminal (6) over swivel joint (10) and insert wire rope into casing.

(11) Install ball end (4) on wire rope (5) until approximately one-half inch protrudes through ball end.

(12) Push wire rope and ball end forward until ball end seats inside casing rear terminal (6), install sleeve nut (3) and tighten 40 to 60 lb.in. Make sure wire rope extends past inspection hole, and lockwire sleeve nut to casing rear terminal.

(13) Install casing front terminal (21) over front swivel joint (19).

(14) Install ball end (4) on wire rope (5) until approximately one-half inch of wire rope protrudes through ball end.

(15) Pull casing front terminal forward until ball end (4) seats inside, install control terminal (20) and tighten 40 to 60 lb.in. Make sure wire rope extends past inspection hole.

(16) Install jam nut (22) and front clevis (23) on front control terminal (20). Do not tighten.

(17) Install rigging pin (PWC50745) in cambox.

(18) Install new jam nut (2) and rear clevis (1) on sleeve nut (3), and adjust to align clevis at previously marked position on propeller control lever (6, Fig. 201). Tighten jam nut 14 to 16 lb.in. Make sure clevis is in safety.

NOTE: Clevis is considered in SAFETY when inspection hole in body is blocked by internal threaded end.

(19) Install rear clevis to propeller control lever (6) with pin (7), washer and cotterpin.

(20) Push the propeller reversing lever (7, Fig. 202) rearward, to make the beta valve plunger touch at the bottom of its travel.

(21) Adjust front clevis (11) to align with propeller reversing lever (7) and install bolt (4), spacer (6) and nut (10). Tighten nut 12 to 18 lb.in., and install cotterpin. Make sure clevis (11) is in safety. Tighten jam nut 14 to 16 lb.in. and lockwire.

(22) Secure governor interconnect rod upper rod end (2) to control terminal with bolt (5), washers, spacer (3) and nut (1). Torque nut (1) 12 to 18 lb.in. and install cotterpin.

(23) Remove rigging pin (PWC50745) from cambox. Check system rigging (Ref. Aircraft Maintenance Manual).

(24) Check reversing linkage installation (Ref. Adjustment/Test).

6. Cleaning/Painting

Clean all parts with solvent (PWC11-027) or (PWC11-031), and dry with filtered compressed air and/or clean with lint-free cloths.

7. Inspection/Check

A. Inspection of Reversing Linkage Components

(1) Examine actuating levers, control cam and control lever mounting bracket for cracks. Cracks are not permitted.

(2) Examine parts for surface damage such as scores, nicks, scratches and gouges. Minor surface defects may be removed with a fine stone or abrasive cloth (PWC05-061). Remove all sharp edges and high spots.

(3) Examine pin and bolt holes in each part and slot in control cam, for burrs and/or chipped edges. Clean up minor damage with a suitable Swiss file or fine stone.

(4) Examine grooved pin for burrs, nicks, scores and similar defects on serrations which might interfere with fit in mating parts. Clean up minor defects with a fine stone and check fit of mating parts.

(5) Examine wire rope casing for cuts, dents, cracks, kinks and similar defects which might prevent free movement of internal wire rope. Minor damage is acceptable, providing wire rope will operate freely without binding.

(6) Check wire rope for breaks in wires, twisting, kinking and for separation of reverse wound coils. Reject wire rope if damaged. Repair is not permitted.

B. Checking of System

(1) Operate power control lever and check system is free over total range of movement without binding or sticking.

(2) Check for freedom of movement at spherical rod end bearings.

(3) Check complete system to make sure all locknuts and connections are lockwired, and cotterpins installed in pins and castellated nuts.

8. Adjustment/Test

A. Procedure

(1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and do checks associated with Installation/Replacement of Reversing Linkage (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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Figure 201 Removal/Installation of Propeller Reversing Linkage - Rear

Figure 202 Removal/Installation of Propeller Reversing Linkage - Front

Figure 203 Removal/Installation of Push/Pull Control Assembly

77-20-00
ENGINE INDICATING - DESCRIPTION AND OPERATION

1. Description and Operation

The indicating system consists of the interturbine temperature (T5) sensing system that provides the pilot with an indication of the engine operating temperature occurring in the zone between the compressor turbine and the first-stage power turbine stator vane ring. The system consists of a bus-bar and probe assembly, a wiring harness, externally mounted terminal block, and a trim harness incorporating a T1 thermocouple probe and preset variable resistor.The T1 thermocouple is connected in parallel with the T5 harness to bias the interturbine temperature (ITT) signal so that the indicated ITT bears a fixed relationship with the compressor inlet temperature. This signal is representative of the interturbine temperature in the engine.

77-20-01
T5 SENSING SYSTEM - DESCRIPTION AND OPERATION

1. General

The interturbine temperature (T5) system consists of positive and negative bus-bars, immersion thermocouple probes, wiring harness, T1 trim thermocouple, and related parts.

The T5 bus-bar and immersion thermocouple probe assembly is located on the outer section of the power turbine stator housing with the probes passing through ports in the housing. The probes are individually fastened to their respective bosses by coupling nuts, while the bus-bars are fastened to the individual probes.

The wiring harness provides the electrical connection between the bus-bar and the T5 terminal block mounted on the engine. The chromel and alumel terminals at each end of the harness are fastened to the respective terminals on the bus-bars and terminal block. A flange on the harness is fastened with a gasket which provides a seal, to a boss on the exhaust duct.

The T1 trim thermocouple is located at the 2 o'clock position immediately above the air inlet screen on the gas generator case. It is attached by an integral flange to the front fireseal mounting bracket and by loop clamps at the rear. The leads at the front of the thermocouple are connected to the T5 terminal block on flange C.

2. Description and Operation (Ref. Figs. 1 and 2)

The bus-bar and probe assembly consists of alumel/chromel thermocouple probes connected in parallel by one positive (chromel), and one negative (alumel) bus-bar. The probes protrude through individual threaded bosses in the power turbine stator housing into the compressor turbine discharge airstream immediately in front of the power turbine stator. The probe locations are equispaced around the housing and attached to their respective bosses by a floating threaded fitting which forms an integral part of the assembly.

The harness assembly consists of single alumel and chromel leads encased in a flexible shield. The ends of the leads are welded to their respective alumel or chromel terminal lugs. The terminal lugs are in turn secured to the appropriate connection points on the bus-bars by stainless steel nuts and bolts. To prevent inadvertent cross-connection, the terminal lugs and bus-bar connection points are of different diameters, alumel terminals being larger in diameter and slightly magnetic.

The individual leads are secured with wire to clips installed on the stator housing. The leads are then led forward towards the stator housing and exhaust duct flange, clipped once, then fed through a tubular passage welded to the exhaust duct, to exit immediately forward of flange C at the 1 o'clock position. The section of harness located within the tubular passage is protected by a stainless steel tube, the outer end of which incorporates a mounting flange. The flange secures the assembly to the boss of the exhaust duct. The outer ends of the assembly leads are connected to respective terminals on the terminal block mounted on flange C.

The T1 trim thermocouple consists of chromel/alumel leads encased in a stainless steel tube with a variable, preset chromel resistor at the forward end. The required resistance value is determined during final engine acceptance checks; the variable resistor is adjusted to suit and the unit is sealed. The trim data, in terms of temperature change, is recorded on the engine data plate. The unit may only be replaced in the field by an identically adjusted and sealed unit. The tube is mounted at the approximate 2 o'clock position in the inlet air stream immediately above the inlet screen. The leads at the front end of the tube assembly are connected to their respective terminals on the T5 terminal block.

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Figure 1 Interturbine Temperature (T5) Schematic

Figure 2 Interturbine Temperature (T5) Indicating System

T5 SENSING SYSTEM - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be specified in instructions.

D. All maintenance procedures for the T1 probe are contained in the Abbreviated Component Maintenance Manual, P/N 77-20-11.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-007	Fluid, Check
PWC05-061	Cloth, Abrasive Coated Crocus
PWC05-066	Tape, Insulating
PWC05-101	Cloth, Abrasive
PWC05-110	Lockwire
PWC06-036+	Compound, Lubricating
PWC07-002	Enamel, Glyceryl Phthalafe

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC30114-05	Wrench
PWC51775	Probe Locator
PWC70448	Socket, T5 Thermocouple

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Test Set	Barfield, TT1000A

5. Removal/Installation

A. Removal of Bus-bar and Thermocouple Probe Assembly (Ref. Fig. 202)

(1) Remove power section from gas generator case (Ref. 72-00-00, REMOVAL/INSTALLATION).

(2) Remove nuts (15 and 20) and bolts (17 and 18) and wiring harness from bus-bars (6 and 3) respectively.

(3) Remove bolts (4) and lockwashers (22) which fasten positive (CR) bus-bar (3) to top cover of thermocouple probes (7). Carefully remove bus-bar (3).

(4) Remove bolts (5) and lockwashers (23) which fasten negative (AL) bus-bar (6) to top cover of thermocouple probes (7). Carefully remove bus-bar (6).

(5) Remove thermocouple probes (7) by loosening bolt/coupling (8) from bosses on PT stator housing (1) with wrench (PWC30114-05) or T5 thermocouple socket (PWC70448) as an alternative. Carefully withdraw probes from PT stator housing (1) and keep washers (10).

B. Removal of Wiring Harness (Ref. Fig. 202)

(1) Remove power section from gas generator case (Ref. 72-00-00, REMOVAL/INSTALLATION), and leave loop clamps (14) on harness.

(2) Remove nuts (15 and 20) and bolts (17 and 18) which fasten wiring harness to bus-bars (6 and 3) respectively.

(3) Remove lockwire which fasten wiring harness to PT stator housing (1).

(4) Remove bolts (12) which fasten wiring harness flange (11) to exhaust duct.

(5) Carefully remove wiring harness from exhaust duct by passing harness through guide tube.

(6) Remove gasket (13) from flange on harness.

C. Removal of Trim Thermocouple and Terminal Block

(1) Remove self-locking nuts (9 and 10, Fig. 201) which fasten harness, trim thermocouple leads, and airframe leads to thermocouple terminal block (11).

(2) Remove self-locking nut and bolt which fasten trim thermocouple loop clamp (3) to similar loop clamp on propeller reversing linkage push/pull control assembly. Remove clamp.

(3) Remove self-locking nut and bolt which fasten trim thermocouple loop clamp (1) to bracket at air inlet screen. Remove clamp.

(4) Note locations of loop clamps (8 and 12), and remove nuts and bolts which fasten loop clamps to flange C.

(5) Remove self-locking nuts (6) and bolts (4) which fasten trim thermocouple to center mount ring.

(6) Remove trim thermocouple by withdrawing forward through mount ring.

(7) Remove bolts and self-locking nuts which fasten terminal block (11) to flange C. Remove terminal block.

D. Installation of Bus-bar and Thermocouple Probe Assembly (Ref. Fig. 202)

CAUTION: MAKE SURE THE CONFIGURATION OF THE THERMOCOUPLES MATCHES THE CONFIGURATION OF COMBUSTION CHAMBER LINER INSTALLED IN THE GAS GENERATOR MODULE (GGM).

D. Installation of Bus-bar and Thermocouple Probe Assembly (Ref. Fig. 202)

CAUTION: MAKE SURE THE CONFIGURATION OF THE THERMOCOUPLES MATCHES THE CONFIGURATION OF COMBUSTION CHAMBER LINER INSTALLED IN THE GAS GENERATOR MODULE (GGM).

(1) Clean all contact surfaces with abrasive cloth (PWC05-101).

(2) Test each thermocouple probe assembly (Ref. Adjustment/Test).

(3) Install new copper washer (10) on each thermocouple probe (7).

CAUTION: APPLY LUBRICATING COMPOUND (PWC06-036+) TO THE THREADS OF THE THERMOCOUPLE PROBE ONLY.

(4) Apply a thin layer of lubricating compound (PWC06-036+) to threads of the thermocouple probe (7) with a small paint brush.

CAUTION: MAKE SURE BOLT/COUPLING (8) IS FREE TO ROTATE ON SUPPORT SLEEVE OF THERMOCOUPLE PROBE.

(5) Apply engine oil (PWC03-001) between bolt coupling (8) and thermocouple probe.

NOTE: The thermocouple threads must not be lubricated with oil.

(6) Insert the thermocouple probes (7), with the washers (10), into the threaded insert of the power turbine stator housing (1). Make sure the larger hole (AL) is toward the front of the engine. Use fixture (PWC51775) to align each thermocouple probe perpendicular to housing rear flange, torque bolt/coupling (8) 40 to 50 lb.in. Check minimum clearance (Ref. Fig. 202, Sheet 2).

NOTE: Chase threads with tap (0.3125-24UNJF-3A) if it is not possible to put the thermocouple probes (7) with the washers (10) into the power turbine stator housing (1).

(7) Position negative (AL) bus-bar (6) over thermocouples. Align holes for lug bolt (17) at approximately 2 o'clock position and align holes in bus-bar with corresponding holes (AL) on thermocouple probes.

(8) Fasten negative (AL) bus-bar (6) to thermocouples with bolts (5) and lockwashers (23). Tighten bolts 30 to 35 lb.in.

(9) Position positive (CR) bus-bar (3) over thermocouples. Align holes for lug bolt (18) at approximately 8 o'clock position and holes in bus-bar with corresponding holes (CR) on thermocouple probes.

(10) Fasten positive (CR) bus-bar (3) to thermocouples with bolts (4) and lockwashers (22). Tighten bolts 30 to 35 lb.in.

(11) Connect the negative (AL) wiring harness terminal lug (16) to the negative bus-bar (6) with the bolt (17) and the nut (15). Torque the nut (15) 23 to 26 lbf.in.

(12) Connect the positive (CR) wiring harness terminal lug (19) to the positive bus-bar (3) with the bolt (18) and the nut (20). Torque the nut (20) 12 to 14 lbf.in.

(13) Function test (Ref. Adjustment/Test).

(14) Assemble power section to gas generator case (Ref. 72-00-00, REMOVAL/INSTALLATION).

(15) Do engine test (Ref. 71-00-00, ADJUSTMENT/TEST).

E. Installation of Wiring Harness (Ref. Fig. 201 and 202)

(1) Install gasket (13, Fig. 202) on wiring harness and carefully pass inner section of harness through guide tube in exhaust duct.

NOTE: Tube section of harness should fit centrally in guidetube when flange is finally bolted to exhaust duct.

(2) Fasten flange to exhaust duct with bolts (12). Tighten bolts 15 to 20 lb.in., then 32 to 36 lb.in., without loosening, and lockwire.

(3) Clean all contact surfaces immediately prior to assembly with abrasive cloth (PWC05-101).

NOTE: Wire should retain harness firmly in locating clips. Tension on wire should be such that fretting of harness is eliminated and crushing of harness insulation is avoided. To achieve this, wire must pass with adequate tension over and under harness, except for semi-rigid leadout where wire must pass over harness only.

(4) Install wiring harness sleeves in clips on power turbine stator housing (1) with lockwire.

(5) Connect the negative (AL) wiring harness terminal lug (16) to the negative bus-bar (6) with the bolt (17) and the nut (15). Torque the nut (15) 23 to 26 lbf.in.

(6) Connect the positive (CR) wiring harness terminal lug (19) to the positive bus-bar (3) with the bolt (18) and the nut (20). Torque the nut (20) 12 to 14 lbf.in.

(7) Assemble power section to gas generator case (Ref. 72-00-00, REMOVAL/INSTALLATION). Locate and install harness loop clamps (14) on forward face of flange C.

(8) Install T5 probe harness, trim thermocouple leads and airframe leads to respective AL and CR terminal posts on terminal block (9, Fig. 201) with self-locking nuts (7) and (8). Torque large nut (alumel) (8) 24 to 40 lbf.in. and small nut (chromel) (7) 15 to 20 lbf.in.

(9) Do a function test (Ref. Adjustment/Test).

(10) Test engine (Ref. 71-00-00, ADJUSTMENT/TEST).

F. Installation of Trim Thermocouple and Terminal Block

(1) Make sure resistance value is adjusted to same value as that previously installed (Ref. Para. 9.).

(2) Install trim thermocouple (2, Fig. 201) through center mount ring from front and secure with self-locking nuts (5). Torque nuts 36 to 40 lbf.in.

(3) Install loop clamp (3) on trim thermocouple to propeller reversing linkage push/pull control assembly loop clamp, with bolt and self-locking nut. Tighten nut 36 to 40 lb.in.

NOTE: Align clamps without exerting bending pressure on trim thermocouple.

(4) Install trim thermocouple loop clamp (1) to bracket at air inlet screen with bolt and self-locking nut. Tighten nut 36 to 40 lb.in.

(5) Install loop clamps (6) and (10) at previously marked locations on Flange C and install nuts and bolts, bolt heads rear and torque nuts 36 to 40 lbf.in.

(6) Install T5 terminal block (9) to Flange C between loop clamps (6) and (10) with bolts, heads rear and nuts. Torque nuts 36 to 40 lbf.in.

(7) Install probe harness, trim thermocouple leads and airframe leads to respective AL and CR posts on terminal block (9) with self-locking nuts (7) and (8). Torque large nut (8) 24 to 40 lbf.in. and small nut (7) 15 to 20 lbf.in.

6. Cleaning/Painting

A. Cleaning of System Components

(1) Clean probes which exhibit carbon deposits with a fine brass wire brush.

(2) Clean contact surfaces of AL and CR terminals and all harness lugs with abrasive cloth (PWC05-101).

(3) Remove corrosion on wiring harness tubing and on trim thermocouple outer casing with abrasive cloth (PWC05-061).

(4) Clean all sealant residue from mating flanges of thermocouple wiring cable on exhaust duct and from mating flanges of terminal block on gas generator case using solvent (PWC11-023) or by scraping carefully with suitable scraper.

7. Inspection/Check

A. Inspection of System Components

(1) Examine bus-bar probe assembly for integrity and damage. Damaged probes will require individual replacement. Loose terminal posts and missing insulation may be repaired (Ref. Para. 8.).

(2) Examine wiring harness leads for damage to outer covering and for damaged or loose terminal lugs. Braiding that is lifted or broken may be cut away, providing insulation is unbroken.

(3) Examine trim thermocouple leads for damage to outer covering and loose or damaged terminal lugs. Check probe outer casing for damage and corrosion, and flange for security. Check integrity of variable resistor access hole locking media (gray paint).

(4) Examine terminal posts on terminal block for damage to threads and loose terminals. Tighten loose AL terminal 24 to 40 lb.in., and CR terminal 15 to 20 lb.in.

8. Approved Repairs

A. Replacement of Harness Lugs (Ref. Figs. 203 and 204)

NOTE: To maintain resistance within acceptable limits, harness leads must not be shortened more than is absolutely necessary to carry out lug replacement.

(1) Push back braid to expose ears of terminal lug.

(2) Open ears of terminal lug and cut wire as close as possible to weld. Remove lug from lead.

(3) Unfold chafing sleeve.

(4) Remove and discard stainless steel sleeve (if installed) and chafing sleeve.

(5) Remove and discard insulating tape (on previously repaired installations only).

(6) Work braiding back over conductor, exposing approximately one inch of conductor.

(7) Use a sharp knife to remove insulation from wire, leaving approximately 0.15 inch of wire exposed.

(8) Wrap two layers of insulating tape, approximately 0.20 inch wide, around end of exposed insulation over wire.

(9) Work braiding towards end of wire as far as possible and trim end of braiding square, flush against inside edge of insulating tape.

(10) Install chafing sleeve approximately 1.5 inch long over braiding, leaving approximately 0.75 inch of sleeve extended beyond end of braiding.

(11) Install new stainless steel sleeve over chafing sleeve with end of sleeve even with end of braiding. Gently crimp sleeve, enough to prevent sleeve from slipping back and forth, taking care to prevent over-crimping and puncture of insulation.

(12) Fold chafing sleeve back over stainless steel sleeve. Trim off loose ends.

CAUTION: USE CHROMEL TERMINAL LUG ON THE POSITIVE CONDUCTOR, AND ALUMEL TERMINAL LUG ON THE NEGATIVE CONDUCTOR.

(13) Fasten terminal lug of appropriate material (chromel or alumel):

(a) Open large ears of terminal lug slightly to facilitate assembly.

(b) Install lug over chafing sleeve and crimp small ear over bared wire, leaving approximately 0.15 inch of wire exposed.

(c) Make sure large ears of lug are positioned directly over stainless steel sleeve. Crimp large ears over chafing sleeve around stainless steel sleeve (Ref. Fig. 204).

CAUTION: DO NOT USE FILLER MATERIAL. FILLER MATERIAL CAN AFFECT THE RESISTANCE OF THE CONDUCTORS.

(d) Using TIG method (Ref. 70-00-00, REPAIR) fusion weld wire to terminal lug. Check integrity of weld by gently pulling on lug with pliers. (Ref. Fig. 203).

(14) Clean contact surfaces of terminal lug with abrasive cloth (PWC05-101), or a stainless steel wire brush.

(15) Do loop resistance and continuity check (Ref. Inspection/Check).

B. Repair of Harness Braiding

(1) Remove all loose strands of braiding around damaged area (Ref. Fig. 205).

(2) Wrap tape (PWC05-066) around harness, covering all damaged area as shown.

(3) Wrap repaired area with lockwire (PWC05-110) as shown. Hold wrapping wire snugly along length of harness braid beginning from the left. Starting at opposite end, wrap wire tightly and uniformly over harness braid and repaired area.

(4) When approximately two-thirds of wrapping length is completed, allow short end of loop to remain exposed. Continue wrapping wire to complete remaining distance, shown as 1/3X.

(5) After final turn of wrapping, insert wire A through loop as shown. Remove surplus end of wire B so that length is approximately one-third of repair length. Pull loop end C until wire at A is snug and end of wire B has just disappeared underneath final turn of wrappings. Cut wire end C flush.

9. Adjustment/Test

NOTE: When installed on the engine, the bus-bar, probe assembly and wiring harness form a single unit, and probes cannot be checked individually. For individual component checks, refer to Subparas A., B., C..

A. Testing of Thermocouple Probe

NOTE: This test is done with the thermocouple at room temperature. The probe being tested must be removed from the bus bar.

(1) Measure and record continuity resistance of probe loop by connecting leads of test set to thermocouple terminals.

(2) Switch test set leads to opposite terminals on the probe and measure and record continuity and loop resistance.

(3) Add both recorded values and divide by two to determine the average. Acceptable resistance is 0.27 to 0.34 ohms.

(4) Using test set, measure insulation resistance between either AL or CR terminal and thermocouple housing. Do not connect test leads to probe sheath as oxidized layer will give false reading. Minimum acceptable resistance at each terminal is 50,000 ohms.

NOTE: If insulation resistance test is unsatisfactory, but does not indicate a direct short to ground, bake probe at 93°C (200°F) for one hour to dry out all traces of moisture. Repeat test. If still unsatisfactory, reject probe on the basis that a residual contaminant, other than moisture, is present.

CAUTION: DO NOT ALLOW THE PROBE TEMPERATURE TO EXCEED TO 538°C (1000°F) DURING THE FOLLOWING TEST.

(5) When performing the heat response check of the probe, confirm that the output signal is of the same polarity as that of other the probes. Connect the test set to the AL and CR terminals, apply heat to each probe in turn and check for a positive indication of temperature change. A heat source, such as a 100 watt soldering iron, capable of heating the individual probes to 94°C (200°F) can be used.

NOTE: A heat response check of probes installed and connected to the bus-bar assembly, may be performed provided the previously heated probe is allowed to cool before applying heat to the next probe.

(6) Failure of any of the above test requires changing of the probe assembly.

B. Testing of Wiring Harness

(1) Using test set, with bus-bar and probe assembly disconnected from wiring harness, measure insulation resistance between alumel and chromel lug, and between individual lugs and wiring harness shield. Resistance measured must be not less than 25,000 ohms.

(2) Using test set, measure continuity of each wiring harness lead (alumel to alumel, chromel to chromel). Continuity must prevail in both instances. Alumel 0.333 to 0.407 ohms. Chromel 0.909 to 1.111 ohms.

(3) If test at step (1) or (2) is not satisfactory, replace wiring harness.

(4) If air leakage is suspected through wiring harness conduit (Ref. 72-00-00, FAULT ISOLATION):

(a) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and let stabilize at ground-idle.

WARNING: AVOID PROPELLER AND HOT EXHAUST GASES DURING LEAK CHECK.

(b) Apply fluid (PWC05-007) to external portion of wiring harness at conduit/lead exit point and around flange at exhaust duct.

(c) Increase engine power and watch for leaks at check points. Slow appearance of bubbles is acceptable. If steady stream is visible, determine source and replace gasket and/or wiring harness as applicable.

C. Testing of Trim Thermocouple

(1) Using test set, with thermocouple disconnected, measure insulation resistance between either alumel or chromel lug and thermocouple outer casing. Resistance measured must be not less than 50,000 ohms.

(2) Connect test set to opposite lugs on trim thermocouple, and measure and record loop resistance.

NOTE: Take the two readings quickly in succession to keep temperature variation at minimum.

(3) Add both readings, and divide by two to find the average loop resistance. The resistance must be within the limits specified in Table 201.

(4) If the insulation resistance or continuity test is not satisfactory, change the thermocouple. If loop resistance is outside limits, do the following:

(a) Remove protective cover (7, Fig. 201) from trim resistor.

(b) Remove sealing paint from access hole (5) in resistor body.

(c) Adjust trimmer screw in small increments. Check resistance value.

(d) Repeat adjustment until the required loop resistance value is obtained.

NOTE: Some engines have zero trim adjustment. These engines have an open circuit trim resistor i.e. the resistance is infinity (∞). The symbol on the engine data plate and resistor cover is ∞. For these engines the resistor should be adjusted until the test set shows no continuity.

D. Testing of T5 Indicating System

NOTE: The following test shows circuit malfunctions such as an internal short circuit, or an open circuit.

(1) When installed on the engine, the bus-bar, probe assembly and wiring harness form a single unit, and probes cannot be checked individually. The following tests will therefore only reveal circuit malfunctions such as an internal short circuit, or an open circuit.

(2) Remove aircraft external leads and T1 trim thermocouple leads from terminal block on gas generator case.

(3) Connect test set to alumel and chromel terminals on gas generator case terminal block and measure loop resistance of T5 system. Measured resistance must be 1.30 to 1.55 ohms.

NOTE: If several probes are broken or damaged, the loop resistance will not necessarily fall outside the permitted tolerance. However, incorrect temperature indications can occur due to reduced sampling.

(4) To check for presence of damaged probes or harness lead, it is necessary to remove engine power section assembly (Ref. 72-00-00, REMOVAL/INSTALLATION, Rem/Inst of PS).

(5) Connect test set leads between either alumel or chromel terminal on terminal block and ground (gas generator case) and measure insulation resistance. The measured insulation resistance must be not less than 50 000 ohms.

(6) Reconnect external leads and trim thermocouple leads to appropriate alumel and chromel terminal posts on terminal block. Tighten alumel terminal 24 to 40 lbf.in. and chromel terminal 15 to 20 lbf.in.

NOTE: Always clean all contact surfaces immediately before assembly with abrasive cloth (PWC05-101).

E. Determination of Trim Thermocouple Adjustment

NOTE: The following test shows circuit malfunctions such as an internal short circuit, or an open circuit.

(1) This T5 trim check is to be done on installed engines. Aircraft cockpit gages are acceptable for measurement Ng, Np and Tq, but not for measurement of T5. Disconnect aircraft cockpit T5 gage and connect a suitable precision tester for T5 measurement.

NOTE: The following procedure should be used when a malfunction of the T5 indicating system is suspected, and/or the T1 trim thermocouple was replaced during troubleshooting, and should be done without interruption to avoid change in readings due to ambient temperature changes.

(2) Procedure

CAUTION: THE FOLLOWING PROCEDURE ONLY APPLIES WHEN FITTING A REPLACEMENT TRIM THERMOCOUPLE UNIT. UNDER NO CIRCUMSTANCES SHALL AN INSTALLED UNIT BE READJUSTED IN THE FIELD.

(a) Do loop and resistance checks on complete T5 system (Ref. Para. D.). If checks are not satisfactory, troubleshoot and repair system as required.

(b) Do engine performance checks (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Performance Check). If checks are unsatisfactory, troubleshoot and rectify as necessary.

(c) Disconnect T1 trim leads from terminal block on gas generator case.

(d) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and increase power as near to takeoff without exceeding 800°C T5. Stabilize for a minimum of seven minutes and record the following: Ng, Np, Tq, Tam (°C) and PA. Record T5 as X. Shutdown engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Shutdown).

(e) Reconnect T1 trim leads to relevant terminals on terminal block.

(f) Start engine, increase power to Ng and Np settings as in step (d) above, and allow to stabilize. Record torque, Tam and PA. Record T5 as Y. Shutdown engine.

(g) Determine normalized (X-Y) temperature trim value (°C):

1 Normalize X (Ref. Step (d))

(g) Determine normalized (X-Y) temperature trim value (°C):

1 Normalize X (Ref. Step (d))

a Derive θ

a $\theta = \frac{\text{Tam °C} + 273}{288}$

b Normalized X

b Normalized X = $\frac{\text{X °C}}{\theta}$

2 Normalize Y (Ref. Step (f))

a Derive θ

a $\theta = \frac{\text{Tam °C} + 273}{288}$

b Normalized Y

b Normalized Y = $\frac{\text{Y °C}}{\theta}$

3 Normalized temperature, X - Y should equal existing data plate T5 trim value ± 10°C.

(h) If the normalized temperature exceeds the limits specified in sub-step 3, proceed as follows:

1 Disconnect the T1 thermocouple. Check resistance (Ref. Inspection/Check) is within 5% of the value indicated on engine data plate and on the trim resistor cover or on the trim thermocouple . Adjust as require . Repeat steps (a) thru (g) to confirm improvement.

2 If resistance check is within limits, an individual T5 probe and harness test which involves removal of the power section, is recommended (Ref. Inspection/Check). Repeat steps (d) to (g) to confirm improvement.

3 If the troubleshooting carried out is unsuccessful, ship engine to an approved overhaul facility.

(i) If adjustment is necessary:

(i) If adjustment is necessary:

1 Do loop and ground resistance checks on T5 system (Ref. Para. D.).

Table 201 Loop Resistance

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Figure 201 Removal/Installation of Trim Thermocouple and Terminal Block

Figure 202 Removal/Installation of Temperature Indicating Components

Figure 203 Wiring Harness - Repair

Figure 204 Wiring Harness - Repair

Figure 205 Wiring Harness Braid Repair

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201 Loop Resistance

OIL - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

A. General

The engine oil system consists of a pressure system, a scavenge system and a breather system. The self-contained lubrication system provides a constant supply of clean oil to the engine bearings, reduction gears, accessory drives, torquemeter and propeller governor, drawn from an integral oil tank. Items such as oil coolers are airframe supplied. The oil lubricates and cools the bearings and carries any extraneous matter to the oil filter where it is prevented from further circulation. A chip detector is located in the reduction gearbox to detect and transmit signals to airframe-mounted instrumentation to warn operators of impending component failure.

B. Pressure System

Pressure oil is delivered to the oil filter outlet where the oil separates into several paths. Lubrication of the accessory drives and bearings is directed through cored passages and transfer tubes in the compressor inlet case, accessory diaphragm and gearbox housing and into the gearbox bearing areas. The No. 1 bearing is lubricated by pressure oil from the filter outlet through a cored passage in the compressor inlet case to a nozzle at the center rear of the compressor rear hub. The nozzle, incorporating a fine strainer directs the calibrated oil flow into a collector ring mounted on the rear of the compressor rear hub and through passages in the split inner race to the bearing.

A common supply is provided to lubricate the No. 2 bearing, the reduction gearbox and front accessories, power turbine No. 3 and 4 bearings, and the propeller installation. Oil from the filter outlet is directed through a cored passage and transfer tube to an outlet boss at the 4 o'clock position on the compressor inlet case. This boss is utilized to mount the P3 air filter housing; however, a separate core in the housing connects to an external oil transfer tube which conducts the oil forward to a tee coupling at the gas generator case. An internal oil transfer tube conducts the oil to an oil transfer gallery in the No. 2 bearing compartment. The gallery houses two nozzles which are protected by a fine strainer. The nozzles direct the oil flow on to the front and rear faces of the bearing. The external transfer tube extends forward from the tee to a coupling and second external oil transfer tube which conducts the oil to a boss on the front case of the reduction gearbox.

From the boss, the oil is directed internally via cored passages and transfer tubes to three areas. One, to the first-stage reduction gears, the torquemeter, and the No. 3 and 4 bearings. Oil to the torquemeter flows through a metering valve which controls the flow into the torquemeter piston which reacts in direct proportion to engine torque. Oil is directed to three nozzles in the No. 3 bearing oil tube in the power turbine shaft housing via a transfer tube in the rear case of the reduction gearbox. Two nozzles direct oil to the front and rear faces of the No. 3 roller bearing, while the third nozzle directs the oil flow to the rear face of the No. 4 bearing.

The second oil delivery line directs oil to the propeller shaft front roller and ball thrust bearings, the second-stage reduction gears and the No. 4 bearing. The oil flow is directed through the rear annulus of an oil transfer sleeve mounted on the propeller shaft, and, via the rear section of the propeller oil transfer tube in the shaft, to the No. 4 bearing oil nozzle installed at the rear end of the transfer tube. The oil is sprayed into the hollow front section of the power turbine shaft through a restrictor (oil dam) and axial holes in the shaft spigot; centrifugal force directs the oil through a drilled annulus in the shaft to passages between the No. 4 bearing inner races. Radial holes in spigot direct oil onto the sun gear coupling. Oil from the rear section of the propeller shaft oil transfer tube is also directed, via drilled holes in the propeller shaft and the second-stage gear carrier, to the shaft/second-stage gear coupling splines, second-stage planet gearpins and propeller shaft rear roller bearing. From the front section of the propeller shaft oil transfer tube, oil is directed forward to an annular chamber formed by an adapter, where, by centrifugal force and drilled holes in the propeller shaft, oil lubricates the propeller shaft front roller and ball thrust bearings.

The third oil delivery line directs oil, via an external annulus and cored passages, to the externally mounted propeller governor and the accessory drive gear bearings. Oil pressure from the propeller governor is directed, via a port in the mounting flange and cored passages in the front case of the reduction gearbox, to a transfer tube which connects to the front annulus in the oil transfer sleeve mounted on the propeller shaft. The oil in the annulus passes through the propeller shaft into the rear annular chamber formed by the adapter on the propeller shaft oil transfer tube and is then directed forward into the propeller shaft centerbore.

An externally adjustable pressure regulating valve and a cold oil pressure relief valve are attached to the forward face of the accessory gearbox diaphragm in the upper section of the integral oil tank.

C. Scavenge System

The scavenge system incorporates two double-element gear-type pumps, contained in cast housings, and are driven by the accessory gearbox driveshafts. One pump is mounted within the accessory gearbox, while the other is externally mounted at the rear of the gearbox.

Oil from the No. 1 bearing compartment is returned by gravity, via an internal cored passage, to the bottom of the compressor inlet case. From there, it is directed through the oil tank compartment by a transfer tube and a port in the accessory diaphragm and is then discharged into the gearbox.

The No. 2 bearing oil drains, via internal tubes, to a boss at the 5 o'clock position on the gas generator case. A flanged transfer tube directs the oil rearward to a boss at the 6 o'clock position on the compressor inlet case; the oil then passes through cored passages and a transfer tube to the front element of the internal scavenge pump. Scavenged oil is dumped into the accessory gearbox.

Oil from the Nos. 3 and 4 bearings drains into the bottom of the power turbine shaft housing where it flows forward to the reduction gearbox sump, or by a tube (open at the rear) when the engine is in a nose-up attitude. In the latter instance, oil is returned to the front element of the external scavenge pump.

Oil from the propeller, front thrust and roller bearings, reduction gears, accessory drives and torquemeter bleed orifice drains into the gearbox sump. From the sump, oil is scavenged by the rear element of the external scavenge pump via a strainer in the front case of the reduction gearbox and a second external oil transfer tube. The rear element of the scavenge pump forces the oil to an airframe-mounted cooler from where it is returned to the oil tank via an inlet adapter located at the 12 o'clock position on the compressor inlet case. Oil flows from the adapter into a de-aerator tray, installed at the top of the tank, and drains into the tank.

Oil from the centrifugal breather, accessory gearshafts and bearings, input gearshaft and bearing drains into the accessory gearbox sump where it is scavenged by the rear element of the internal scavenge pump which forces the oil through the externally mounted oil-to-fuel heater. Oil from the heater is returned to the oil tank by one of two circuits dependent on the temperature of the oil leaving the heater. When the oil is cold, it passes through a thermostatic bypass and check valve mounted on a boss at the 5 o'clock position on the compressor inlet case, and, via an internal cored passage, is discharged at the top of the tank. The discharged oil does not flow into the de-aerator. When the oil is hot, all or part of the oil is directed by the thermostatic bypass and check valve into an external transfer tube that connects with the circuit to the airframe-mounted cooler, and then is returned to tank as described above.

D. Breather System

Breather air from the engine bearing compartments and the accessory and reduction gearboxes is vented overboard through the centrifugal breather installed in the accessory gearbox. The bearing compartments are connected to the accessory gearbox by cored passages and existing scavenge oil return lines.

The No. 1 bearing compartment vents rearward through the rear bearing housing and oil tank center tube and into the accessory gearbox.

A bypass valve, immediately upstream of the front element of the internal scavenge pump, lets oil and air vent into the accessory gearbox under certain transient operating conditions to prevent overpressurizing the No. 2 bearing area. Under normal operating conditions, the valve is closed to prevent oil from flooding back into the tube assembly.

The No. 3 and 4 bearing compartment and the reduction gearbox areas vent to the accessory gearbox and oil tank respectively through their scavenge oil lines. The oil tank is vented to the accessory gearbox through the oil tank pressurizing valve installed at the 11 o'clock position in the oil tank.

2. Fault Isolation

For detailed procedures on the engine oil system, refer to Chapter 72-00-00, FAULT ISOLATION.

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Figure 1 Engine Lubrication Schematic

79-20-00
OIL DISTRIBUTION - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

A. Oil Tank

The oil tank is an integral part of the compressor inlet case and is located in front of the accessory gearbox. The tank is provided with a filler neck and an integral quantity dipstick and cap located at the 11 o'clock position on the accessory gearbox housing. The cap and dipstick are fastened to the filler neck, which passes through the gearbox housing and accessory diaphragm and into the oil tank. The markings on the dipstick correspond to US quarts, and indicate the amount of oil required to fill the tank to the full mark. An anti-foaming device and breather arrangement, located at the 12 o'clock position on the compressor inlet case, prevents foaming when scavenged oil is returned to the tank during engine operation. The tank is vented to the top of the accessory gearbox, where the air/oil mist is passed through a centrifugal breather. The breather separates the oil from the air and returns the oil to the bottom of the accessory gearbox. The relatively oil free air is discharged overboard via a cored passage in the accessory diaphragm and transfer tube, to a breather boss located at the 2 o'clock position on the gearbox housing. Draining of the oil tank is done by removal of a plug located at the 6 o'clock position of the compressor inlet case (Ref. 72-00-00, SERVICING, Lubricating Oil System).

B. Oil Pump

Pressure oil is circulated from the integral oil tank and through the engine lubricating system by a self-contained gear-type pump mounted at the bottom of the oil tank. The oil pump consists of two gears contained in a cast housing bolted to the front of the AGB diaphragm. The pump gears are driven by an accessory gearshaft which also drives the internal scavenge pump. A removable inlet screen is fitted at the oil pump. The pump housing incorporates a support boss at the pump for the oil filter housing, and is counterbored to accommodate the check valve which is mounted at the inner end of the filter housing. The lubrication system pressure relief valve (Ref. 72-60-00, Removal/Installation) is installed on a pad located at the upper end of the housing. An internal cored passage connects the relief valve to pump outlet.

C. Oil Filter

The oil filter, installed in the pressure line downstream of the oil pump, consists of cartridge type filter element, a spring loaded bypass valve, and a check valve mounted in a removable alloy housing. Depending on installation requirements, the filter element may be of the cleanable (reusable) or non-cleanable (disposable) type.

D. Centrifugal Breather

The centrifugal breather consists of an aluminum alloy, shrouded impeller housing attached to the front face of the starter generator gearshaft by a retaining ring. Rotational torque is transmitted from the gearshaft to the impeller by three equi-distant pins. Breather air flows radially inward through the rotating impeller housing where oil particles in the breather air are separated by centrifugal force, and drain freely into the gearbox sump. The relatively oil-free air passes inward and into the hollow rear section of the gearshaft. The air flows forward and into a cored passage in the accessory diaphragm. From the cored passage, the air passes through a transfer tube to a breather boss on the accessory gearbox housing at the 2 o'clock position.

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Figure 1 Engine Oil Pump and Pressure Regulating Valve

79-20-01
EXTERNAL OIL TUBES - DESCRIPTION AND OPERATION

1. Description and Operation

A. Pressure System

Pressure oil from the filter outlet is delivered to the engine bearing areas and the accessory and reduction gearboxes through internal cored passages and internal and external oil transfer tubes. Pressure oil is delivered to the No. 1 bearing and the accessory gearbox via cored passages and internal transfer tubes, while oil to Nos. 2, 3 and 4 bearings and reduction gearbox is passed through a cored passage in the body of the P3 air filter housing at the 5 o'clock position on the compressor inlet case, then through an external transfer tube to an elbow fitting at the front end of the reduction gearbox. Oil is then delivered to the various areas within the gearbox by cored passages and transfer tubes. Oil to the No. 2 bearing is tapped off the external transfer tube and directed to the bearing area through internal piping.

B. Scavenge System

Scavenge oil from the No. 2 bearing area is directed through internal tubes to a port at the 7 o'clock position on the gas generator case. The flanged No. 2 bearing scavenge tube directs oil rearward to a boss at 6 o'clock on the compressor inlet case. The oil is then passed through internal transfer tubes to the front element of the internal scavenge pump which discharges the scavenged oil into the accessory gearbox sump.

Oil from the reduction gearbox and No. 3 and 4 bearing areas is returned through twin external tubes to respective scavenge pumps at the rear of the engine. The stainless steel scavenge tubes are connected to the respective ports on the reduction gearbox through short transfer tubes and a common twin-port adapter bolted to the front case of the gearbox. The scavenge tubes are supported by a flange-mounted coupling on flange C. The rear ends of the tubes fit into elbow extensions of the front and rear elements of the external scavenge pump. The No. 3 and 4 bearing oil is scavenged by the front element and discharged into the accessory gearbox sump, while the reduction gearbox oil is scavenged by the rear element which returns the oil to the oil tank via an airframe-mounted cooler. (Refer to Aircraft Maintenance Manual.)

EXTERNAL OIL TUBES - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used, unless otherwise specified, shall comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-021	DELETED
PWC11-021C	Compound, Cold Carbon Remover
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine

3. Special Tools

Not Applicable

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

CAUTION: WHEN REMOVAL OR INSTALLATION OF AN INDIVIDUAL ITEM IS REQUIRED, IT IS ESSENTIAL THAT TUBES ARE NOT SUBJECTED TO BENDING STRESSES. UNDER NO CIRCUMSTANCES, BEND OR FORCE TUBES IN OR OUT OF POSITION. WHEN REMOVING ANY ONE TUBE, THE ADJACENT TUBE, COUPLING OR ELBOW, TOGETHER WITH SEAL RETAINING PLATES (IF APPLICABLE), MUST FIRST BE REMOVED, AND THE PROCEDURE REVERSED AT REINSTALLATION.

A. Removal of Front Pressure Oil Tube (Ref. Fig. 201)

(1) Drain engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove bolts and washers fastening elbow (2) to front case of reduction gearbox.

(3) Remove self-locking nuts, washers and bolts from coupling (5) at flange C.

(4) Withdraw elbow (2) from boss on reduction gearbox case and remove elbow from front tube (4). Remove and discard preformed packing (1).

(5) Remove and separate front tube and coupling (5). Remove and discard preformed packings (3).

B. Removal of Rear Pressure Oil Tubes (Ref. Fig. 202)

(1) Drain engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove bolts and self-locking nuts fastening ignition cable bracket, seal retaining plates (13), retaining plate heat shields (14) and seals (15) to center mount ring.

(3) Remove center oil tube (17) from rear oil tube (10). Remove and discard preformed packings (16) from tube.

(4) Remove bolts and self-locking nuts fastening retaining plates (2, 7 and 9), heat shields (3), seals (4 and 8) to rear mount ring.

NOTE: Mount ring sealing parts at this location are shared jointly with P3 air filter housing.

(5) Remove bolts fastening No. 2 bearing tube flange of rear tube (10) to gas generator case.

(6) Disconnect P3 air tubes at front and rear of P3 air filter housing. Cap/cover openings and tube ends.

(7) Remove long and short bolts and washers fastening air filter housing to compressor inlet case.

(8) Withdraw housing from boss and remove from transfer tube (6). Remove and discard preformed packing (1) from housing.

(9) Remove transfer tube (6) from coupling of rear tube (10). Remove preformed packings (5), retaining plate (2), heat shields (3) and seals (4) from tube. Discard packings (5).

(10) Withdraw tube flange from boss on gas generator case, and remove rear tube (10) from center and rear mount rings. Remove retaining plates (7 and 9), seal (8) from coupling at rear of tube. Remove and discard gasket (11) and preformed packing (12).

C. Removal of No. 2 Bearing Scavenge Oil Tube (Ref. Fig. 203)

(1) Drain engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove bolts and washers fastening No. 2 bearing scavenge tube (7) to gas generator case.

NOTE: Removal of bolts releases fuel tube and ignition cable loop clamps (10 and 11) respectively. Move leads and clamps clear of flange.

(3) Remove self-locking nuts and bolts fastening scavenge tube loop clamp (1) to ignition cable loop clamp.

(4) Remove bolts and self-locking nuts fastening seal retaining plates (2), insulation plates (3) and seals (4). Remove plates, plate assemblies and seals from tube.

(5) Remove bolts fastening No. 2 bearing scavenge tube (7) and rear support bracket (5) to compressor inlet case.

(6) Remove bolt and self-locking nut fastening scavenge oil tube loop clamp to ignition cable loop clamps if applicable (Ref. 74-20-00, Removal/Installation).

(7) Remove bolts and self-locking nuts and support bracket (5) from rear mount ring.

(8) Withdraw scavenge tube from bosses on gas generator and compressor inlet cases, and remove tube rearward through hole in rear mount ring.

(9) Remove and discard preformed packings (6 and 8) from flanges and gasket (9) from front flange.

D. Removal of Front Scavenge Oil Tubes (Ref. Fig. 204)

(1) Drain engine oil system (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove bolts and washers fastening elbow (5) to propeller reduction gearbox.

(3) Remove bolts, washers and self-locking nuts, fastening coupling (8) to flange C.

(4) Withdraw front elbow (5) from short transfer tube (2) and transfer tubes (7). Remove preformed packing (3) and sleeve seal (4). Discard preformed packing.

(5) Withdraw short transfer tube (2) from reduction gearbox. Remove and discard preformed packings (1).

(6) Withdraw front tubes (7) from coupling (8). Remove and discard preformed packings (6).

(7) Remove external coupling.

E. Removal of Rear Scavenge Oil Tubes (Ref. Fig. 205)

(1) Drain engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove bolts and self-locking nuts, seals (9), insulations (8) and retaining plates (7) from rear mount ring.

(3) Remove bolts and self-locking nuts, ignition cable bracket (3), seals (6), insulations (5) and retaining plates (4) from center mount ring.

(4) Remove tubes (2) from scavenge pump ports and carefully withdraw tubes from center and rear mount rings, removing seals and seal retaining plates from tubes during withdrawal of tubes through mount rings.

(5) Remove and discard preformed packings (1) from each rear tube.

(6) Cap/cover all openings and tube ends.

F. Installation of Front Pressure Oil Tube (Ref. Fig. 201)

(1) Install new lubricated preformed packings (3) on tube (4), and new lubricated preformed packing (1) on elbow (2). Install elbow (2) on tube.

(2) Install rear of tube in coupling (5) at flange C.

(3) Install coupling (5) to flange C with bolts, washers and self-locking nuts. Tighten nuts 36 to 40 lb.in.

NOTE: Do not tighten nuts if installation of rear oil tubes is yet to be accomplished.

(4) Install elbow (2) on boss at reduction gearbox front case and secure with bolts and washers. Tighten bolts 36 to 40 lb.in.

(5) Refill engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(6) Check oil tube installation (Ref. Adjustment/Test).

G. Installation of Rear Pressure Oil Tube (Ref. Fig. 202)

(1) Install seal retaining plate (9), seal (8) and seal retaining plate (7) on rear of tube (10). Install retaining plate (13), heat shields (14) and seal (15) on front of tube (10). Slide components toward center of tube.

(2) Insert tube forward through center mount ring and rearward through rear fireseal mount ring. Locate bearing supply flange adjacent to boss on gas generator case.

(3) Install heat shields (3), seal (4), second heat shields (3) and retaining plate (2) on protruding section of tube (10) at rear mount ring.

(4) Install new lubricated preformed packings (5) on transfer tube (6) and insert into rear tube (10).

(5) Install new lubricated preformed packing (1) on P3 air filter housing and push housing on rear of tube (6).

(6) Locate P3 air filter housing on boss of compressor inlet case and fasten loosely with long and short bolts and washers.

(7) Install new gasket (11) and new lubricated preformed packing (12) on flange of tube (10).

(8) Install tube flange in boss on gas generator case with bolts and washers. Tighten bolts 36 to 40 lb.in., and lockwire.

(9) Install retaining plate (13), heat shields (14) and seal (15) on rear of tube (17) adjacent to mount ring.

(10) Install new lubricated preformed packings (16) on center tube (17). Install tube (17) into tube (10).

(11) Install coupling to flange C with bolts, washers and self-locking nuts. Tighten nuts 36 to 40 lb.in.

(12) Tighten bolts fastening P3 air filter housing to compressor inlet case 36 to 40 lb.in., and lockwire.

(13) Refill engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(14) Check oil tube installation (Ref. Adjustment/Test).

H. Installation of No. 2 Bearing Scavenge Oil Tube (Ref. Fig. 203)

(1) Install new lubricated preformed packings (6 and 8) on front and rear flanges respectively of No. 2 bearing tube (7). Install new gasket (9) on front flange.

(2) Pass front of scavenge tube through rear mount ring and locate flanges on respective bosses on gas generator and compressor inlet case.

(3) Locate rear mount ring support bracket (5) on front hole of rear flange with bolts. Tighten bolts 36 to 40 lb.in., and lockwire.

NOTE: Install forward flange of bracket (5) to rear mount ring using bolts and nuts. Tighten nuts 36 to 40 lb.in.

(4) Locate fuel tube loop clamp on right hole, and ignition cable loop clamp on left hole of tube front flange. Tighten bolts 36 to 40 lb. in.

(5) Fasten oil tube loop clamp (1) to ignition cable loop clamp with bolt and self-locking nut. Tighten nut 36 to 40 lb.in.

(6) Install seals (4), insulation (3) and retaining plates (2) on tube (7) to rear mount ring with bolts and self-locking nuts. Tighten nuts until firm contact is made plus one half turn.

(7) Refill engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(8) Check oil tube installation (Ref. Adjustment/Test).

I. Installation of Front Scavenge Oil Tubes (Ref. Fig 204)

(1) Install new lubricated preformed packings (1) on short tube (2) and insert tube into boss on reduction gearbox case.

(2) Install sleeve seal (4) and new lubricated performed packing (3) in scavenge port of front scavenge elbow (5).

(3) Install new lubricated performed packings (6) on each end of tubes (7). Insert tubes into respective ports in elbow (5).

(4) Locate elbow and tubes under reduction gearbox case. Insert short tube (2) into port in elbow and rear of tubes (7) into respective ports in coupling (8).

(5) Locate elbow (5) on mounting flange of reduction gearbox case. Make sure packing (3) and sleeve (4) mate with corresponding hole in flange, and fasten bolts and washers. Tighten bolts 36 to 40 lb.in., and lockwire.

(6) Tighten self-locking nuts that attaches coupling (8) to flange C, 36 to 40 lb.in.

NOTE: Do not tighten nuts at this time if installation of rear scavenge oil tubes is yet to be accomplished.

(7) Refill engine oil system (Ref.72-00-00, SERVICING, lubricating oil system).

(8) Check out tube installation (Ref. Adjustment/Test)

J. Installation of Rear Scavenge Oil Tubes (Ref. Fig. 205)

(1) Install new lubricated preformed packings (1) on each end of tubes (2).

(2) Loosely install scavenge line seals (6 and 9), insulations (5 and 8) and retaining plates (4 and 7) on respective mount rings with bolts and self-locking nuts.

NOTE: Bolt heads must be located on air inlet face of respective mount rings.

(3) Insert tubes (2) through mount rings and associated seals, and connect to respective ports on external scavenge pump.

(4) Install coupling on tubes and locate coupling on front face of flange C.

NOTE: Loosely secure coupling to flange with bolts, washers and self-locking nuts if front scavenge tubes are to be installed.

(5) Tighten self-locking nuts fastening coupling to flange C, 36 to 40 lb.in.

(6) Tighten self-locking nuts fastening seals and seal retaining plates to respective mount rings until firm contact is made, plus one half turn.

(7) Refill engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(8) Check oil tube installation (Ref. Adjustment/Test).

6. Cleaning/Painting

A. Cleaning of Tubes

(1) Soak tubes in cold carbon removing compound (PWC11-021C) for two hours at room temperature.

(2) Remove tube from solvent and pull a suitable sized swab, or lint-free cloth through tube.

CAUTION: MAKE SURE NO PART OF SWAB OR CLOTH REMAINS IN OIL TUBE; OTHERWISE, OIL FLOW WILL BE RESTRICTED.

(3) Rinse tube exterior and pressure flush tube bore with solvent (PWC11-027) or (PWC11-031).

(4) Dry interior and exterior with dry, compressed air.

7. Inspection/Check

A. Inspection of Tubes

(1) Cracked tubing must be replaced. No repair is permitted.

(2) Dented tubing must be replaced if any of the following conditions apply:

1. If dent has sharp corners.
2. If dent length and depth exceed 10 percent of tube outside diameter.
3. If more than one dent exists per 12 inch length.
4. If dent is within one inch of ferrule scarf-welds or bend.

(3) Light scratching of no appreciable depth is acceptable. Tubes must be replaced if scratches, nicks, pitting or chafing cannot be smoothed out within $^1/_2$ square inch, to maximum 0.0085 inch deep (Ref. 70-00-00, REPAIR). Any number of such blended areas are permitted provided they are separated by at least $^1/_2$ inch of undamaged material.

(4) Rust and stains are acceptable if they can be removed by light polishing with fine abrasive cloth, otherwise step (3) applies.

8. Adjustment/Test

Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do checks associated with Installation/Replacement of External Oil Tubes (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501).

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Figure 201 Removal/Installation of Front Pressure Oil Tube

Figure 202 Removal/Installation of Rear Pressure Oil Tubes

Figure 203 Removal/Installation of No. 2 Bearing Scavenge Oil Tube

Figure 204 Removal/Installation of Front Scavenge Oil Tubes

Figure 205 Removal/Installation of Rear Scavenge Oil Tubes

79-20-02

OIL FILTER HOUSING AND CHECK VALVE - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

The oil filter installation consists of a removable filter housing containing a disposable cartridge-type filter element with metal screen, a spring-loaded bypass valve and a check valve. The oil filter assembly and filter housing is located in the compressor air inlet case at the 3 o'clock position and retained by the filter cover; the cover is fastened to the inlet case by self-locking nuts. The inner end of the filter housing locates in the oil pump support boss and is sealed by a preformed packing.

Pressure oil from the oil pump passes through holes in the housing, lifts the check valve off its seat and flows into the filter housing. Oil then filtrates through the filter element into the center core and out into cored passages in the inlet case. Any extraneous foreign matter in the pressure oil is deposited on the outer face of the filter element. The check valve closes under the influence of a spring to prevent gravity oil flow into the engine after shutdown and also facilitates filter element replacement without having to drain the oil tank.

A filter bypass is provided by a spring-loaded valve piston installed between the check valve and the inner end of the filter element. The bypass valve is normally closed and sealed from the element core. In the event of a filter blockage, increased pressure overcomes the bypass valve spring and moves the valve piston, enabling oil to flow directly into the center core of the filter element. A coarse hat-type screen attached to the inner end of the filter element partially filters the bypass oil before entering the engine.

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Figure 1 Oil Filter Check Valve and Bypass Valve

OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used shall, unless otherwise specified, comply with specification AMS 5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-019	Compound, Lapping
PWC05-145	Use PWC05-019
PWC05-190	Patch, Filter
PWC11-014	Alcohol, Isopropyl
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-074	Solvent, Non-Aqueous
PWC11-084	Degreaser, Water-Repellent

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC30328	Puller, Filter HSG	Replaced by PWC50726
PWC30556	Oil Filter Element Puller	

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Cleaner, Electrosonic	
Vacuum Pump	Oil Filter Element Rinsing and Debris Apparatus Kit

5. Servicing

For oil system servicing and inspection criteria, refer to Chapter 72-00-00, SERVICING, Lubricating Oil System.

6. Removal/Installation

A. Removal of Oil Filter Element (Ref. Fig. 201)

(1) Remove self-locking nuts (13) and plain washers (14) fastening oil filter cover (7) to compressor inlet case (1).

(2) Remove cover (7) complete with preformed packing (5) and teflon spacer (6). Discard preformed packing.

NOTE: Do not remove spacer (6) from cover (7) unless damaged.

(3) Withdraw filter element (3) from oil filter housing (8) using puller (PWC30556) as follows:

(a) Unscrew knurled nut (10) to end of thread on rod (11).

(b) Screw rod into collet assembly (12) until enlarged end of rod clears collet teeth.

(c) Install puller (9) over filter housing (8) so that end of housing seats on counterbore of puller.

(d) Push rod inward until collet teeth engage behind inner bore of filter element end cover.

(e) Carefully unscrew rod (11) to lock collet teeth in position.

NOTE: Do not over expand collet teeth, as teeth may contact and damage center support tube of filter element.

(f) Screw in knurled nut (10) to withdraw filter element.

(g) Remove puller (PWC30556) and element (3) from filter housing, then remove puller from element.

(h) Remove and discard preformed packings (2 and 4).

B. Removal of Oil Filter Housing (Ref. Fig. 202)

(1) Drain engine oil (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove oil filter element (Ref. Para. A. preceding).

(3) Withdraw oil filter housing assembly (3) from compressor inlet case (1) with puller (PWC30328) or (PWC50726):

(a) Unscrew head (6) from nut (7).

(b) Pull open halves of head (6) at threaded end and insert claw end of head into oil filter housing (3). Release claws of head so that head engages behind shoulder of housing.

(c) Install nut (7) on head (6) to hold head in position.

(d) Operate sliding weight (8) along rod (9) to extract housing (3).

(e) Remove puller (PWC30328) or (PWC50726) from filter housing (3).

(f) Remove and discard preformed packings (2 and 5) and plastic ring (4) from filter housing (3).

C. Removal of Oil Filter Check/Bypass Valve Assembly (Ref. Fig. 203)

(1) Drain engine oil system (Ref. 72-00-00, SERVICING, Lubricating Oil System).

(2) Remove oil filter element (Ref. Para. A. preceding).

(3) Remove oil filter housing (Ref. Para. B. preceding).

(4) Carefully withdraw check/bypass valve from filter housing (3, Fig. 202).

(5) Remove and discard preformed packing (1, Fig. 203) from check valve seat (2).

(6) Remove retaining ring (10) and separate bypass valve seat (5) from valve seat (2).

NOTE: Use care when check valve (3) is removed, as it is spring loaded to valve seat (2).

(7) Remove check valve (3) and spring (4) from valve seat (2).

(8) Apply light pressure to bypass valve (8) and remove cotterpin (11) and washer (9). Separate assembly.

NOTE: Use care during this operation as parts are spring loaded.

(9) Remove spring (6) from guide shaft and V-type preformed packing (7) from valve (8). Discard preformed packing.

D. Installation of Oil Filter Element (Ref. Fig. 201)

(1) Install new lubricated preformed packings (2 and 4) on filter element (3).

(2) Install filter element (3), perforated flanged end first, into filter housing in compressor inlet case.

(3) Install new lubricated preformed packing (5) on filter cover (7).

NOTE: Make sure teflon spacer (6) is in position on lugs of filter cover.

(4) Install filter cover (7) on compressor inlet case with washers (14) and self-locking nuts (13). Tighten nuts (13) 32 to 36 lb.in.

(5) Fill oil tank (Ref. 72-00-00, SERVICING, Lubricating Oil System).

E. Installation of Oil Filter Housing (Ref. Fig. 202)

NOTE: Install oil filter check/bypass valve assembly into oil filter housing prior to installation of housing into compressor inlet case.

(1) Install new lubricated preformed packing (2) in groove at inner end of oil filter housing (3).

(2) Install plastic ring (4) in inner section of groove at center of housing.

(3) Install preformed packing (5) in outer section of groove and butt against plastic ring (4).

(4) Insert filter housing assembly into compressor inlet case and, using hand pressure, push assembly until firmly seated.

NOTE: Do not apply side loads on housing while it is being pressed into inlet case.

(5) Install oil filter element (Ref. Para. D. preceding).

(6) Fill oil tank (Ref. 72-00-00, SERVICING, Lubricating Oil System).

F. Installation of Oil Filter Check/Bypass Valve Assembly (Ref. Fig. 203)

(1) Install V-type preformed packing (7) on bypass valve (8). Make sure 'V' is facing outwards.

(2) Install spring (6) on internal shaft of bypass valve seat (5). Locate bypass valve (8) over shaft, compress spring so that shaft protrudes from end of valve. Install washer (9) and cotterpin (11).

(3) Install spring (4) in recess in external shaft of bypass valve guide (5). Install check valve (3) over external shaft of bypass valve guide.

(4) Install check/bypass assembly in valve seat (2) with retaining ring (10).

(5) Install new lubricated preformed packing (1) on valve seat (2).

CAUTION: PRIOR TO INSERTION OF VALVE ASSEMBLY INTO HOUSING, MAKE SURE PREFORMED PACKING (11) IS CORRECTLY SEATED ON VALVE SEAT AND IS NOT DISTORTED.

(6) Install complete assembly of check/bypass valve in oil filter housing (3, Fig. 202).

(7) Install oil filter housing (Ref. Para. E. preceding).

(8) Install oil filter element (Ref. Para. D. preceding).

(9) Fill oil tank (Ref. 72-00-00, SERVICING, Lubricating Oil System).

7. Cleaning

A. Cleaning of Oil Filter Element (Post-SB14391 and Post-SB14392)

CAUTION: NOT ALL FILTER ELEMENTS ARE CLEANABLE (Ref. SB14391 and SB14392).

CAUTION: DO NOT CLEAN ELEMENT ULTRASONICALLY.

(1) Solvent Wash

(a) Seal central tube opening at both ends of oil filter element with suitable sized rubber plugs.

(b) Agitate element for five minutes in clean, unused solvent (PWC11-027) or (PWC11-031).

(c) Allow element to stand in a clean environment until dry.

(d) Inspect element (Ref. Para. 8.).

(e) Repeat cleaning and inspection, if required, until element is considered serviceable.

NOTE: Use clean, unused solvent for each repeated cleaning operation.

(2) Electrosonic Wash (Ref. Fig. 204)

(a) Plug openings at each end of filter element with suitable plastic or rubber plugs.

(b) Place element in cleaning tank of electrosonic cleaner .

(c) Put sufficient quantity of isopropyl alcohol (PWC11-014) in tank to a level approximately 1/4 inch below top.

(d) Operate unit for 10 minutes.

(e) Rotate element 180 degrees (end-to-end) in tank and reoperate unit for 10 minutes.

NOTE: Cleaning duration should be adjusted depending on condition of element. However, for optimum results, cleaning solvent should be replaced every 20 minutes.

(f) Using clean, lint-free gloves, remove element from tank and remove plugs.

(g) Allow element to stand in clean environment until dry.

(h) Vibropeen cleaning date on end cap.

(i) Inspect element (Ref. Para. 8.).

8. Inspection/Check

A. Main Oil Filter Inspection

(1) Put a small lamp into the inner bore of filter element.

(2) Use magnifying glass and visually examine the oil filter and secondary screen (coarse hat-type screen attached to the inner end of the filter) for breaks, hole, tear or signs of crushing or collapse. There must be no loose particles, broken bonds or joints.

(3) If the external surface of the oil filter is damaged, then replace the main oil filter.

(4) If there is damage or opening on the secondary screen, then do unscheduled inspection (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

B. Main Oil Filter Contamination and Chip Detector Circuit Completion

(1) After an engine/module change due to bearing, gear or bronze bushing distress, it is recommended that the replacement engine have an oil filter patch-check (Ref. Para. C.) after 50 hours. This is to make sure the debris from the original failure has not contaminated the replacement engine, due to incomplete flushing of the airframe/propeller oil system(s).

(2) If magnetic or bronze material is found, as a contaminant, repeat patch check after 50 hours. If the amount of debris has reduced, repeat patch check at 50 hour intervals until no debris (traces are acceptable, except bearing material) is found.

(3) The time between patch checks should revert to standard maintenance intervals after the second consecutive clean patch check. If the amount of magnetic/bronze material increases or if magnetic/bronze material is found, as a major or minor contaminant, after the second clean patch check, the maintenance action required for debris in oil system must be carried out.

(4) In all instances when engine generated metal contamination requiring engine removal occurs and the main oil filter is bypassed, the airframe oil cooler must be replaced, (Ref. Airframe Maintenance Manual) and airframe oil tubes and hoses flushed. Failure to do so will cause contamination of the replacement engine.

(5) Chip detector circuit completion with main oil filter bypass requires engine removal.

NOTE: An assessment of the amount of contamination can indicate whether a main oil filter bypass has actually occurred. If the main oil filter is cleaned or replaced at regular intervals as recommended by P&WC and debris is deposited on most of the surface of filter element and associated housing, it can be considered that a bypass has occurred.

(6) Chip detector circuit completion not with main oil filter bypass requires removal and inspection of the chip detector and associated strainers and main oil filter. Do patch-making procedure on main oil filter and transfer any debris from chip detector.

(7) Inspect chip detector and/or main oil filter debris using a magnifying glass and/or microscope.

(8) After inspection is complete, all debris collected from chip detector and oil filter may be sent to a qualified laboratory for analysis (Ref. 70-00-00, MAINTENANCE PRACTICES, Debris Analysis and Material Specifications).

(9) Record engine TSN, cycles, category, type and origin of debris for trend monitoring purposes.

(10) An operator has the option of doing the filter patch-check or sending the filter to a laboratory for analysis. However, an inspection of the collected debris must be done as quickly as possible to determine the required maintenance action.

NOTE: Keeping a debris generating engine/module in service while removal is planned may substantially increase the cost of repair/refurbishment due to further debris damage.

(11) Allowable Debris

(a) Small quantity of hair-like filaments (fuzz) or powder (including bronze particles), spiral curls (machining swarf) and silver plating.

(b) If silver plating is found, proceed as follows:

1 If the main oil filter contains a large quantity (15 or more) of silver flakes, the engine oil system must be flushed (Ref. 72-00-00, SERVICING, Lubricating Oil System).

2 If silver flakes greater than 0.080 inch are found in the main oil filter, the AGB internal scavenge pump screen must be inspected (Ref. Chapter 72-60-00, INSPECTION and CLEANING). The engine oil system must be flushed (Ref. 72-00-00, SERVICING, Lubricating Oil System).

3 In both cases after performing the above, the engine may be returned to service, and the oil filter reinspected at the next scheduled inspection (Ref. 72-00-00, INSPECTION, Periodic Inspection).

(c) Collect allowable debris, clean and reinstall main oil filter, strainer, chip detector strainer(s) and chip detector(s). The engine may be returned to normal operation and oil filter and chip detector inspection to periodic inspection intervals.

(12) Non-allowable Debris

(a) Category 1:

1 Identifiable fragments i.e., keywasher keys, tooth segments, etc. If non-allowable Category 1 debris is found, replace affected module.

(b) Category 2:

1 Large quantities of hair-like filaments (fuzz) or powder (including bronze particles).

NOTE: Large quantity is defined as sufficient fuzz and/or powder filaments to completely cover the chip detector magnetic poles or more than 40 particles on a filter.

(c) Category 3:

1 Dark irregular magnetic chips (minimum dimension 0.010 in.).

2 Small clusters of magnetic flakes (three or more).

NOTE: Thin, shiny rolled flakes with feathered edges and more than 0.020 in. in size are generated when bearing surfaces break down due to excessive load (spalling). The outer surface of the flakes is highly polished and may show parallel impressions. The inner surface has a rough wavy or granular texture. After the bearing surface breaks down, the underlying material disintegrates and chips with dark, coarse and irregular shapes are produced.

(13) If non-allowable Category 2 or 3 debris is found and engine/module has no history of generating debris (within 400 hours):

(a) Clean and install chip detectors, strainers and main oil filter (Ref. Removal/Installation).

(b) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and run at 80% TAKE OFF power for 10 minutes.

(c) Remove and inspect chip detector, associated strainers and main oil filter (Ref. Removal/Installation).

(d) If no debris is found, clean and reinstall chip detector, strainer and main oil filter.

(e) Return engine to service. Check chip detector and main oil filter after 10 hours, and providing no debris is found, after 50 hours. If no debris is found at 50 hours, return oil filter and chip detector inspection to periodic inspection intervals.

(f) If debris is found, flush engine (Ref. 72-00-00, SERVICING, Lubricating Oil System)(Ref. 72-00-00, SERVICING) and powerplant oil system (Ref. Aircraft Maintenance Manual). Install clean chip detector, strainers and main oil filter (Ref. Removal/Installation).

(g) Fill engine (Ref. 72-00-00, SERVICING, Lubricating Oil System) and powerplant oil system. (Ref. Aircraft Maintenance Manual).

(h) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting) and run at 80% TAKE OFF power for 10 minutes

(i) Remove and inspect chip detector, strainers and main oil filter.

NOTE: It is possible that debris originating from power section module is from propeller governor. To determine the actual source of the debris, remove components individually. Determine the source of debris within 50 hours.

(j) If no debris is found, install chip detector, strainers and main oil filter. Check chip detector and main oil filter after 10 hours and providing no debris is found, after 50 hours. If no debris is found at 50 hours, return to standard periodic inspection interval.

(k) If category 2 or 3 non-allowable debris is found, replace module/engine.

(14) If non-allowable Category 2, not bronze or Category 3 debris is found, and the engine has a history of generating debris (within 400 hours):

(a) Review the results of last laboratory analysis.

(b) If results showed bearing material and origin was from the engine and not the propeller governor, then the engine should be removed.

(c) If results were not bearing material or results and/or origin of debris of last sample are still unknown, and quantity of debris is not increasing or engine is not consistently generating debris, install chip detector, strainers and main oil filter. Return engine to service. Check chip detector and main oil filter after approximately 10 hours and providing no debris is found, after 50 hours. If no debris is found at 50 hours, return oil filter and chip detector inspection to standard periodic inspection intervals.

NOTE: Results and origin of debris should be determined within 50 flight hours of original detection of debris.

(d) If results were not bearing material or results of last sample are still unknown, and quantity of debris is same or increasing and engine is consistently generating debris, replace module/engine at first opportunity within 10 hours of current report of debris.

(15) If non-allowable category 2 bronze debris is found and the RGB has a history of generating similar bronze debris (within 400 hours):

(a) If the RGB/power section is confirmed to be a replacement for one removed (within 100 hours) due to bronze bushing distress, clean and reinstall, main oil filter and strainers. Return the engine to service. Check chip detector and main oil filter after 10 hours and providing no debris is found, 50 hours. If no debris is found at 50 hours, return oil filter and chip detector to standard periodic inspection intervals.

(b) If the RGB/power section is not a replacement for one removed due to bronze bushing distress and the quantity of bronze debris has not increased, clean and reinstall chip detector, main oil filter and strainers. Return engine to service. Check chip detector and main oil filter after 10 hours and providing no debris (major or minor contaminant) is found at 50 hours, return oil filter and chip detector inspections to operator's standard periodic inspection intervals.

(c) If the RGB/power section is not a replacement for one removed due to bronze bushing distress and the quantity of bronze debris is the same or has increased, replace the power section within 10 hours of current report of debris.

(16) Laboratory report covering analysis of debris (filter patch or chip detector collected). The amount of individual constituents in oil filter patch debris after analysis is:

(a) Major - when weight of the constituent is more than 50% of the total debris weight.

(b) Minor - when weight of the constituent is less than 50% but more than 5% of the total debris weight.

(c) Traces - when weight of the constituent is less than 5% of total debris weight.

1 The engine must be replaced if bearing material AMS 6440/6444 or AMS 6490/6491 is found in the debris providing that no propeller governor or overspeed governor failure, if applicable, occurred prior to the generation of debris (i.e., the engine is the source of debris).

2 The engine may remain in service if bearing material AMS 6440/6444 or AMS 6490/6491 was found in the debris and it was confirmed a propeller governor or overspeed governor failure occurred prior to the generation of debris (within 100 hours). A chip detector and main oil filter check must be carried out after 10 hours, and providing no debris is found, after 50 hours. If no debris is found at 50 hours, return oil filter and chip detector to standard periodic inspection intervals. If category 2 or 3 non-allowable debris is found, repeat steps (14) and (15).

3 The engine may remain in service if no bearing material (AMS 6444 or AMS 6491) is found and debris is allowable.

(17) Inspect the following components when gear material is found in non-allowable category 2 and 3 debris.

(a) Power Section: First and Second-stage Planet Gears (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

(b) Gas Generator: Accessory Drive Gears (Ref. 72-00-00, ENGINE, TURBOPROP - INSPECTION).

(c) If debris found during inspection is within limits, engine may remain in service providing a chip detector and main oil filter check is carried out after 10 hours and providing no debris is found, after 50 hours. If no debris is found at 50 hours, return oil filter and chip detector to standard periodic inspection intervals. If category 2 or 3 non-allowable debris is found, do the maintenance actions steps (14) or (15), as applicable. If defects found are outside limits, replace the affected module within 10 flight hours.

(18) The engine may remain in service if any other types of category 2 or 3 debris is found as a filter contaminant. Check chip detector and main oil filter after 10 hours and providing no debris is found, after 50 hours. If no debris is found at 50 hours, return chip detector and oil filter inspection to standard periodic inspection interval. If category 2 or 3 non-allowable debris is found, do the maintenance actions in steps (14) or (15) as applicable.

NOTE: Air seal material found as a major and minor contaminant when carrying out the first oil filter patch check after installation of a new or overhauled engine is acceptable. However, engine generating seal material (AMS 4117, AMS 4127, AMS 4150, AMS 5613, AMS 5671 or Molybdenum) at a later stage may have had a heavy landing or a defect causing high unbalance (e.g., blade airfoil damage) which can produce seal rub.

C. Patch Making and Chip Detector Debris Transfer

NOTE: Operators may send the contaminated filter or debris to a qualified laboratory for filter patch check and/or analysis (Ref. 70-00-00, MAINTENANCE PRACTICES, Debris Analysis and Material Specifications).

(1) Remove filter element from engine (Ref. Removal/Installation).

C. Patch Making and Chip Detector Debris Transfer

NOTE: Operators may send the contaminated filter or debris to a qualified laboratory for filter patch check and/or analysis (Ref. 70-00-00, MAINTENANCE PRACTICES, Debris Analysis and Material Specifications).

(1) Remove filter element from engine (Ref. Removal/Installation).

(2) Using suitable tapered rubber plugs, seal inner cavity of filter element.

(3) Place filter in cylindrical container.

(4) Fill container with solvent (PWC11-027) or (PWC11-031) to cover filter element leaving a space for liquid movement when shaking. Install cover.

(5) Shake container for about three minutes manually or 30 seconds in a vibrator. Remove cover.

NOTE: Make sure there are no deposits left on filter. If yes, install container cover and continue shaking.

(6) Use vacuum pump and pour liquid contents of container into the filter holder.

NOTE: Make sure filter holder has new filter paper.

(7) Flush out all possible loose particles which may still be in container by pouring solvent (PWC11-027) or (PWC11-031) into it, shaking, then emptying into filter holder. Remove filter element from container.

(8) Remove filter paper from filter holder and place in receptacle. Identify sample with type of filter, engine number and TSN.

(9) Send sample to a qualified laboratory for material spectrographic analysis (Ref. 70-00-00, MAINTENANCE PRACTICES, Debris Analysis and Material Specifications).

(10) Dip magnet end in solvent (PWC11-027) or (PWC11-031) to remove oil.

(11) Transfer debris at magnet end to clear adhesive tape and identify with engine S/N, and TSN or TSO.

D. Alternative Patch-Making Procedure

CAUTION: DO NOT USE PATCH-MAKING PROCEDURE AS A CLEANING PROCEDURE FOR FILTER ELEMENTS.

(1) Remove filter element from engine (Ref. Removal/Installation).

(2) Using suitable tapered plugs, seal inner cavity of filter element.

(3) Place filter in cylindrical container.

WARNING: REFER TO MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

(4) Fill the container with solvent (PWC11-074) or degreaser (PWC11-084) sufficient to cover the filter element but leave space for liquid movement when shaking and attach the cover.

(5) Shake container for about three minutes manually or 30 seconds in a vibrator. Remove cover.

NOTE: Make sure there are no deposits left on filter. If there is, secure container cover and continue shaking.

(6) Install new filter patch (PWC05-190) in filter patch holder and place over a suitable container ($^1/_2$ gal. min.).

(7) Remove filter element from container.

(8) Pour liquid contents of container into filter patch holder.

(9) Put some solvent (PWC11-074) or degreaser (PWC11-084) into the container to flush out all possible loose particles which may still be in the container. Shake the container and put the liquid into the filter patch holder.

(10) Remove filter patch from filter patch holder and place in patch receptacle. Identify sample with type of filter, engine serial number and hours run.

(11) If any debris is found (particles large enough to be trapped by filter patch), send sample to laboratory for material spectrographic analysis.

NOTE: Some operators retain the filter patches to establish a visual coloration trend. Operators doing this, need to build up their own experience for patch coloration trend evaluation because trends may vary from one engine to another and may be affected by the operating environment and maintenance practices.

(12) Remove plugs from filter element (make sure the preformed packing does not drop inside the element).

WARNING: WHEN USING COMPRESSED AIR FOR DRYING, REGULATE TO 29 psig OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES.

(13) Dry filter element using clean compressed air at 29 psig.

(14) Install filter element on engine (Ref. Removal/Installation).

(13) Dry filter element using clean compressed air at 29 psig.

(14) Install filter element on engine (Ref. Removal/Installation).

E. Filter Housing

(1) If check valve/housing seating is suspect, inspect both seating surfaces for scoring, scratches, nicks, burrs and foreign matter. No damage is acceptable. Damaged seatings should be lapped (Ref. Para. 9.).

9. Approved Repairs

A. Lapping Oil Filter Check Valve

(1) If either or both mating surfaces of check valve and check valve seat are damaged, or if a new part is to be installed, proceed as follows:

(a) Lap check valve in check valve seat with lapping compound (PWC05-019) or (PWC05-145) sufficiently to give 360 degree surface contact.

(b) After lapping, thoroughly wash check valve and valve seat in solvent (PWC11-027) or (PWC11-031) and remove all traces of lapping compound.

B. Static Leak Test, Oil Filter Check Valve

(1) Install the oil filter housing in the compressor inlet case (Ref. Para. 6.D.).

(2) Fill the oil tank (Ref. 72-00-00, SERVICING).

(3) Do the static leak test:

(a) Let the engine stand for two hours. Monitor the oil leakage into the oil filter housing. The maximum leakage permitted is 0.5 cc/hour.

(4) If necessary, replace the preformed packings and do the Step (3) again.

(5) If the leakage continues, replace parts as necessary and/or do the lapping procedure again (Ref. Para. A.).

(6) Install the oil filter element into the housing (Ref. Para. 6.D.).

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Figure 201 Removal/Installation of Oil Filter Element

Figure 202 Removal/Installation of Oil Filter Housing

Figure 203 Removal/Installation of Oil Filter Element, Housing and Bypass/Check Valve

Figure 204 Electrosonic Cleaner - Oil Filter Element

1. Description

The thermostatic bypass and check valve installation, comprising valve and related parts, is mounted on the compressor inlet case/oil tank. It directs scavenge oil coming from the oil-to-fuel heater to either the oil tank at low oil temperature or to the airframe oil cooler via the external reduction gearbox scavenge line at high oil temperature.

A relief valve is incorporated to safeguard the accessory gearbox scavenge oil system against rising oil pressure. The check valve prevents back flow of oil from the oil cooler line.

2. Operation (Ref. Fig. 1)

Accessory gearbox scavenge oil is delivered by a pump to the oil-to-fuel heater, and then to the tank via the open bypass valve when cold.

A thermal element, sensitive to oil temperature variations, begins to expand at 60°C (140°F) and initiates movement of the bypass valve in a closing direction. At a temperature of 70°C (160°F), the bypass valve is fully closed and scavenge oil is routed through the check valve to join a line conveying reduction gearbox scavenge oil to the airframe oil cooler before returning it to the oil tank.

The thermal element contracts as oil temperature decreases, and a return spring moves the bypass valve in an opening direction to allow accessory gearbox scavenge oil to return direct to the oil tank. At the same time, the check valve will close under the influence of a spring, and prevent back flow of oil from the reduction gearbox scavenge and airframe oil cooler line to the tank.

Failure of the thermal element to contract and open the bypass valve at low oil temperature would return accessory gearbox scavenge oil to the airframe oil cooler instead of directly to tank. To safeguard the system, prevent a pressure buildup, and overloading of the accessory gearbox scavenge oil pump, a relief valve, formed by the closed bypass valve and spring, opens at 40 to 55 psi to return scavenge oil direct to tank.

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Figure 1 Thermostatic Bypass and Check Valve (Cross-section)

THERMOSTATIC BYPASS VALVE - MAINTENANCE PRACTICES

1. General

A. Maintenance personnel should make reference to the INTRODUCTION section and Chapter 70-00-00 STANDARD PRACTICES of this manual to familiarize themselves with general procedures.

B. Install suitable protective caps/covers over all disconnected tubes/lines and component openings.

C. Lockwire used shall, unless otherwise specified, comply with specification AMS5687, heat and corrosion resistant steel wire MS9226-03, which is 0.025 inch diameter, and will not be specified in instructions.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-019	Compound, Lapping Silicon Carbide
PWC05-061	Cloth, Abrasive Coated Crocus
PWC05-101	Cloth, Abrasive
PWC05-145	(Use PWC05-019)
PWC05-166	Solution, Chemical Treatment
PWC11-027	Solvent, Petroleum
PWC11-031	Cleaner, Engine
PWC11-038	Solvent, Cleaning

3. Special Tools

The special tools listed below are used in the following procedures.

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC34532	Puller

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation

A. Removal of Thermostatic Bypass and Check Valve

(1) Remove drain plug at base of oil-to-fuel heater (Ref. 73-10-01, Removal/Installation) and allow residual oil to drain into suitable container.

(2) Remove bolt and self-locking nut from loop clamp (2, Fig. 201) on tube assembly (9) and bracket.

(3) Disconnect coupling nuts at each end of tube assembly (9) and allow residual oil to drain into suitable container. Remove tube and cap all tube and fitting openings.

NOTE: If necessary to increase accessibility, remove P3 air filter cover and element (Ref. 73-10-07, Removal/Installation).

(4) Remove bolts fastening short transfer tube (7) and retaining plate (6) to bypass valve housing (5). Remove retaining plate from groove in transfer tube.

NOTE: If difficulty is experienced in removing plate, allow it to remain loosely in position on tube.

(5) Disengage short transfer tube from oil-to-fuel heater and move tube forward into cavity in bypass valve housing until rear end of tube clears boss on heater.

(6) Remove bolts and washers fastening valve housing to boss on compressor inlet case. Withdraw valve housing from inlet case complete with short transfer tube (7). Remove preformed packing (4) from oil outlet boss on housing.

(7) Withdraw short transfer tube (7) from valve housing and remove two preformed packings (8) from tube.

B. Installation of Thermostatic Bypass and Check Valve

(1) Install new preformed packings (8, Fig. 201) on short transfer tube (7) and insert one end of tube into oil inlet boss on bypass valve housing (5).

(2) Install new preformed packing (4) on valve housing oil outlet boss.

(3) Insert oil outlet boss of bypass valve into boss at 5 o'clock position on compressor inlet case with bolts and washers. Tighten bolts 32 to 36 lb.in., and lockwire.

(4) Withdraw short transfer tube from cavity to bypass valve housing and insert rear end of tube into mating boss of oil-to-fuel heater (3).

(5) Install retaining plate (6), in groove at front end of transfer tube, to valve housing with two bolts. Tighten bolts 36 to 40 lb.in. and lockwire.

(6) Install external oil transfer tube assembly (9) between bypass port on valve housing and scavenge line tee-adapter (1) at rear of engine. Tighten coupling nuts 450 to 500 lb.in. and lockwire.

(7) Install loop clamp (2) on tube assembly (9) to bracket on accessory gearbox housing using bolt and self-locking nut. Tighten nut 32 to 36 lb.in.

(8) Replace preformed packing and reinstall drain plug in oil-to-fuel heater.

NOTE: If previously removed, install P3 air filter cover and element (Ref. 73-10-07, Removal/Installation).

6. Cleaning/Painting

A. Clean Valve Housing

(1) Clean exterior surfaces with solvent (PWC11-027) or (PWC11-031). Wipe surfaces clean with lint free cloths and dry with clean, dry compressed air.

(2) Pressure flush oil transfer tubes with solvent (PWC11-027) or (PWC11-031). Dry exterior and interior of tubes with clean, dry compressed air. Cap tubes until required for installation.

7. Inspection/Check

A. Inspection of Valve Housing

(1) Examine surfaces for corrosion and general condition of protective coating. Repair and apply touch-up solution as needed (Ref. Approved Repairs).

(2) Examine mounting flange for cracks or other defects. Cracks are not permissible; minor surface damage may be blend repaired.

(3) Examine straight adapter at bypass oil outlet for damage. Damaged threads may be cleaned up.

B. Inspection of Oil Tubes

(1) Minor scratches having no appreciable depth are acceptable. Scratches 0.005 inch deep should be smoothed out. Replace tube if scratches exceed 0.005 inch deep.

(2) Individual nicks 0.062 inch long by 0.010 inch wide and 0.003 inch deep are acceptable. Nicks to a maximum depth of 0.005 inch should be smoothed out to remove sharp edges.

(3) Round bottom dents on tubing are acceptable provided length and depth are not greater than 10 percent of outside diameter of tubing. No more than one dent per 12-inch length of tubing is acceptable.

(4) Isolated minor pitting is acceptable provided it is not more than 0.003 inch deep. Clusters of pits not exceeding 0.005 inch deep should be blend repaired.

(5) Surface corrosion is acceptable if removable by light polishing with crocus cloth and oil.

(6) On oil bypass transfer tube, inspect coupling nuts for damaged threads and similar defects. Damaged threads may be cleaned up.

8. Approved Repairs

A. General

(1) Minor damage such as burrs, nicks, scores, scratches and other similar defects, may be repaired with a fine stone or abrasive cloth (PWC05-061). Make sure all high spots and sharp edges are removed.

(2) Damaged threads may be cleaned up with fine Swiss files or appropriate size tap/die.

(3) Light surface corrosion may be removed by careful polishing with abrasive cloth (PWC05-101), followed by (PWC05-061).

B. Application of Protective Coating

WARNING: ALODINE SOLUTION IS EXTREMELY DANGEROUS. IT CONTAINS AN OXIDIZING AGENT WHICH CAN CAUSE AN EXPLOSION IF IT COMES INTO CONTACT WITH COMBUSTIBLE MATERIALS SUCH AS PAINTS AND SOLVENTS.

(1) The finish on surface of the bypass valve housing may be repaired by local application of solution. This treatment must be used on areas where minor repairs have been done.

(a) Prepare repaired area by swabbing with cleaning solution (PWC11-038). Keep surface wetted with cleaning agent for one to five minutes.

(b) Rinse area with clean water to remove all traces of cleaning agent.

(c) Apply solution (PWC05-166) to prepared surface by brush, swab or spray method and allow three to five minutes setting time.

(d) Rinse area with clean water to remove all traces of solution and allow surface to dry.

(e) Examine coating and make sure repair area is completely covered. Reapply solution as necessary.

C. Specific Repairs (Heavy Maintenance Only).

(1) Replacement of Bypass Port Nipple (Ref. Fig. 202).

(a) Remove straight nipple (1) from boss on valve housing (3).

(b) Remove preformed packing (2) from nipple and discard.

(c) Install new preformed packing (2) on straight nipple (1) and fit nipple into boss on bypass valve housing.

(d) Tighten nipple 200 to 225 lb.in. Do not lockwire.

(2) Replacement of Check Valve (Ref. Fig. 202).

(a) Remove bypass and check valve from engine (Ref. Removal/Installation).

CAUTION: THIS ASSEMBLY CONTAINS A SPRING UNDER COMPRESSION. REMOVE BOLTS SECURING COVER WITH CARE.

(b) Remove bolts, check valve cover plate (9) from valve housing (3).

(c) Remove cover (8) from valve housing using puller (PWC34532). Remove preformed packing (7) from cover.

(d) Remove compression spring (6) and valve assembly (5) from sleeve (4) installed in valve housing.

CAUTION: DO NOT TRY TO REMOVE VALVE SLEEVE.

(e) Clean check valve, spring, cover, and interior of valve housing and sleeve with solvent (PWC11-027) or (PWC11-031) and dry with clean, dry compressed air.

(f) Inspect internal sleeve and check valve seating faces for scoring, scratches or similar defects which could prevent correct valve seatings. Valve seatings with such defects should be lapped (Ref. Approved Repairs).

(g) Examine spring condition for evenness of coils and squareness of ends. Check compression as follows:

1 At 0.600 inch length, 1 lb. 0.42 oz. to 1 lb. 0.47 oz.

2 At 0.450 inch length, 1 lb. 5.35 oz. to 1 lb. 5.38 oz.

(h) Lap face of check valve in valve sleeve to obtain a 360-degree surface contact using lapping compound(PWC05-145) or (PWC05-019). After lapping remove valve and thoroughly wash check valve and valve housing in solvent (PWC11-027) or (PWC11-031), to remove all traces of lapping compound. Dry with clean, dry compressed air.

(i) Install new preformed packing (7) on cover (8).

(j) With spring seat on cover uppermost, position compression spring on cover followed by check valve (5).

(k) Keeping parts vertical, slide valve, spring and cover into valve sleeve (4) and valve housing (3) assembly.

(l) With cover inner face contacting end of sleeve (4) and outer face flush with valve housing, install valve cover plate (9) and secure with bolts. Torque bolts 36 to 40 lb.in., and safety wire.

NOTE: Do not lockwire bolts at this stage when replacing thermostatic bypass valve. Lockwiring involves both units

(3) Replacement of Thermostatic Bypass Valve (Ref. Fig. 202).

(a) Remove bypass and check valve (Ref. Removal/Installation).

CAUTION: USE CARE WHEN REMOVING VALVE. THIN SHELL COVER OF THERMAL ELEMENT IS FRAGILE.

(b) Remove lockwire from valve (10).

(c) Unscrew and withdraw valve and thermal element assembly (10) from valve housing (3). Remove preformed packing (11) and discard.

(d) Clean internal portion of valve housing and external areas of thermal element and bypass valve with solvent (PWC11-027) or (PWC11-031)and dry with clean, dry compressed air.

(e) Examine thermostatic bypass valve for damage to threads, for straightness and dents in thin metallic covering of thermal element. Threads may be cleaned up using suitable swiss files and/or fine stone. Other damage is cause for replacement.

CAUTION: USE CARE WHEN INSTALLING VALVE. THIN SHELL COVER OF THERMAL ELEMENT IS FRAGILE.

(f) Install new preformed packing (11) on threaded boss of valve (10).

(g) Install thermostatic bypass valve (10) in valve housing (3). Tighten 300 to 375 lb.in. Lockwire to bolts fastening check valve cover plate.

9. Adjustment/Test

A. Procedure

(1) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST, Engine Starting), and do checks associated with Installation/Replacement of Thermostatic Bypass and Check Valve (Ref. 71-00-00, ADJUSTMENT/TEST, Table 501). Check for oil leaks.

(2) Observe oil temperature for valve functioning. Higher than normal oil temperatures will indicate a malfunction of either the bypass valve or the check valve assembly.

List of Figures

Figure 201 Removal/Installation of Thermostatic Bypass and Check Valve

Figure 202 Thermostatic Bypass and Check Valve - Replacement and Repair

1. General

The Airworthiness Limitations section specifies mandatory Rotor Component Service Life Limits required for type certification. The Airworthiness Limitations section is approved by the Canadian Minister of Transport and specifies maintenance required by any applicable airworthiness or operational rule unless an alternative program has been approved by the Canadian Minister of Transport.

For Rotor Component Service Life Limits, refer to the latest revision of P&WC S.B. No.14002.

Figure 1 Interturbine Temperature (T5) Schematic

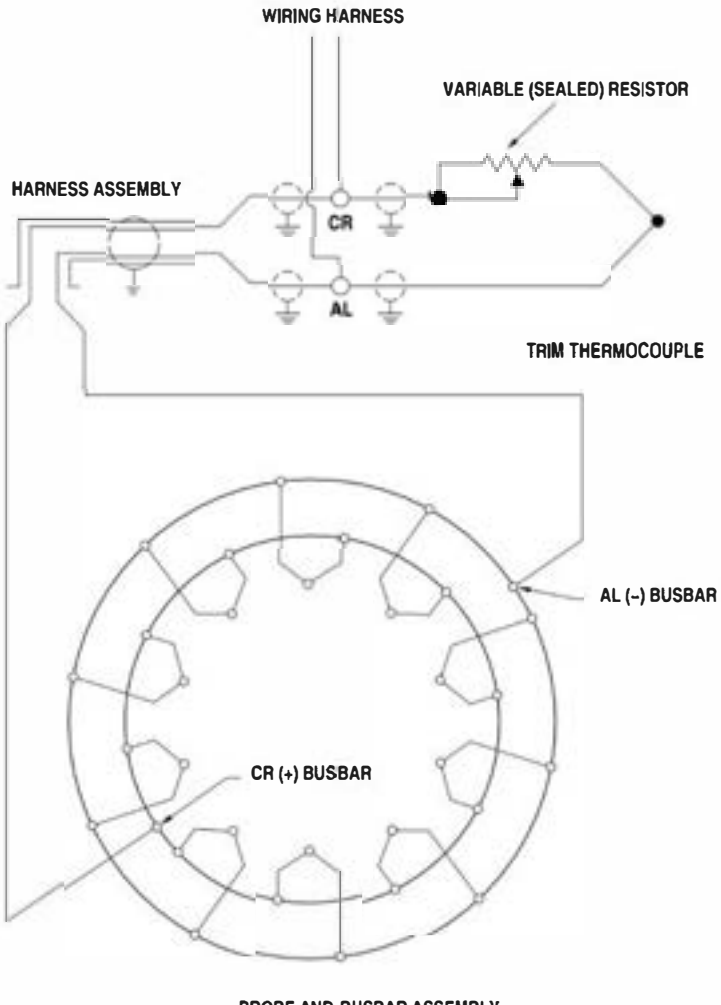


Figure 1 Combustion Chamber Liner Assemblies

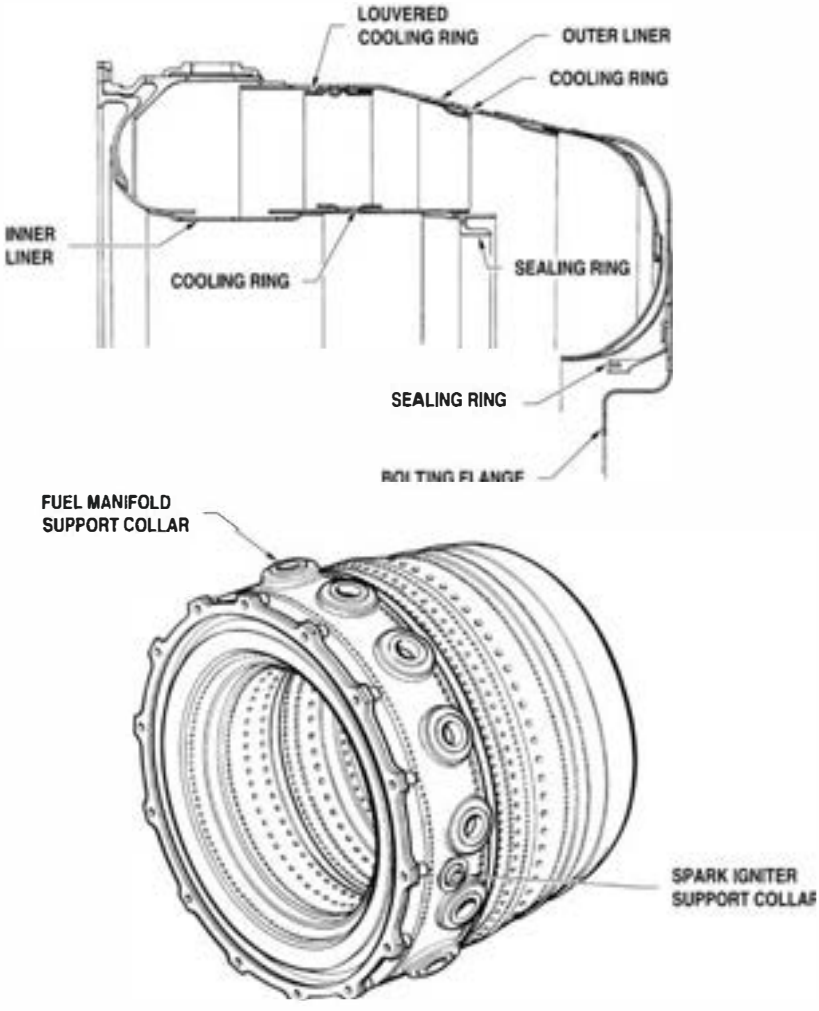


Figure 1 Compressor Bleed Valve Installation

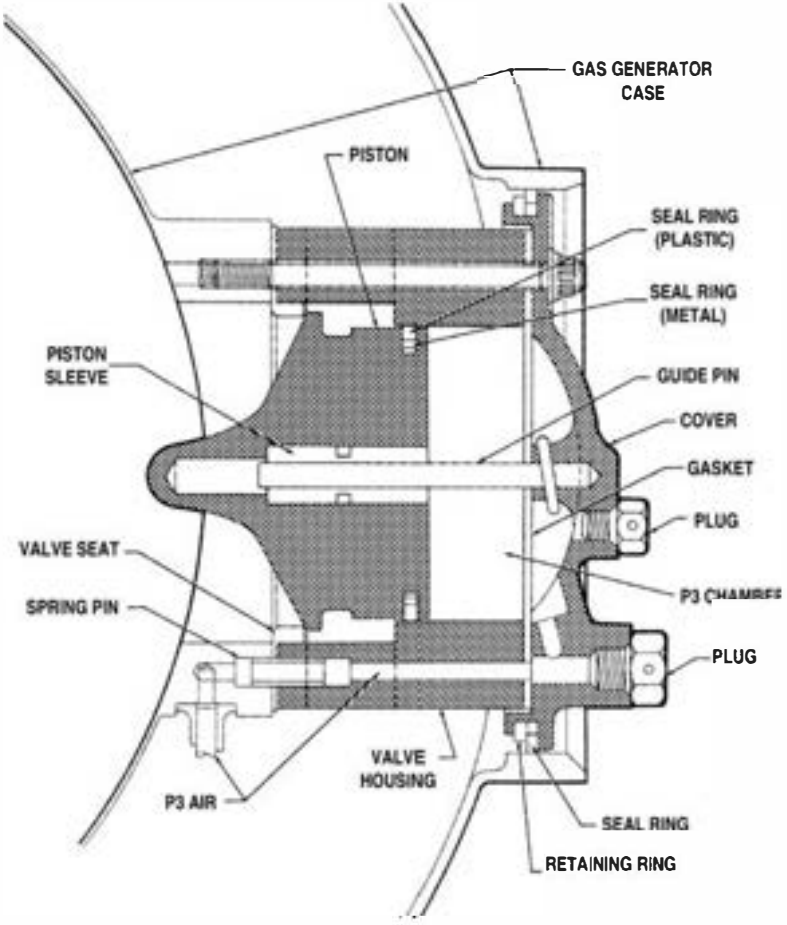


Figure 1 Compressor Inlet Case and Air Inlet Screen Installation

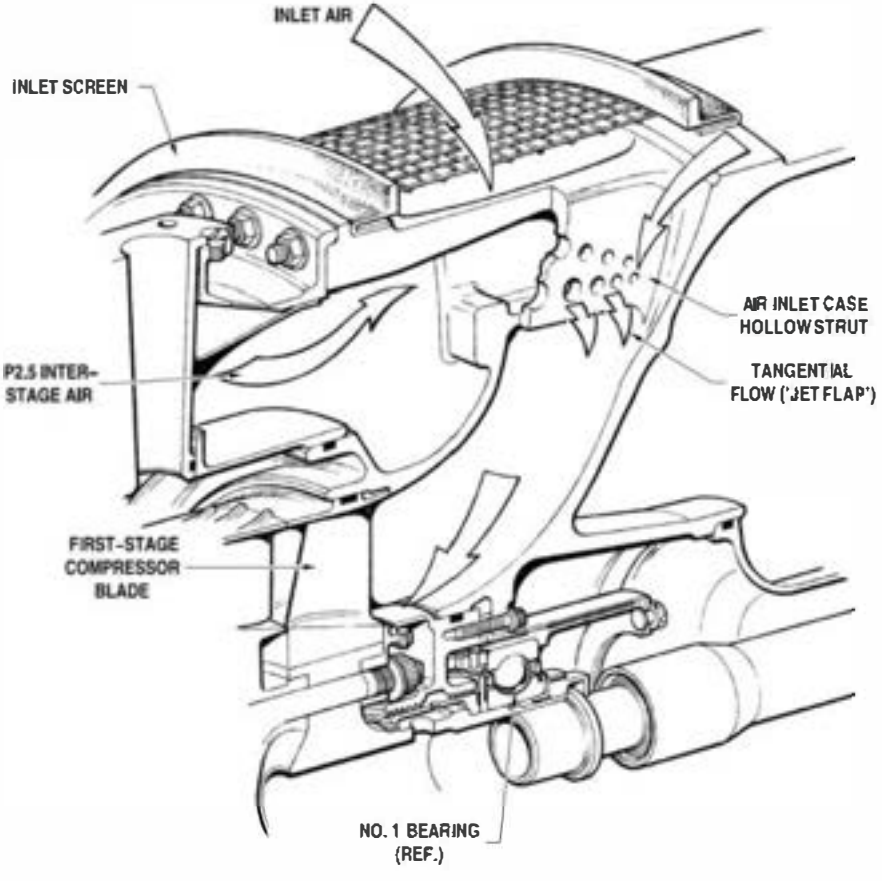


Figure 1 Compressor Turbine and Power Turbine - Cross-section

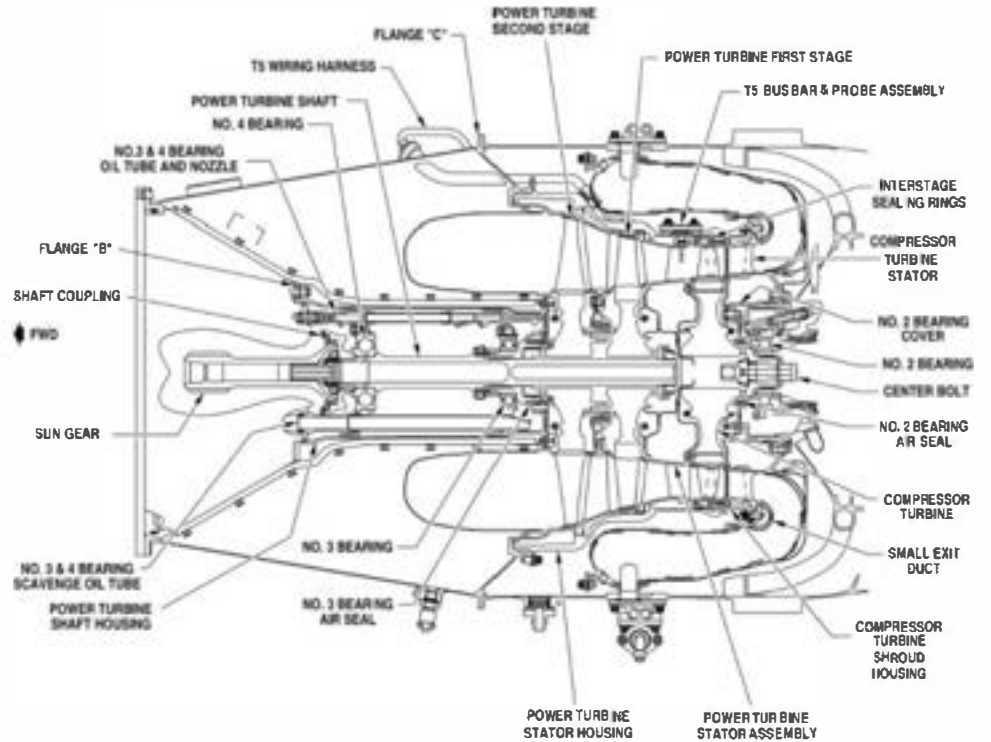


Figure 1 Engine Airflow and Cooling Air (Typical)
(sheet 2 of 2)

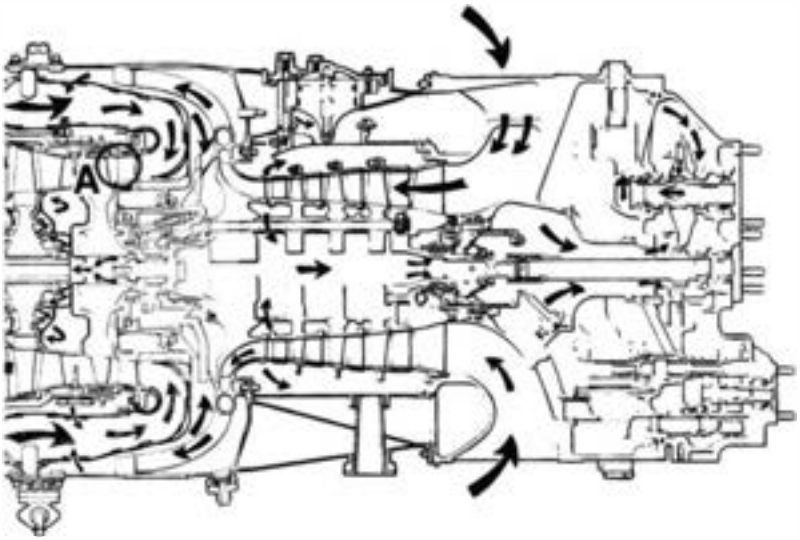
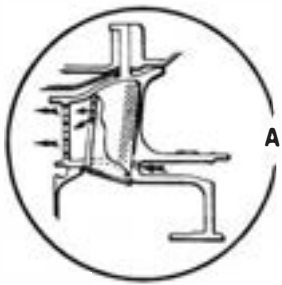


Figure 1 Engine Airflow and Cooling Air (Typical) (sheet 1 of 2)



A COOLING AIRFLOW THROUGH COMPRESSOR TURBINE VANES

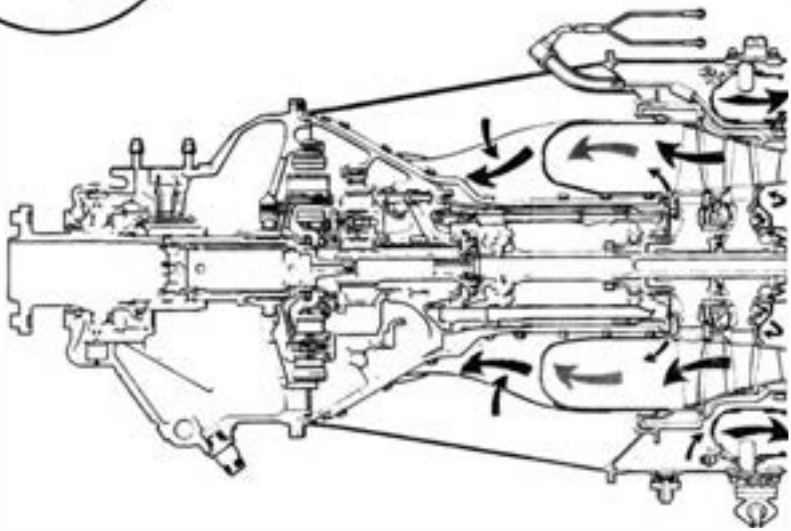


Figure 1 Engine Controls and Propeller Reversing Linkage

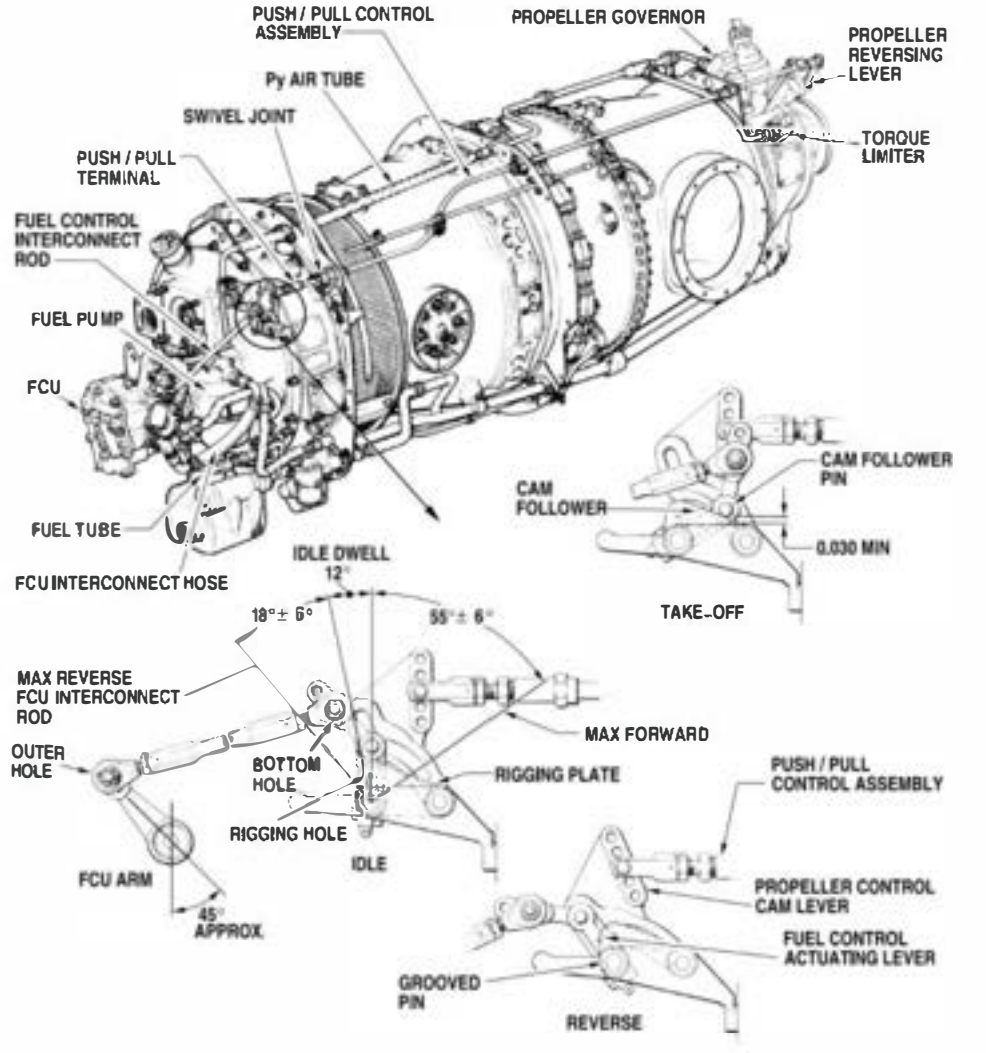


Figure 1 Engine Oil Pump and Pressure Regulating Valve

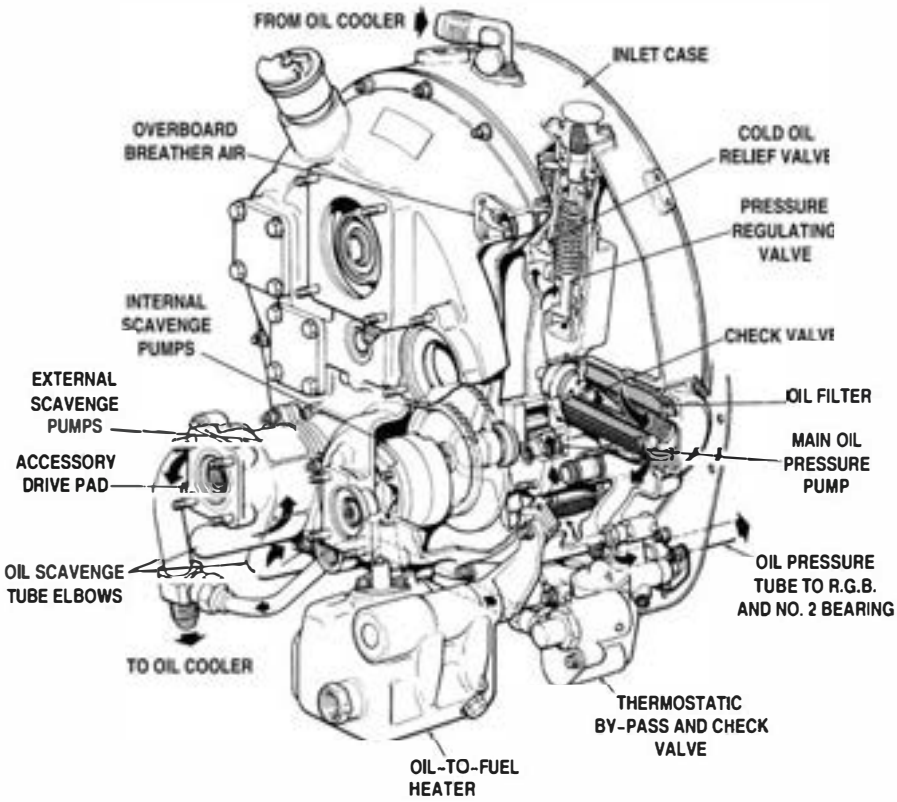


Figure 1 Fuel Control Unit

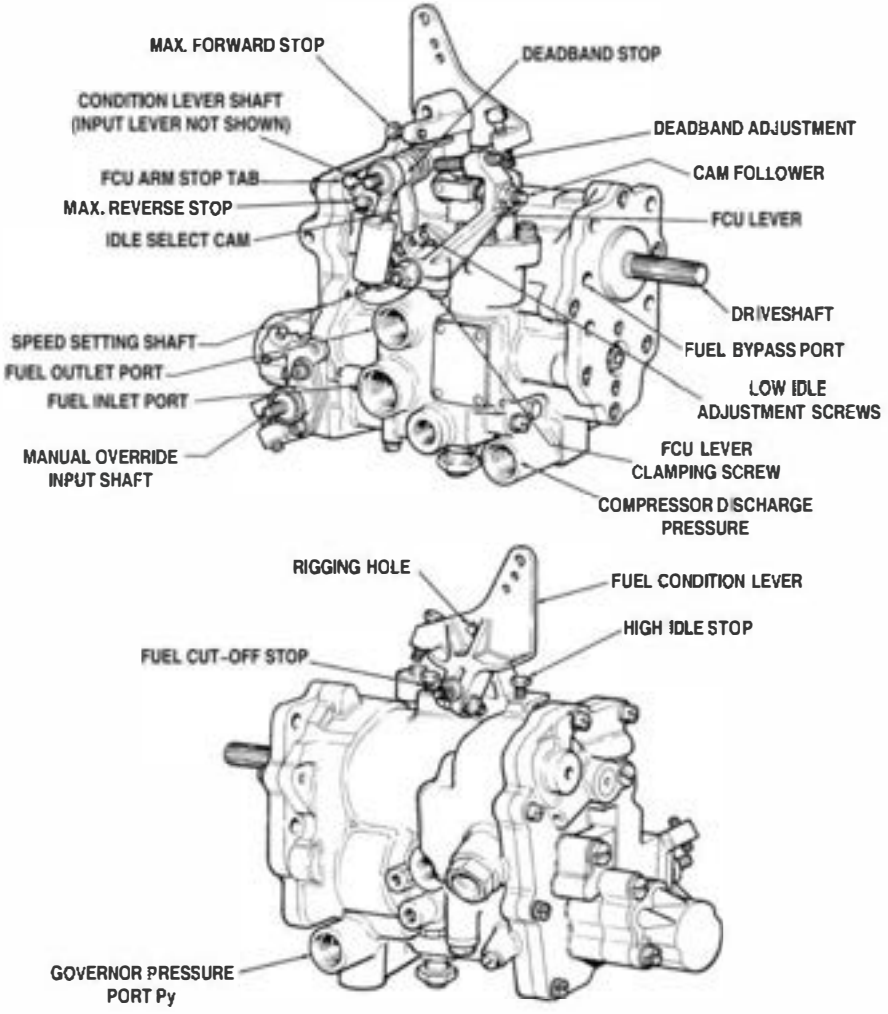
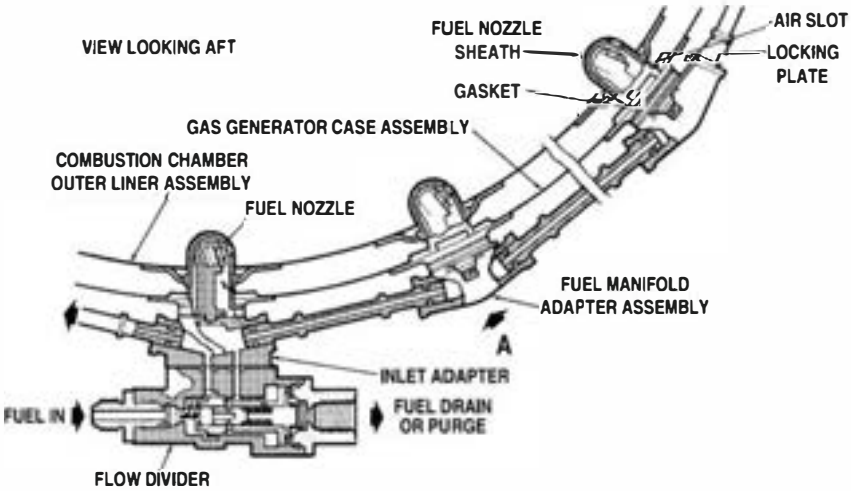
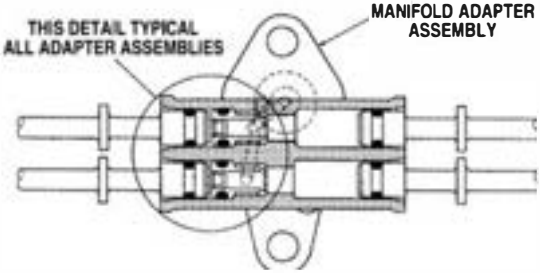


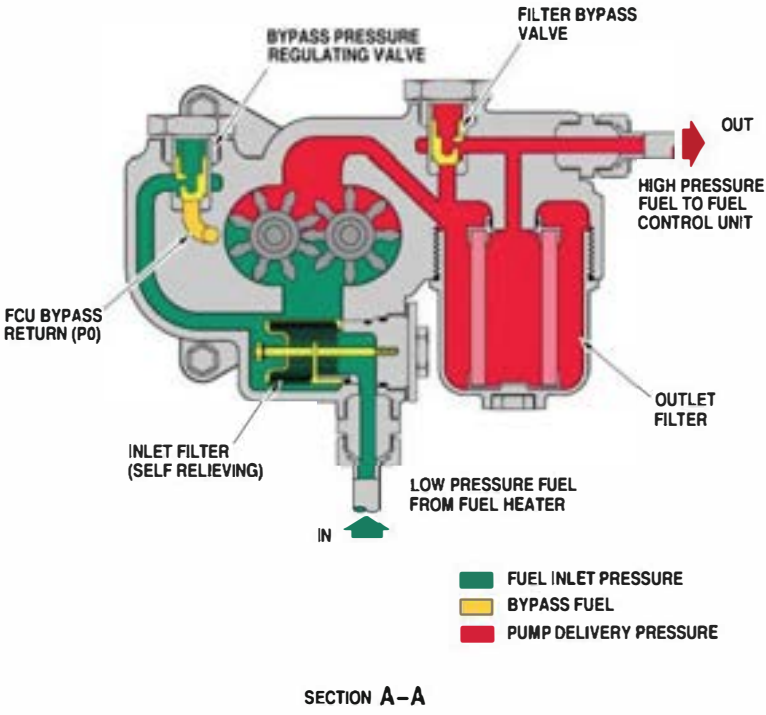
Figure 1 Fuel Manifold Assembly





VIEW A

Figure 1 Fuel Pump (sheet 2 of 2)



SECTION A–A

Figure 1 Fuel Pump (sheet 1 of 2)

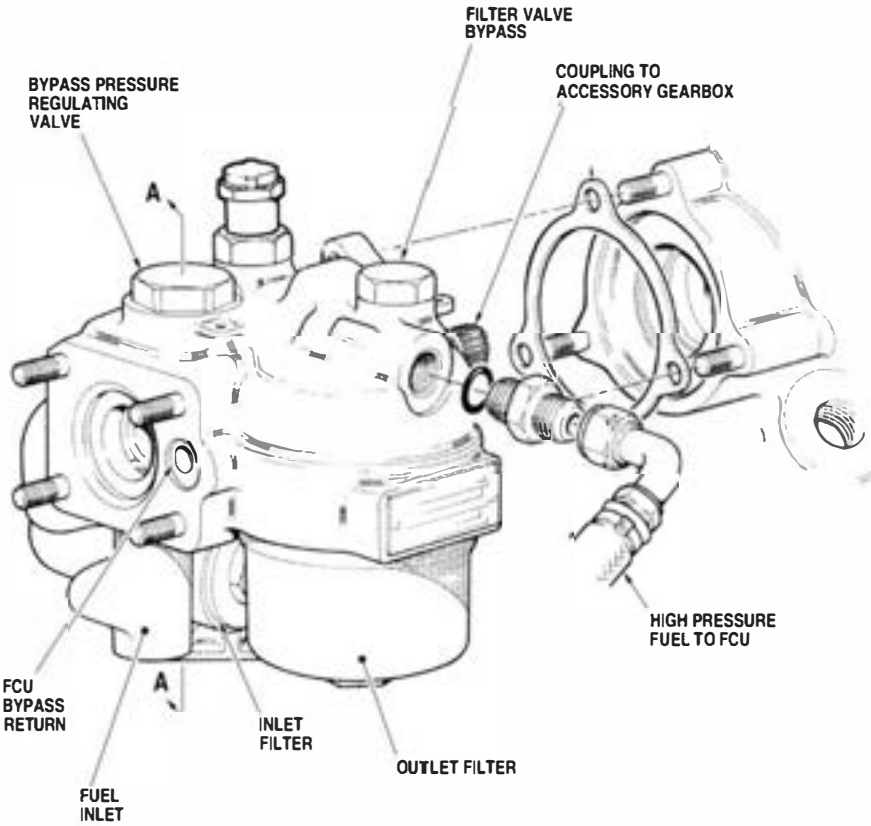


Figure 1 Gas Generator Case Installation - Cross-section

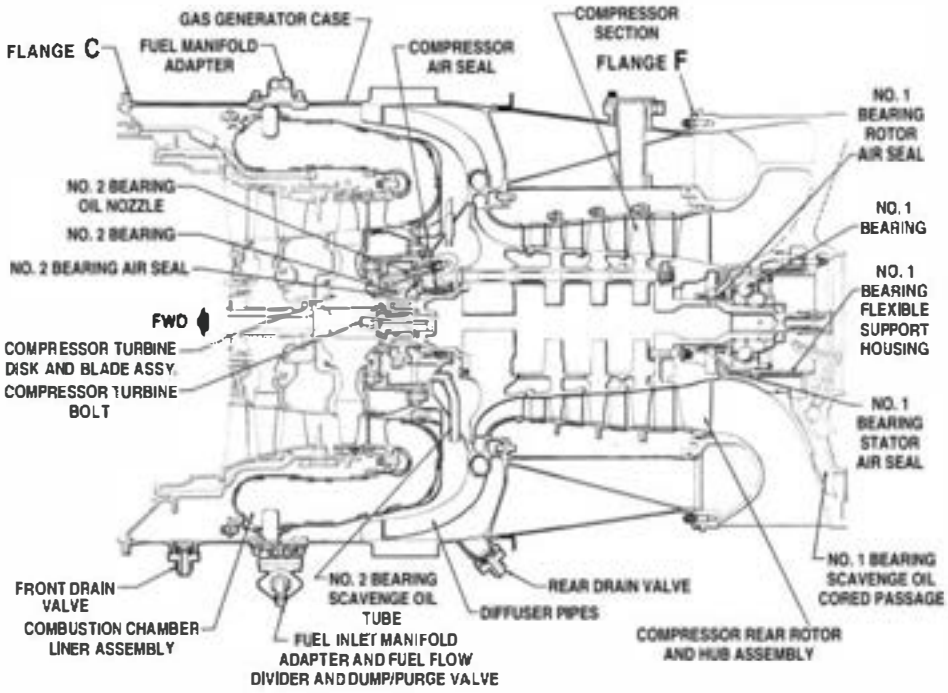


Figure 1 Ignition System - Components

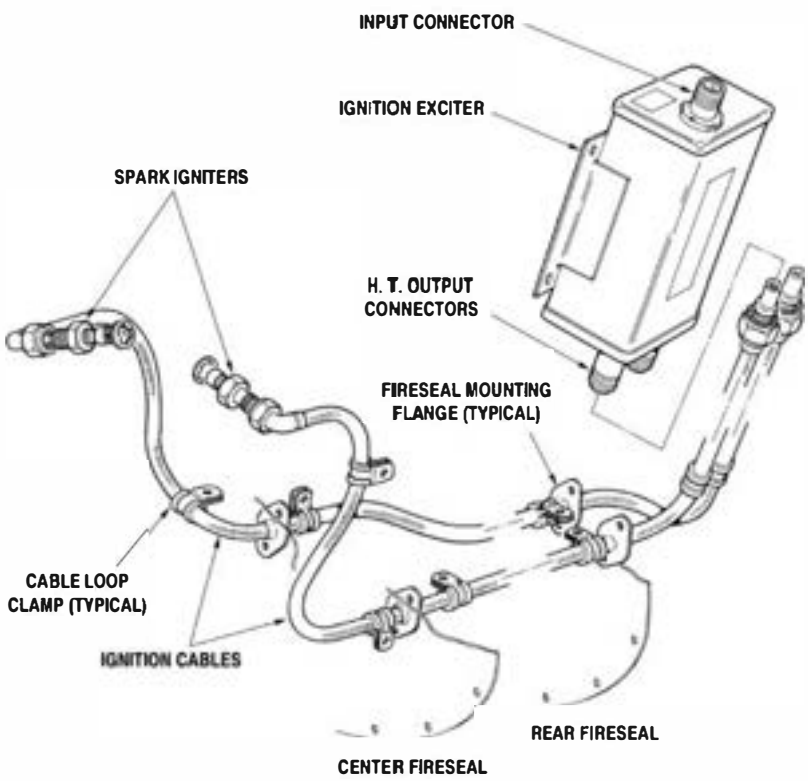


Figure 1 Integral Oil-to-Fuel Heater Schematic

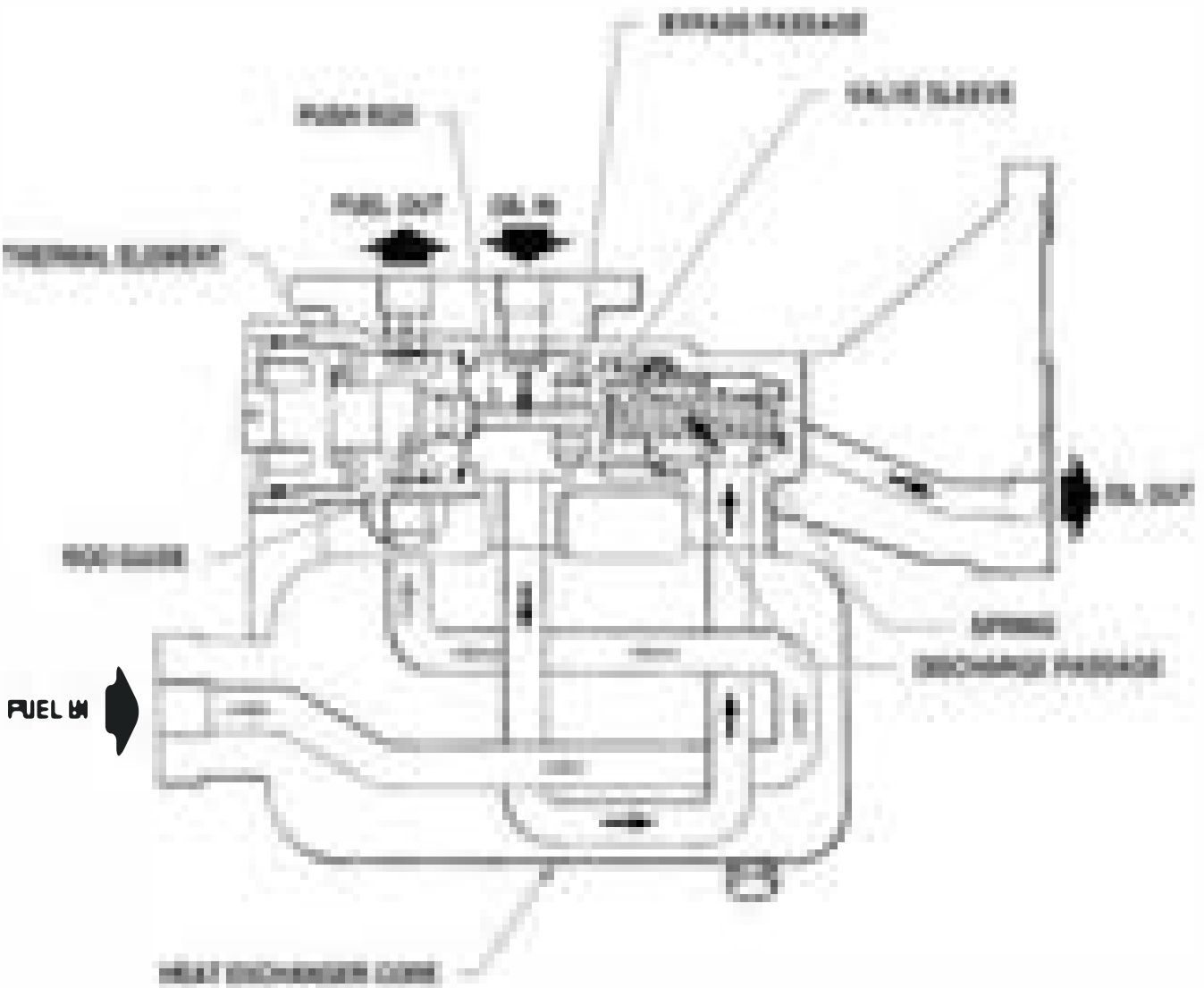


Figure 1 Reduction Gearbox Assembly Cross-Section

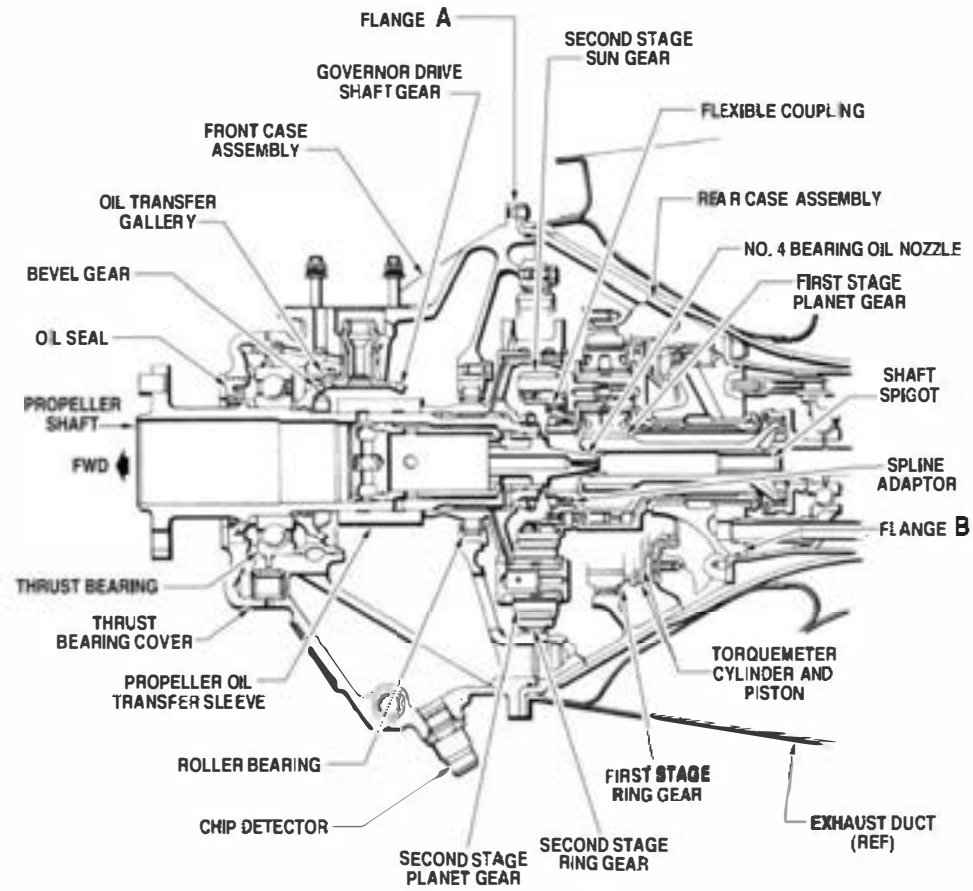


Figure 1 Spark Igniter Installation

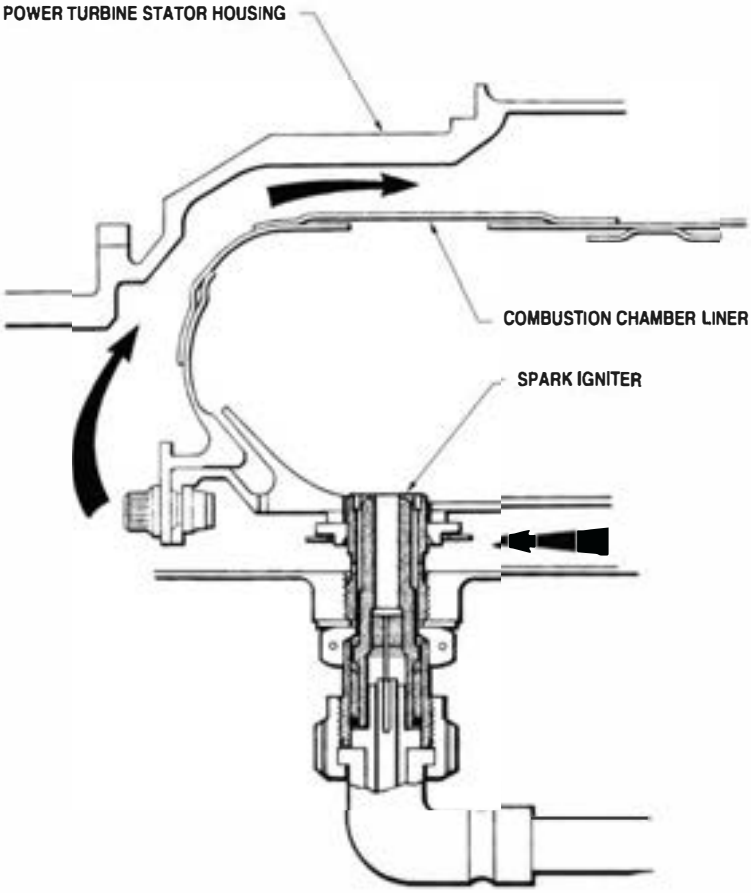


Figure 1 Engine - Three Quarter View, Right Side

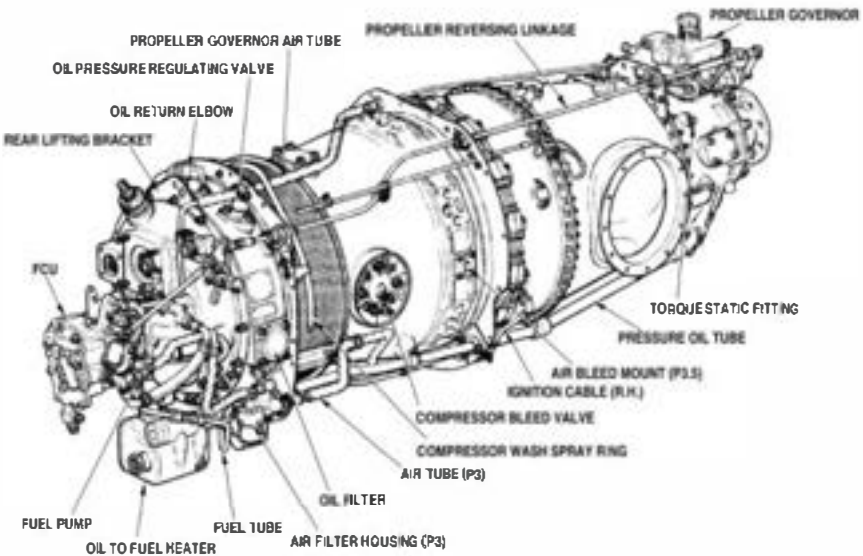


Figure 2 Interturbine Temperature (T5) Indicating System

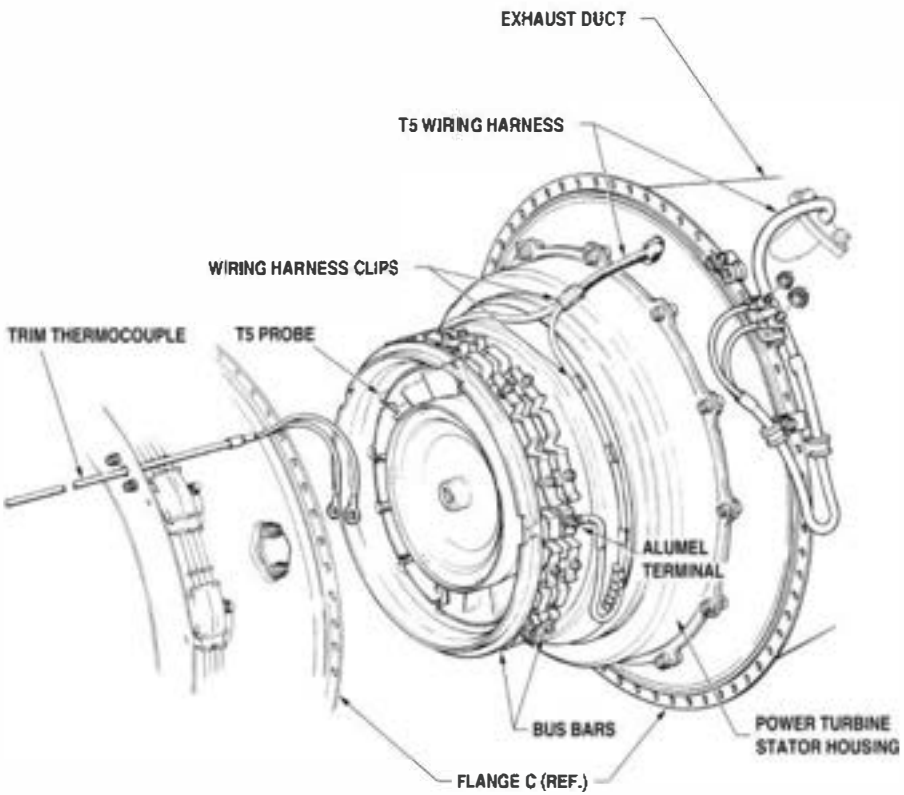


Figure 2 Torquemeter - Schematic (Typical)

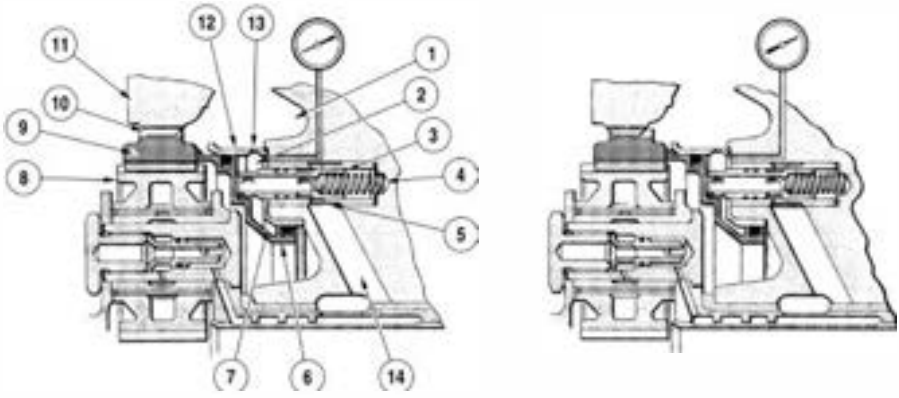


Figure 2 Engine - Three Quarter View, Left Side

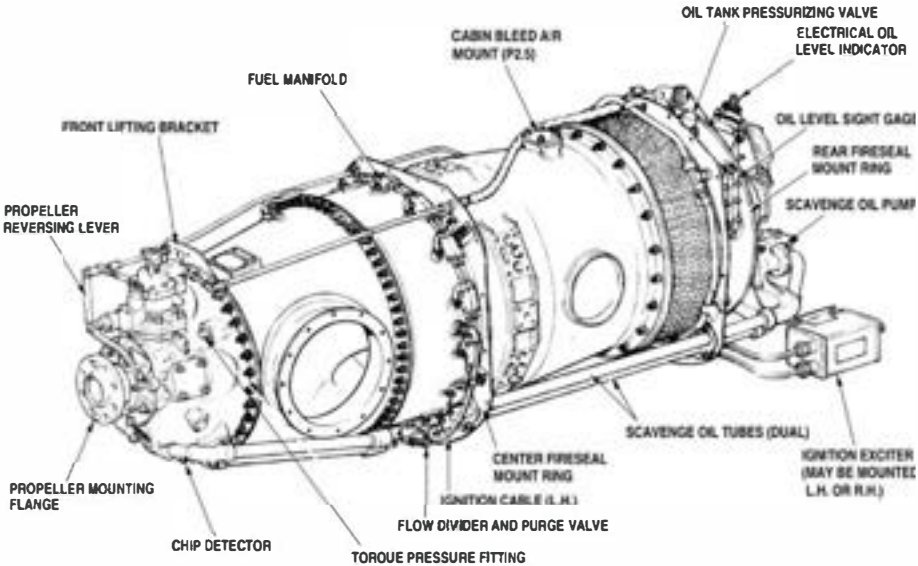


Figure 3 Engine Cross-section (sheet 2 of 2)

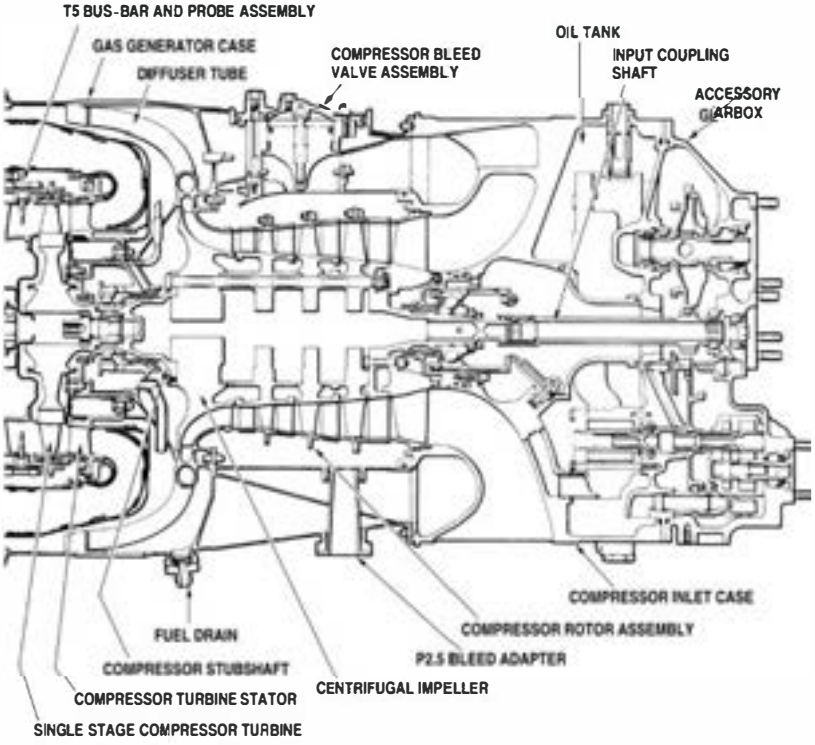


Figure 3 Magnetic Chip Detector - Cross-Section (Typical) (sheet 2 of 2)

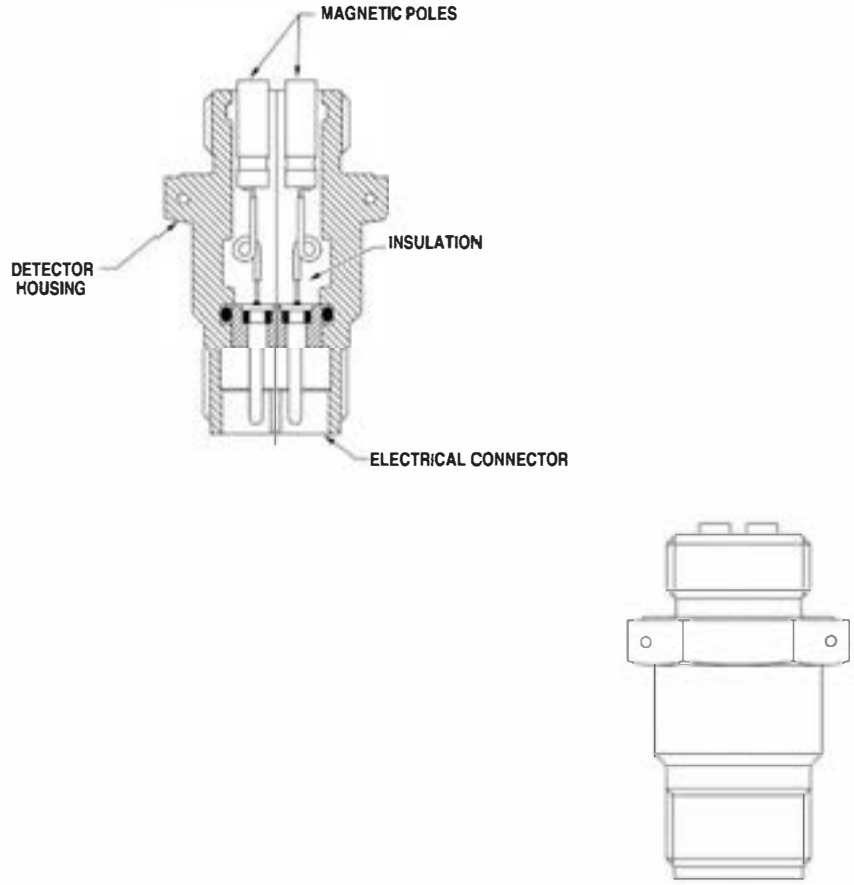


Figure 3 Magnetic Chip Detector - Cross-Section (Typical) (sheet 1 of 2)

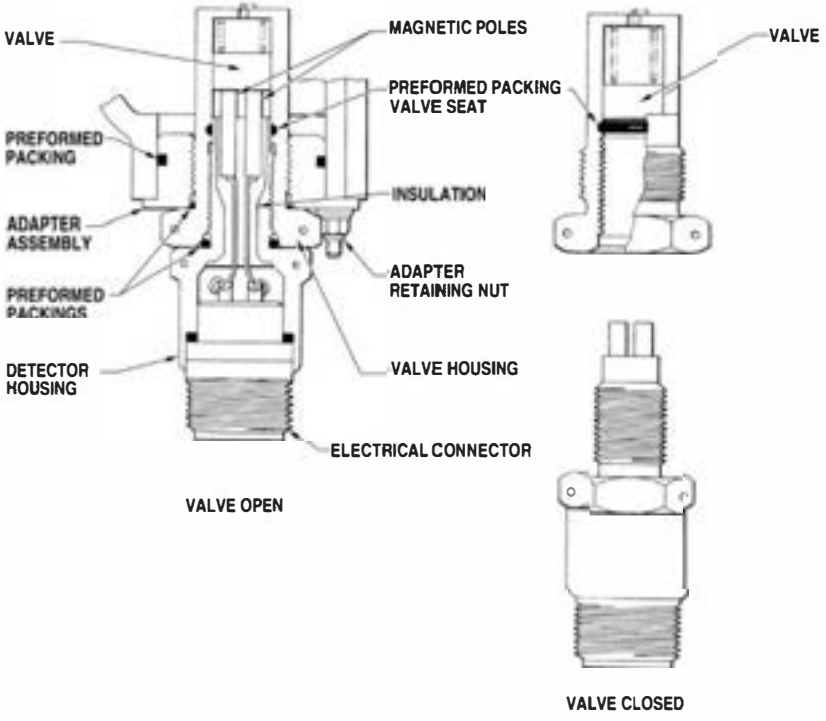


Figure 3 Engine Cross-section (sheet 1 of 2)

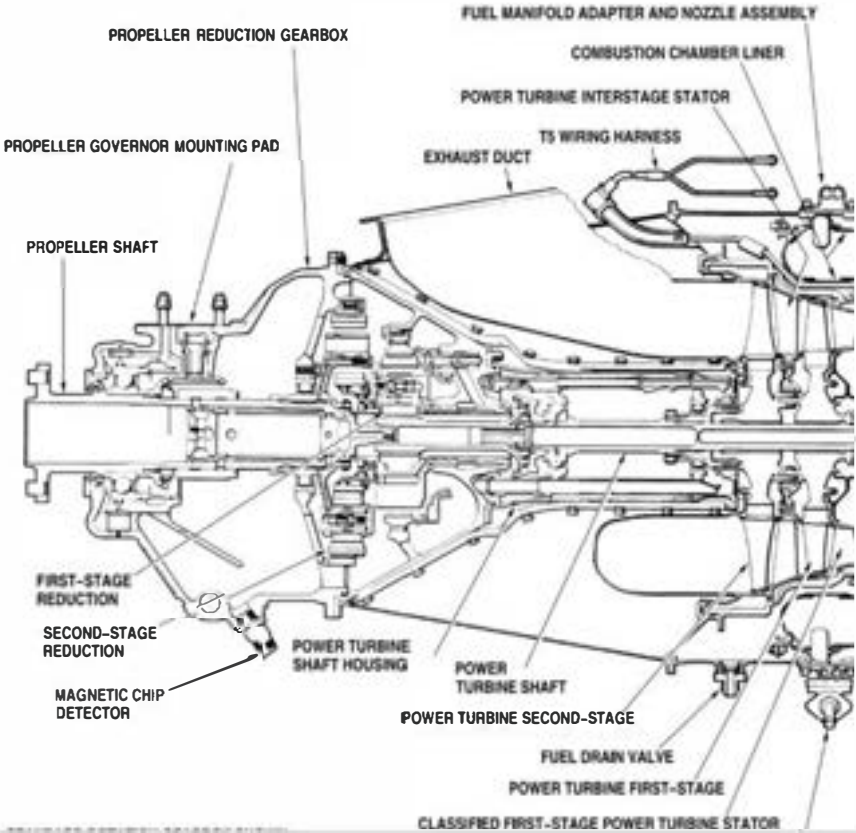


Figure 4 Engine Bearings, Stations and Flanges (sheet 2 of 2)

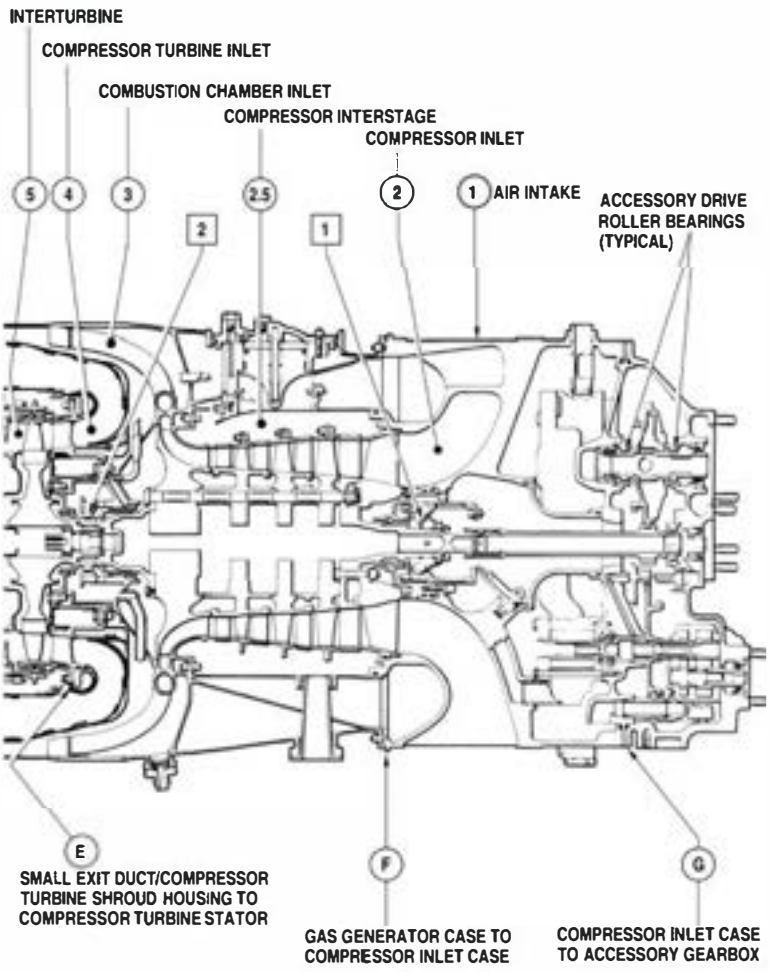


Figure 4 Engine Bearings, Stations and Flanges (sheet 1 of 2)

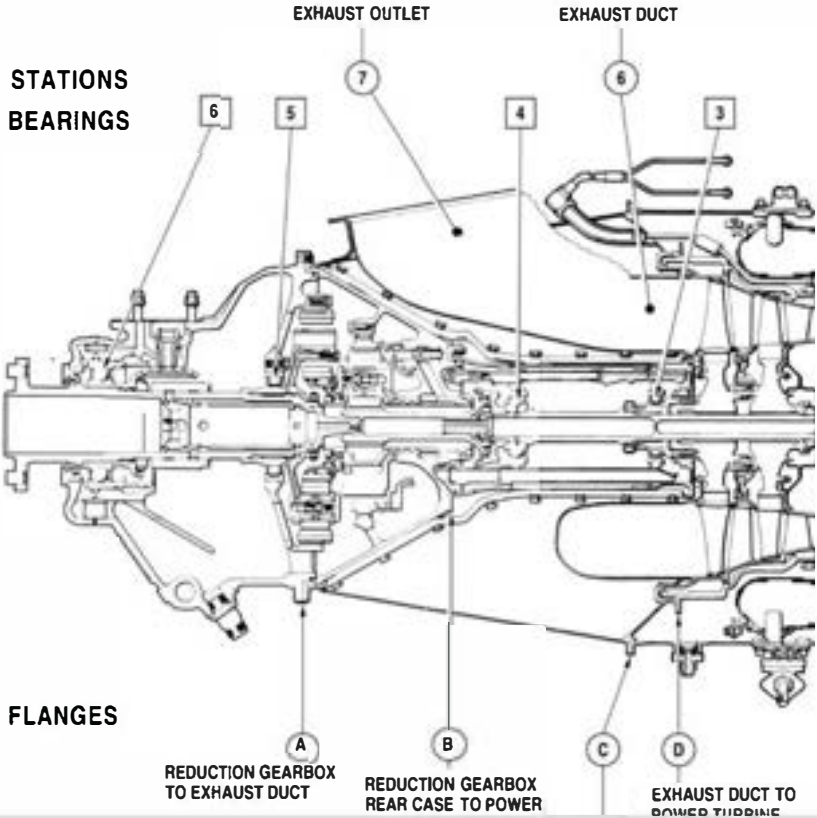


Figure 5 Engine Accessory Drives

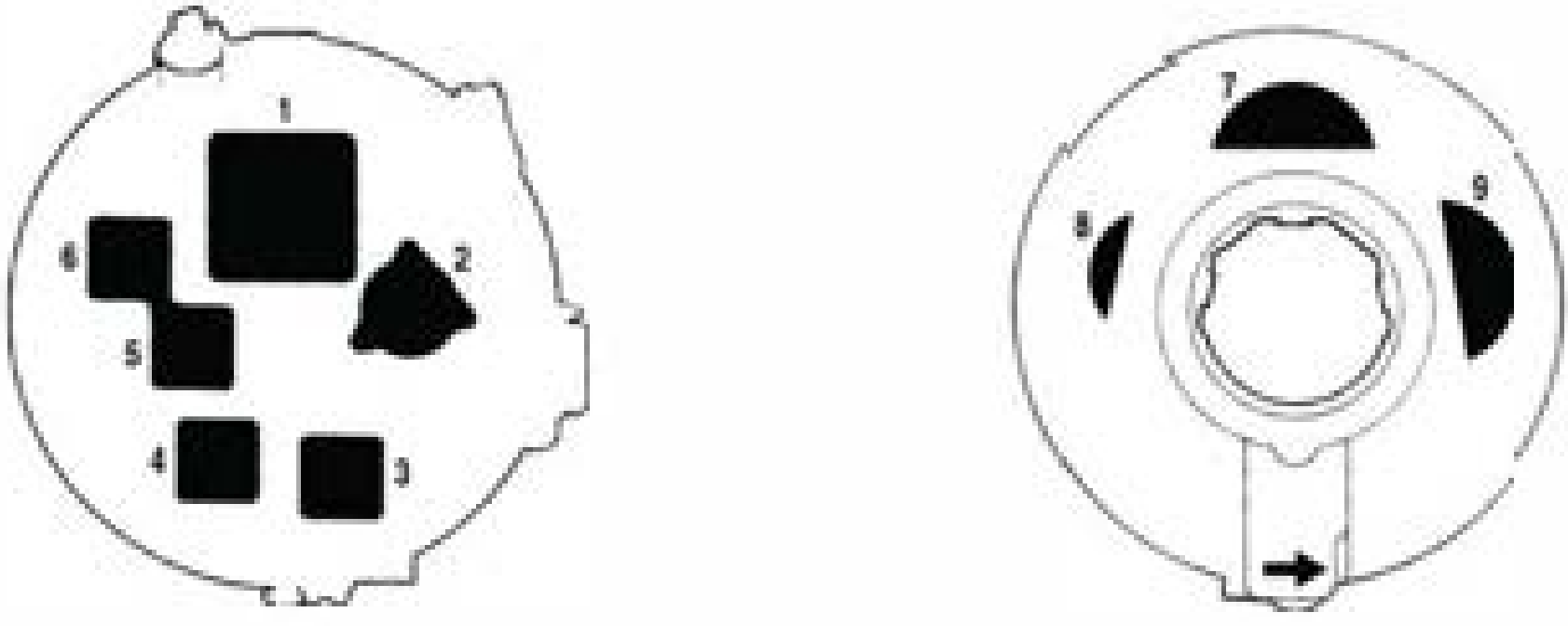


Figure 101 Engine Starting Fault Isolation Chart (sheet 2 of 8)

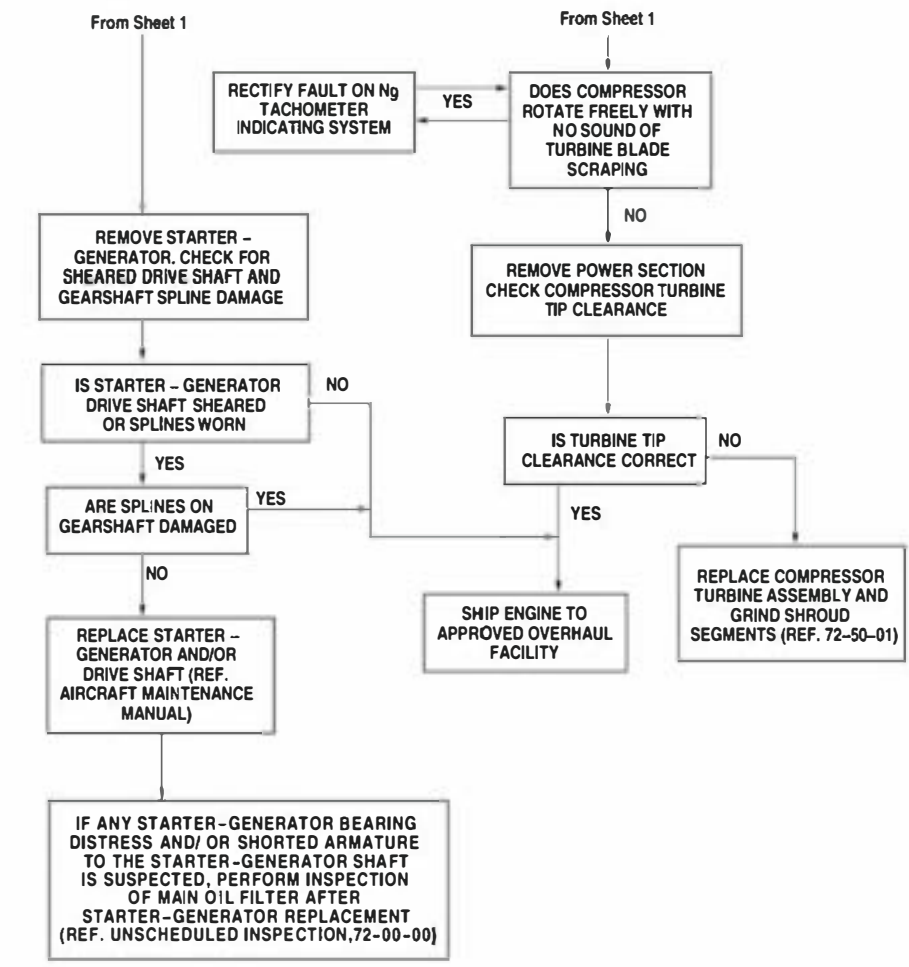
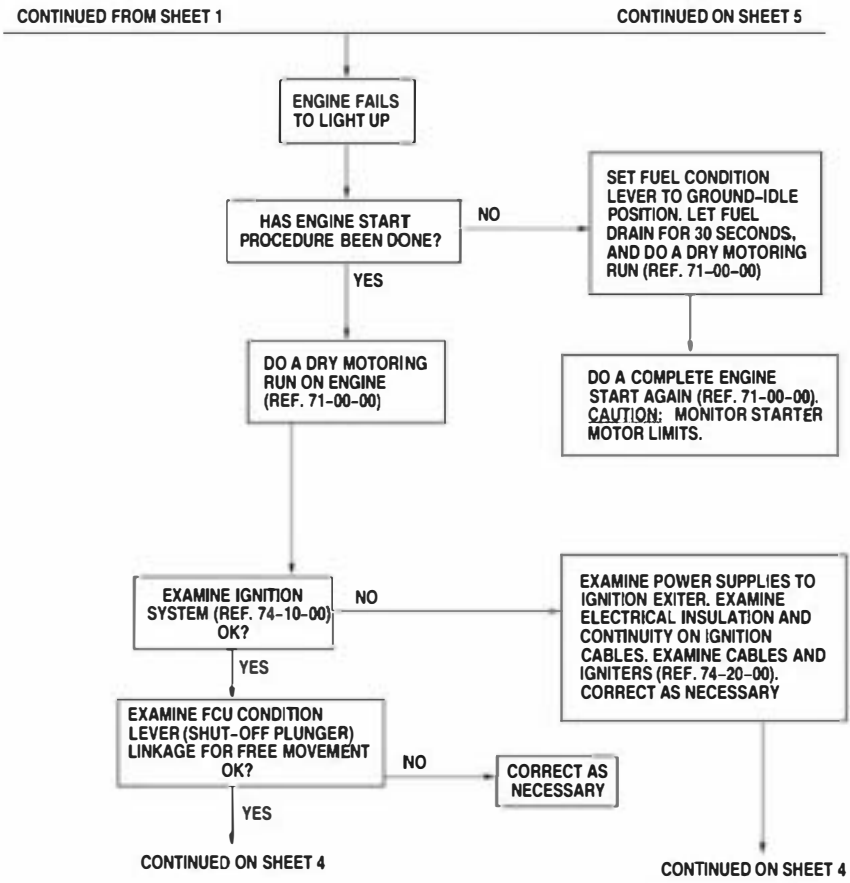


Figure 101 Engine Starting Fault Isolation Chart (sheet 3 of 8)



CAUTION: RESIDUAL VOLTAGE IN IGNITION EXITER MAY BE DANGEROUSLY HIGH. MAKE SURE THAT THE IGNITION SYSTEM HAS BEEN SWITCHED OFF AT LEAST SIX MINUTES BEFORE YOU DISCONNECT.

Figure 101 Engine Starting Fault Isolation Chart (sheet 4 of 8)

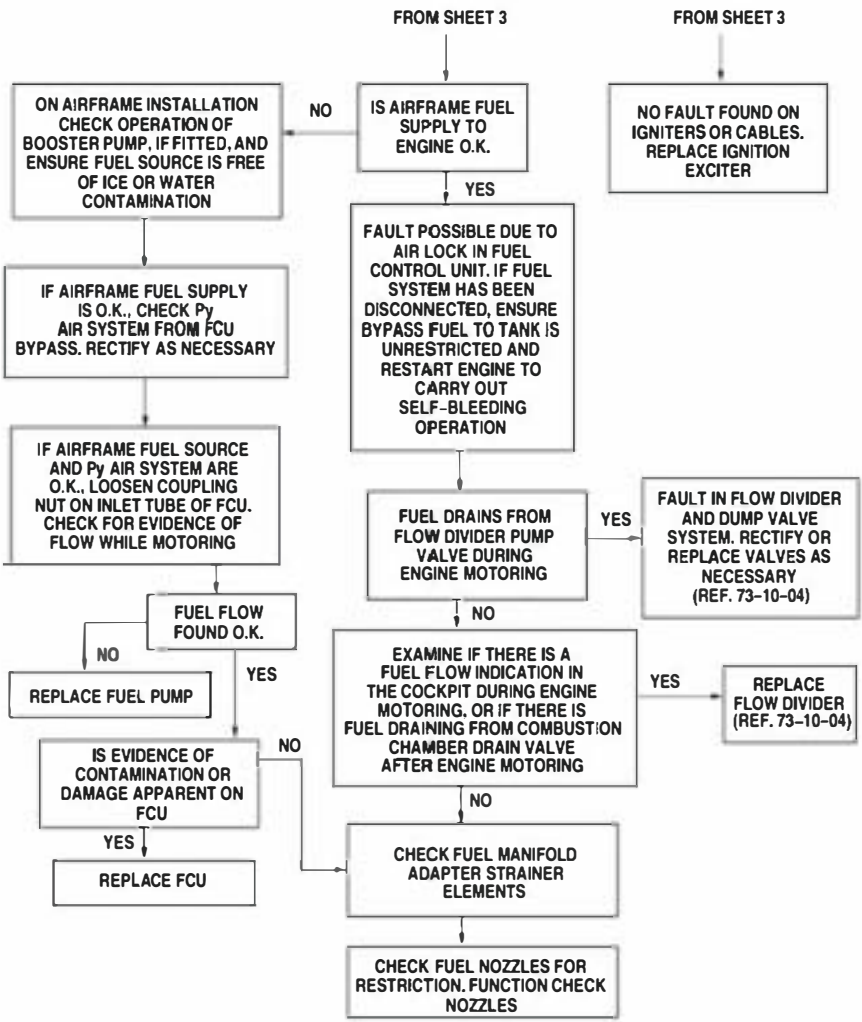


Figure 101 Engine Starting Fault Isolation Chart (sheet 5 of 8)

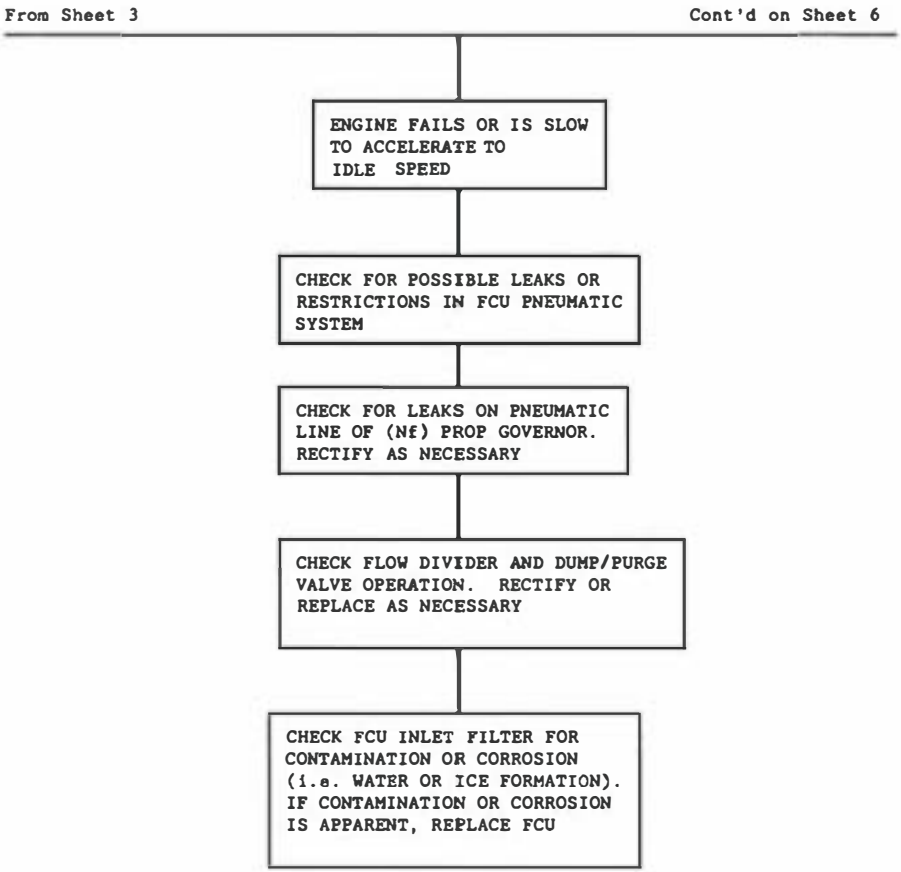


Figure 101 Engine Starting Fault Isolation Chart (sheet 6 of 8)

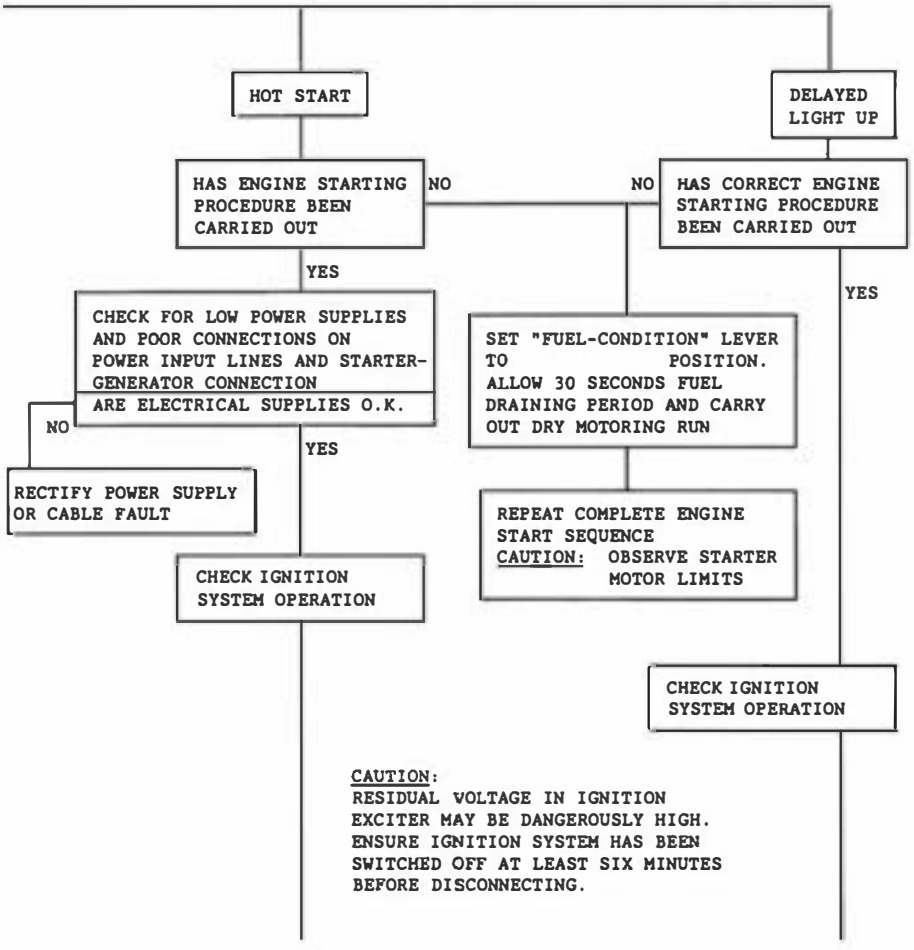


Figure 101 Engine Starting Fault Isolation Chart (sheet 7 of 8)

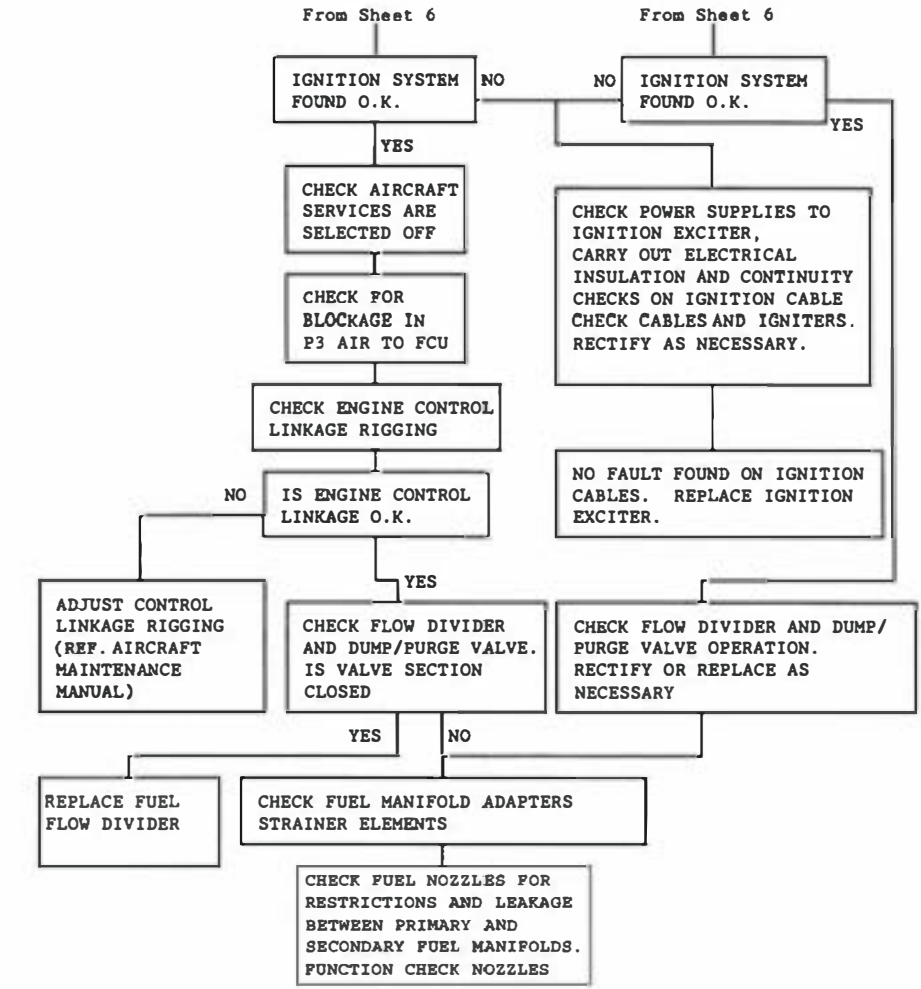
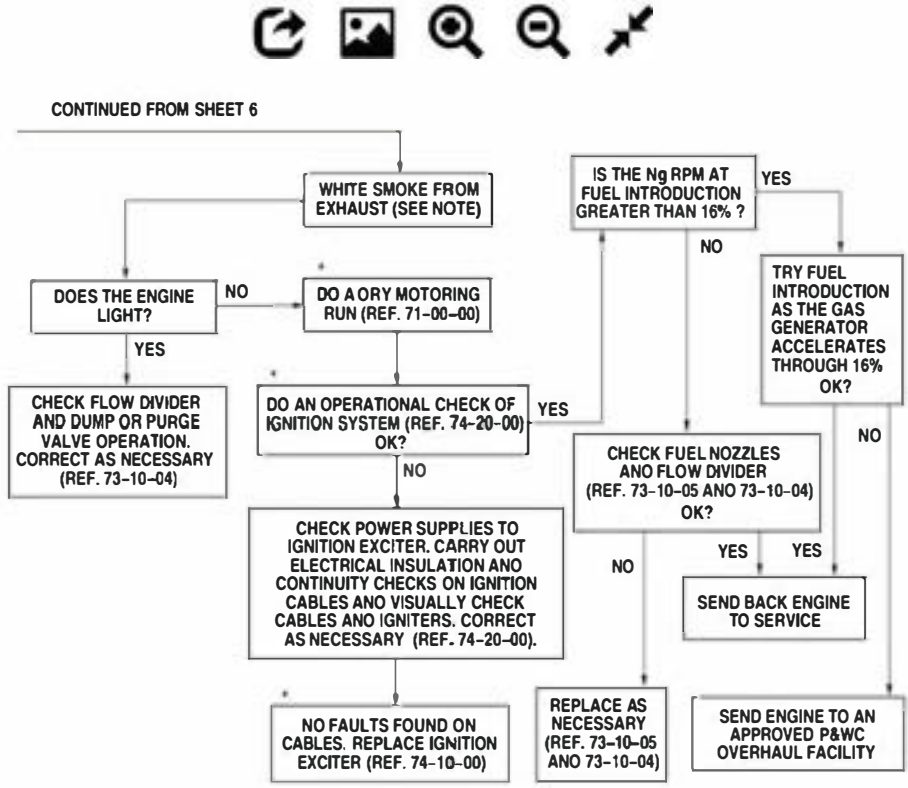


Figure 101 Engine Starting Fault Isolation Chart (sheet 8 of 8)



* CAUTION:

1. RESIDUAL VOLTAGE IN IGNITION EXCITER MAY BE DANGEROUSLY HIGH. MAKE SURE THAT THE IGNITION SYSTEM HAS BEEN SWITCHED OFF AT LEAST SIX MINUTES BEFORE YOU DISCONNECT.
2. MONITOR STARTER MOTOR LIMITS. REFER TO STARTER MOTOR MANUFACTURER'S MANUAL.

NOTE:

1. WHITE SMOKE FROM THE EXHAUST IS AN INDICATION THAT FUEL IS IN THE ENGINE AND BECAME A GAS ON START.
2. SMOKY STARTS CAN BE PREVENTED BY REPLACEMENT OF FLOW DIVIDER AND PURGE VALVE (REF. 73-10-04).

Figure 101 Engine Starting Fault Isolation Chart (sheet 1 of 8)

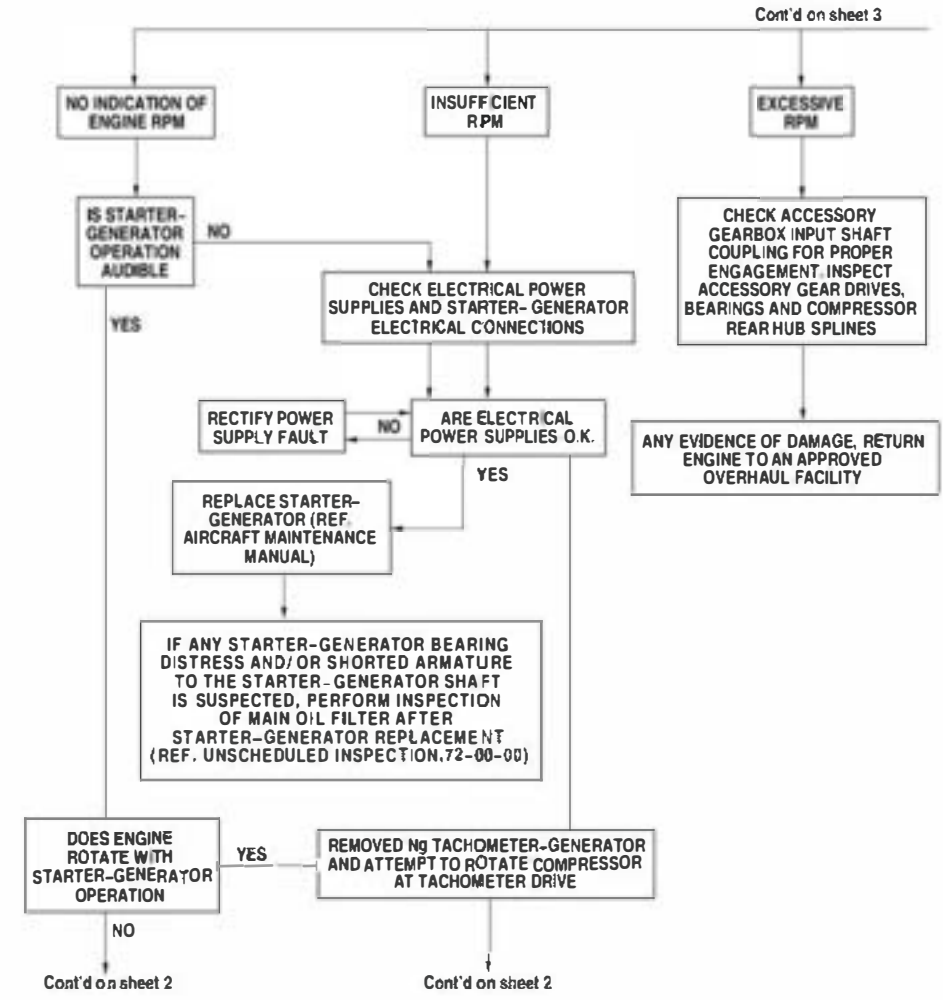


Figure 102 Engine Operating Fault Isolation Chart (sheet 2 of 13)

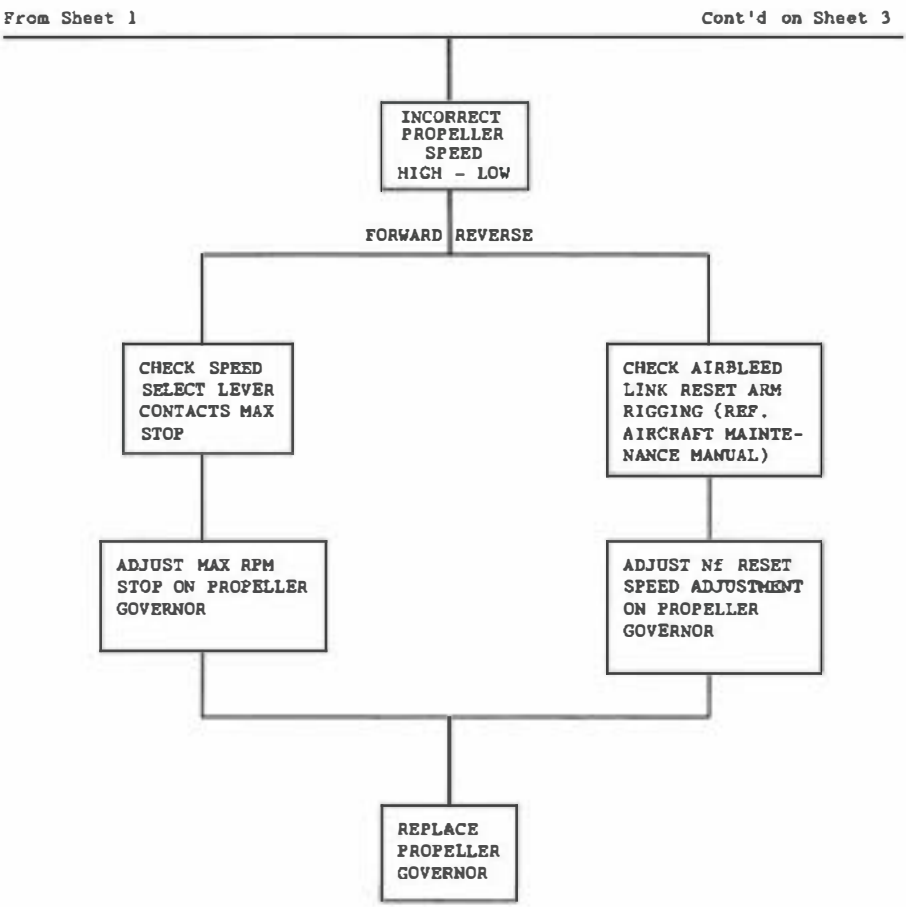


Figure 102 Engine Operating Fault Isolation Chart (sheet 3 of 13)

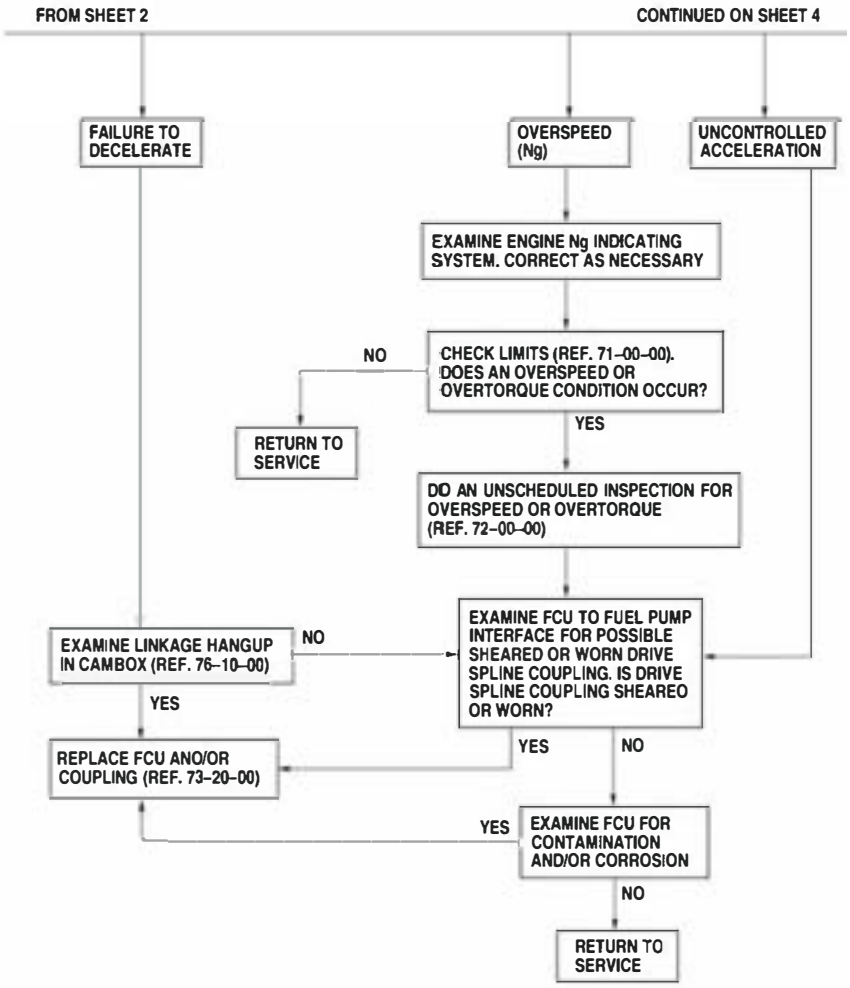


Figure 102 Engine Operating Fault Isolation Chart (sheet 4 of 13)

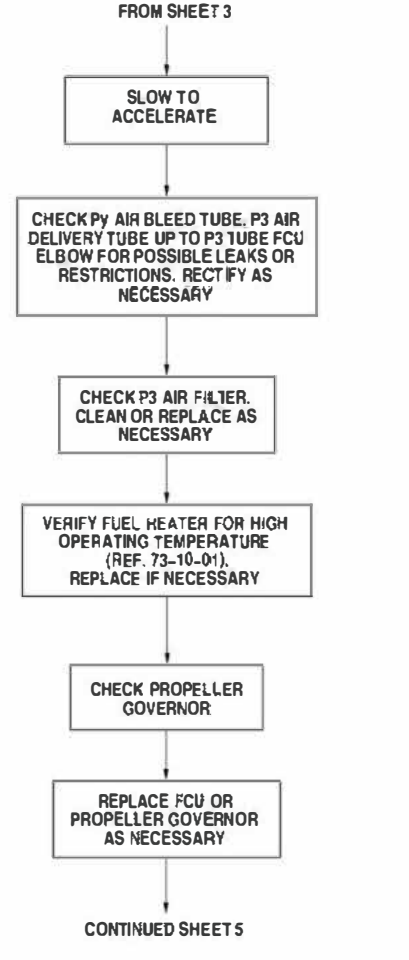


Figure 102 Engine Operating Fault Isolation Chart (sheet 5 of 13)

NOTES:
1. LARGE BENT AIRFOIL WILL GENERATE A HIGH PITCH NOISE AND POSSIBLE VIBRATION DAMAGE TO DOWNSTREAM COMPONENTS.
2. BORESCOPE MAY BE USED TO AVOID REMOVAL OF INLET SCREEN.

FROM SHEET 4

CONTINUED ON SHEET 6

HIGH PITCH NOISE FROM COMPRESSOR AREA. (EXAMPLE-WHINNING OR WHISTLING NOISE)

EXAMINE FIRST-STAGE COMPRESSOR BLADES FOR FOREIGN OBJECT DAMAGE (FOD) (REF.72-30-05) (REF. NOTES 1 AND 2)

COMPRESSOR BLADES FOUND O.K (REF.72-30-05)

NO

YES

DAMAGE IS WITHIN REPAIRABLE LIMIT (REF.72-30-05)

CONTACT P&WC

YES

NO

REPAIR & RETURN TO SERVICE

SEND ENGINE TO AN APPROVED P&WC OVERHAUL FACILITY FOR LIGHT OVERHAUL

SURGE DURING ACCELERATION

CARRY OUT COMPRESSOR WASH PROCEDURE

REPLACE COMPRESSOR BLEED VALVE

EXAMINE FIRST-STAGE COMPRESSOR BLADES FOR FOREIGN OBJECT DAMAGE (FOD) (REF. 72-30-05) (REF. NOTE 2)

COMPRESSOR BLADES FOUND O.K.

NO

YES

REPLACE FCU

SHIP ENGINE TO APPROVED OVERHAUL FACILITY

FUEL LEAKAGE AT FUEL PUMP DRAIN PORT

REMOVE FCU AND CHECK PREFORMED PACKING AT BYPASS PORT. IS LEAKAGE VISIBLE?

YES

NO

REPLACE PREFORMED PACKING AND FCU

LEAKAGE AT FUEL PUMP SHAFT SEAL. REPLACE FUEL PUMP

c221135

Figure 102 Engine Operating Fault Isolation Chart (sheet 6 of 13)

From Sheet 5

Cont'd on Sheet 7

* OVERTEMPERATURE (MAX. ALLOWABLE TEMPERATURE HAS BEEN EXCEEDED)

CHECK OPERATION OF TEMPERATURE INDICATING SYSTEM. IF FAULTY, RECTIFY.

IF O.K.

CHECK ENGINE OVERTEMPERATURE CHART. ENGINE REMOVAL NECESSARY

YES

REMOVE ENGINE AND INSPECT. PROCEED AS NOTED ON OVERTEMPERATURE CHART

NO

CHECK ENGINE TORQUE INDICATING SYSTEM. IF FAULTY, RECTIFY

* NOTE:
ON TWIN AND MULTI-ENGINED AIRCRAFT, CROSS-GENERATOR STARTS MAY RESULT IN HIGH INDICATIONS

CHECK AIR INLET AND COMPRESSOR FOR CONTAMINATION BUILD-UP

NO

COMPRESSOR DIRTY

YES

CHECK FOR EXCESSIVE AIRFRAME ACCESSORY POWER LOADING (REF. AIRCRAFT MAINTENANCE MANUAL)

CARRY OUT COMPRESSOR WASH PROCEDURE

c23222

Figure 102 Engine Operating Fault Isolation Chart (sheet 7 of 13)

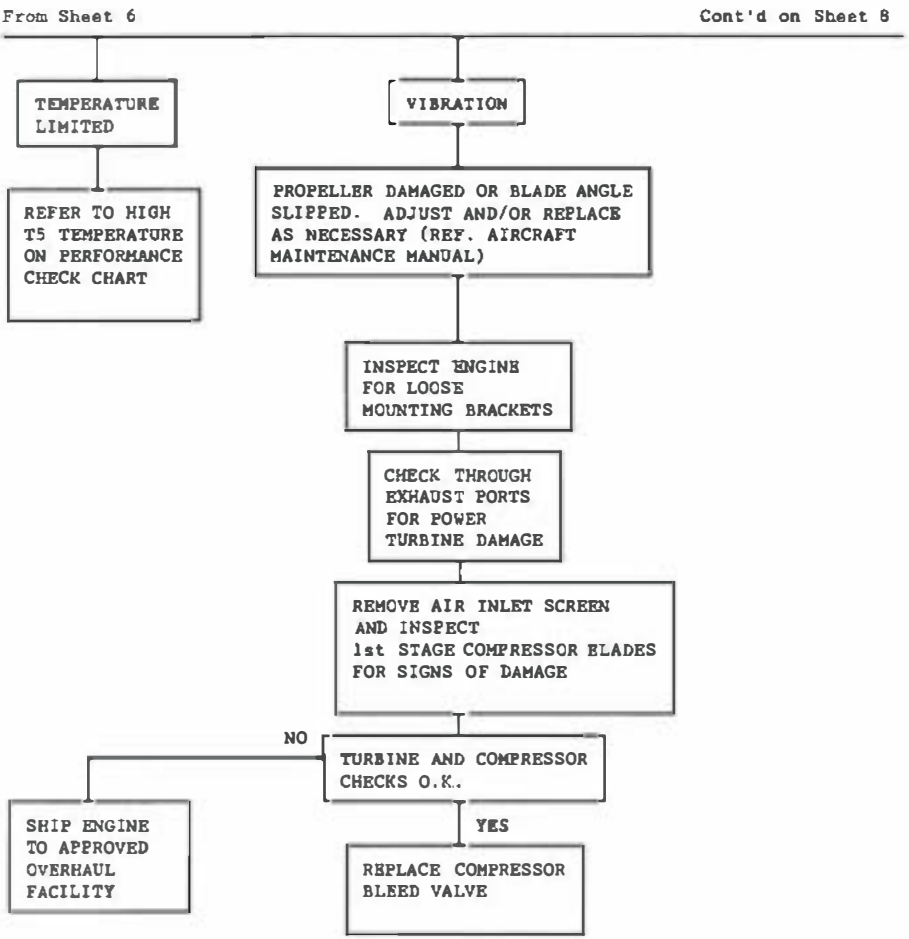
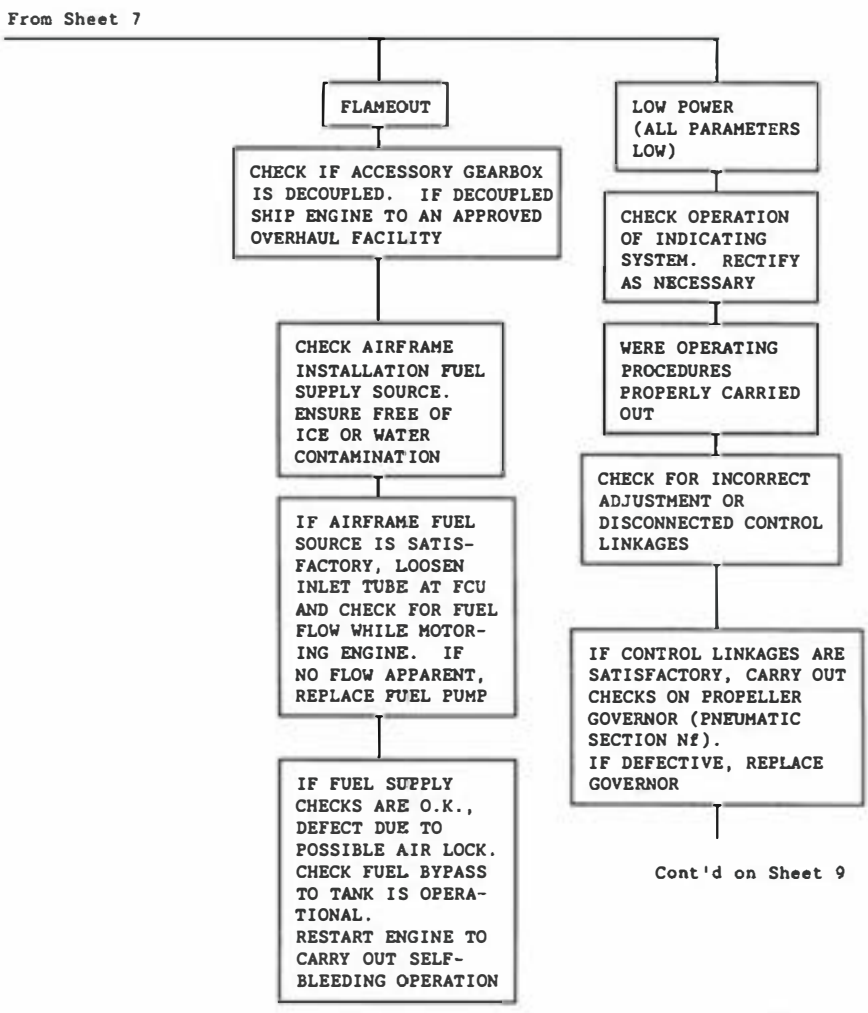
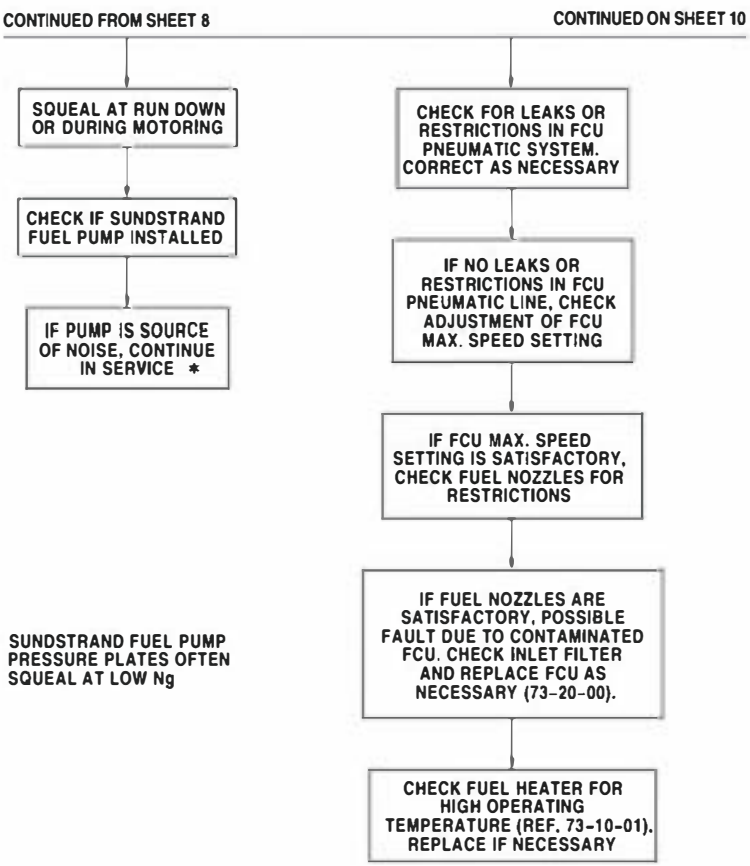


Figure 102 Engine Operating Fault Isolation Chart (sheet 8 of 13)



c23224

Figure 102 Engine Operating Fault Isolation Chart (sheet 9 of 13)



c236961

Figure 102 Engine Operating Fault Isolation Chart (sheet 10 of 13)

FROM SHEET 9

CONTINUED ON SHEET 11

RUBBING NOISE WHILE TURNING PROPELLER BY HAND. IS RUBBING CONSIDERED LIGHT OR HEAVY?

LIGHT

HEAVY

IS RUBBING STILL PRESENT ONE HOUR AFTER SHUTDOWN?

YES

NO

LOUD NOISE MECHANICAL INTERFERENCES OR UNABLE TO MOVE PROPELLER BY HAND ONE HOUR AFTER SHUTDOWN.

IS NON-ALLOWABLE DEBRIS FOUND ON CHIP DETECTOR OR OIL FILTER?

YES

NO

IS OIL CONSUMPTION OUTSIDE OF LIMIT (REF. 72-00-00)?

YES

CONTACT P&WC.

NO

RETURN ENGINE TO SERVICE.

Figure 102 Engine Operating Fault Isolation Chart (sheet 11 of 13)

From Sheet 10

Cont'd on Sheet 12

IDLE SPEED INCORRECT

CHECK CONTROL LINKAGE RIGGING. ADJUST AS NECESSARY. (REF. AIRCRAFT MAINTENANCE MANUAL)

CARRY OUT PROPELLER GOVERNOR CHECKS

INSPECT FCU PNEUMATIC SYSTEM TUBES FOR LEAKS. RECTIFY AS NECESSARY

IDLE SPEED SETTING OF FCU INCORRECT. RE-ADJUST AS NECESSARY

IF ADJUSTMENTS FAIL TO CORRECT PROBLEM, REPLACE FCU

MISMATCH IN TWIN ENGINE INSTALLATION (RAPID ACCELERATION OF ONE ENGINE)

CHECK OPERATION OF COMPRESSOR BLEED VALVE OR REPLACE *

REPLACE FCU

* OPERATION OF BLEED VALVE CAN ONLY BE CHECKED MANUALLY AFTER REMOVAL FROM ENGINE, OR BY SUBSTITUTION.

Figure 102 Engine Operating Fault Isolation Chart (sheet 12 of 13)

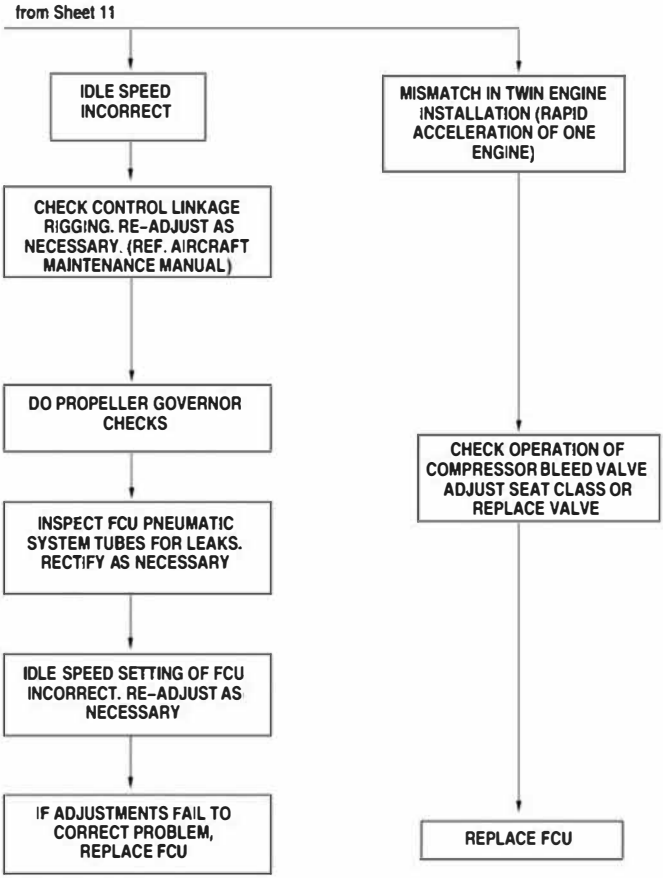


Figure 102 Engine Operating Fault Isolation Chart (sheet 13 of 13)

NOTE: 1. Review ECTM data, pilot reports and maintenance log book entries and troubleshooting for the last 6 months. Hot section components and performance gradually deteriorate as running time accumulates. The deterioration rate varies according to operating conditions (environment and type of operation) and for different engine modification standards. If engine performance apparently improves T5 decrease without maintenance action, check indicating systems (usually T5 system is at fault).

NOTE: 2. A rapid shift in engine parameters is usually the result of an indicating system defect.

NOTE: 3. To extend hot section life, the following preventive maintenance, based on the increase in T5 from the values established at engine installation (engine performance/ground power check or ECTM), is recommended: For a 10°C (20°F) increase in T5, do a performance recovery wash. In addition, indicating system and engine performance/ground power checks are recommended to ensure reliable engine performance data. Also, test spray pattern or refurbish fuel nozzles.
For a 15°C (27°F) increase in T5 or a 1 to 1.5% decrease in Ng, do a borescope inspection of the combustion chamber, small exit duct, CT stator vanes and CT blades. In addition, do the maintenance recommended above.

NOTE: 4. A significant difference between ECTM and engine performance/ground power check parameters indicate that the defect is within the aircraft air bleed system on the affected engine (air bleed is off during an engine performance/ground power check). An alternative method is to do an engine performance/ground power check with air bleed ON then OFF. Compare the shift parameters for the engines on the same aircraft. A significant difference indicates bleed sharing problems. For single engine installations, contact P&WC for typical parameter shift recommendations.

NOTE: 5. When an engine is temperature limited on climb or cruise and the engine performance/ground power check is satisfactory, the defect is within the aircraft bleed system of the affected engine.

NOTE: 6. An increase in temperature without other parameter shifts may be the result of defective fuel nozzles or a deteriorated combustion liner altering combustion profile and changing the temperature distribution.

NOTE: 7. Compressor deterioration (which increases Ng) and hot section normal deterioration (which reduces Ng) may balance each other and the effect deterioration has on Ng will be very small or zero (i.e. Ng will remain constant).

NOTE: 8. When the engine is running on the ground, inlet plenum air pressure is lower than ambient air pressure. Therefore, if the inlet or firewall seals are damaged, hot air from around the engine may be ingested causing a temperature increase. Similarly, if the wind direction is from the rear, exhaust gas may be ingested and temperature increased.

NOTE: 9. The relationship between T5 and the temperature in front of CT stator may change due to hot section component deterioration altering combustion profile and/or gas path temperature distribution. This may affect the T5 trim and the indicated T5 and the relationship between T5 and the temperature in front of the CT vane used for engine certification. A T5 trim verification on the wing or in the test cell will confirm a shift in the indicated temperature.

NOTE: 10. To remove doubts, a T5 system check (including individual thermocouple checks) is recommended before doing a complete HSI.

Figure 102 Engine Operating Fault Isolation Chart (sheet 1 of 13)

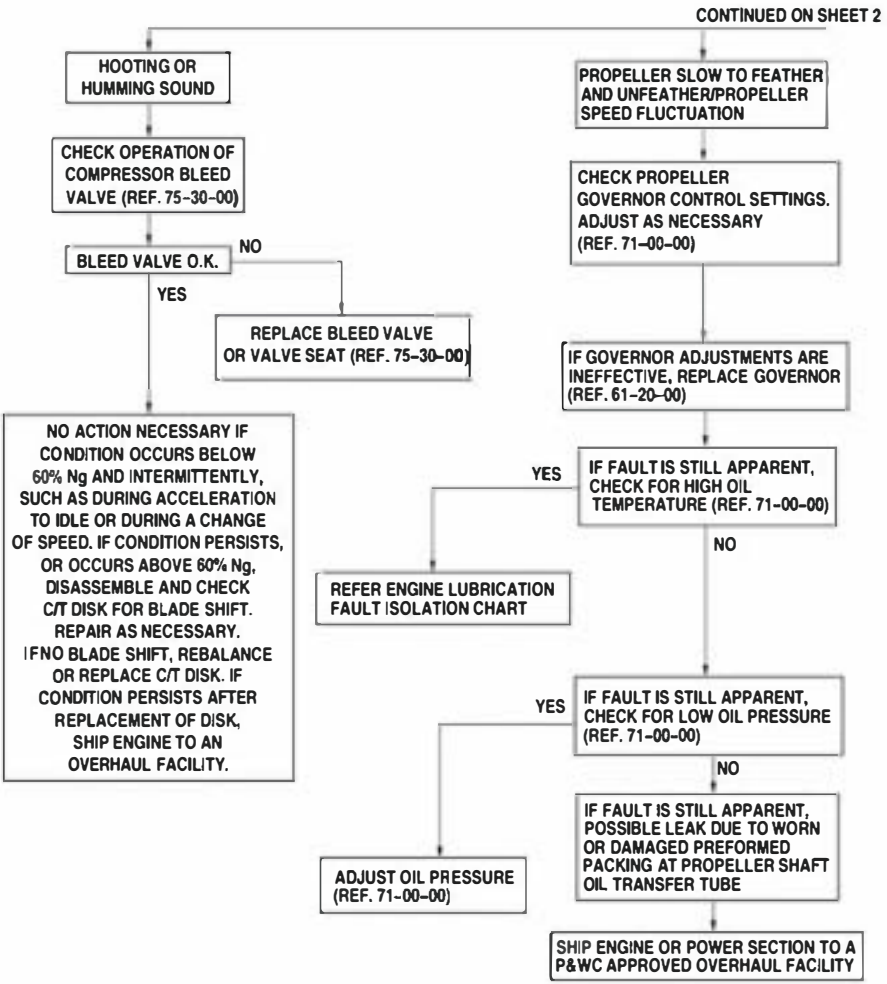


Figure 103 Engine Performance Fault Isolation Chart (sheet 2 of 9)

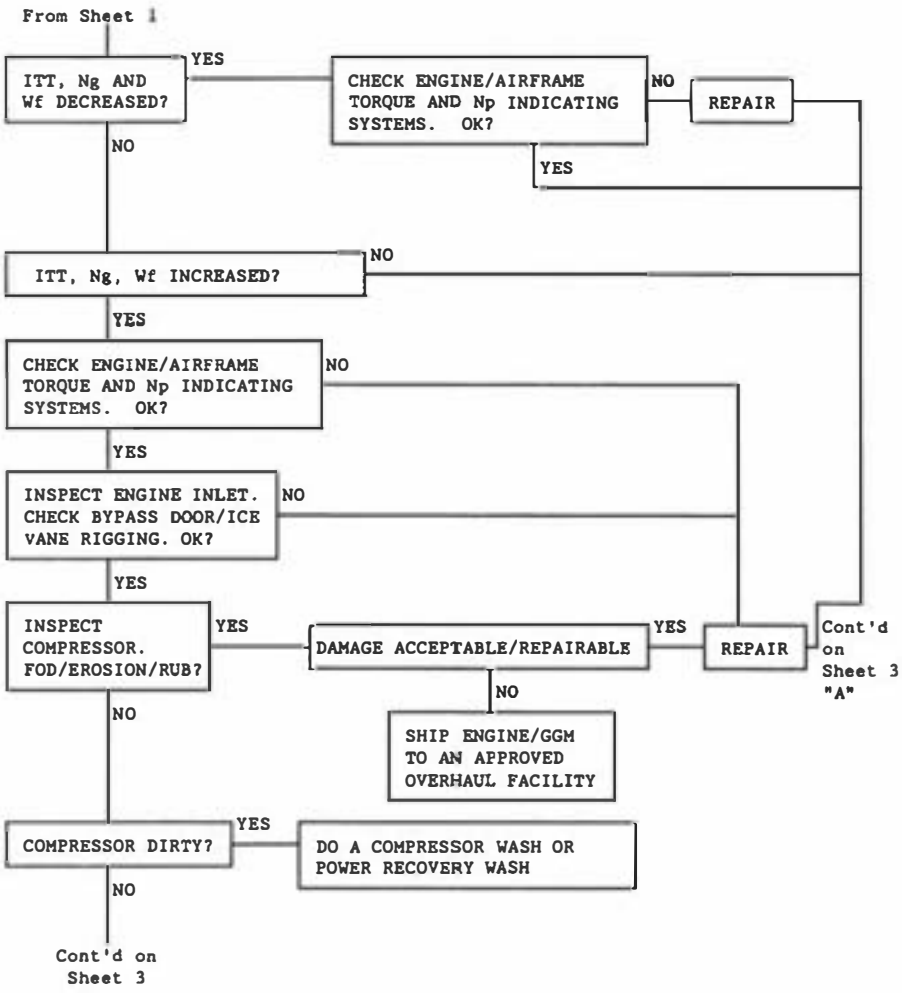


Figure 103 Engine Performance Fault Isolation Chart (sheet 3 of 9)

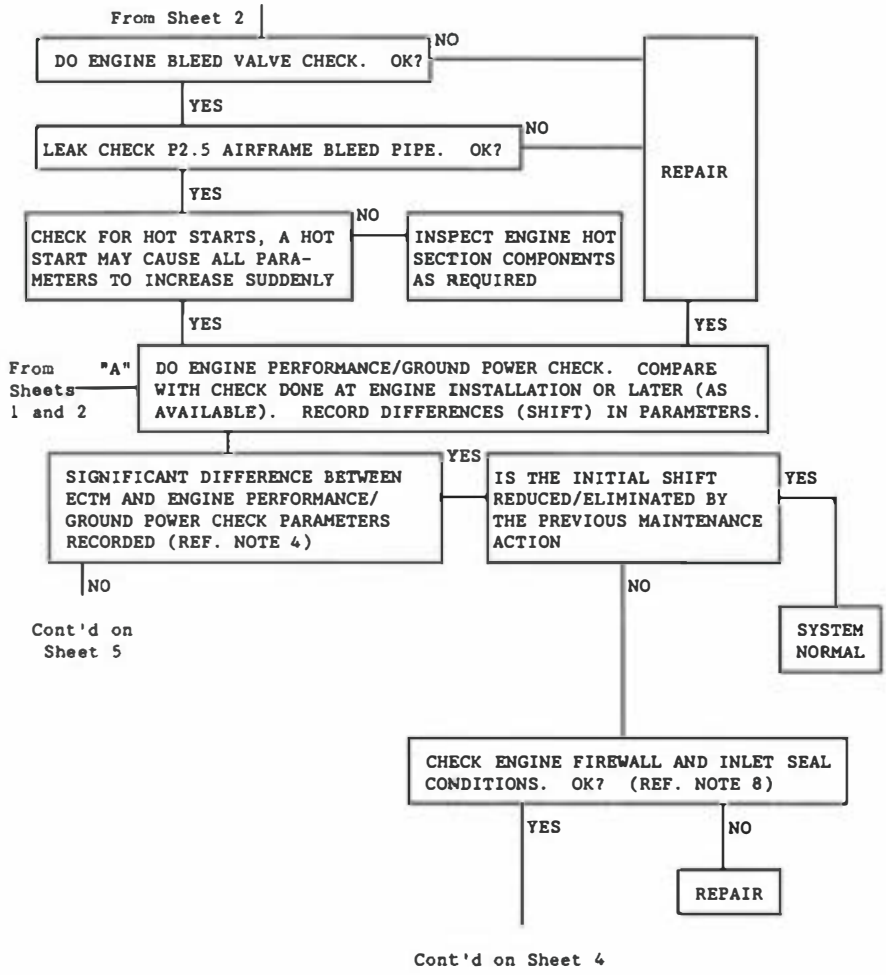


Figure 103 Engine Performance Fault Isolation Chart (sheet 4 of 9)

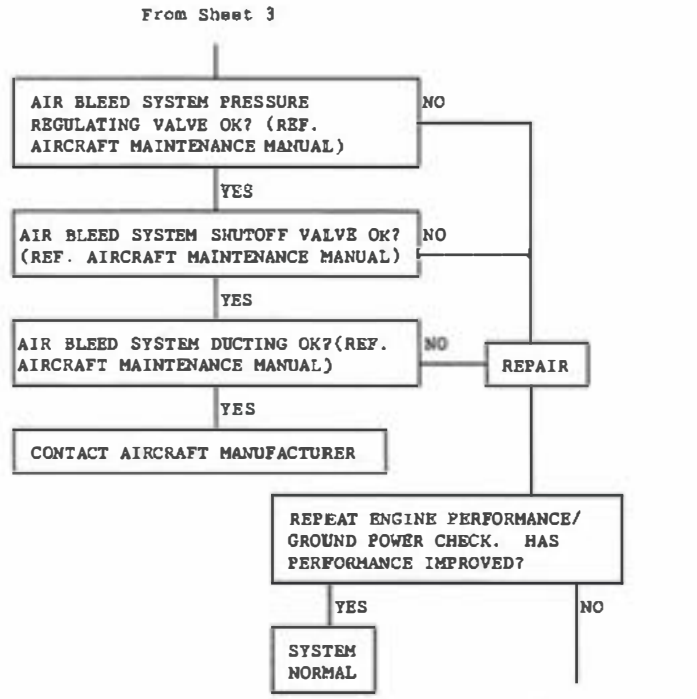


Figure 103 Engine Performance Fault Isolation Chart (sheet 5 of 9)

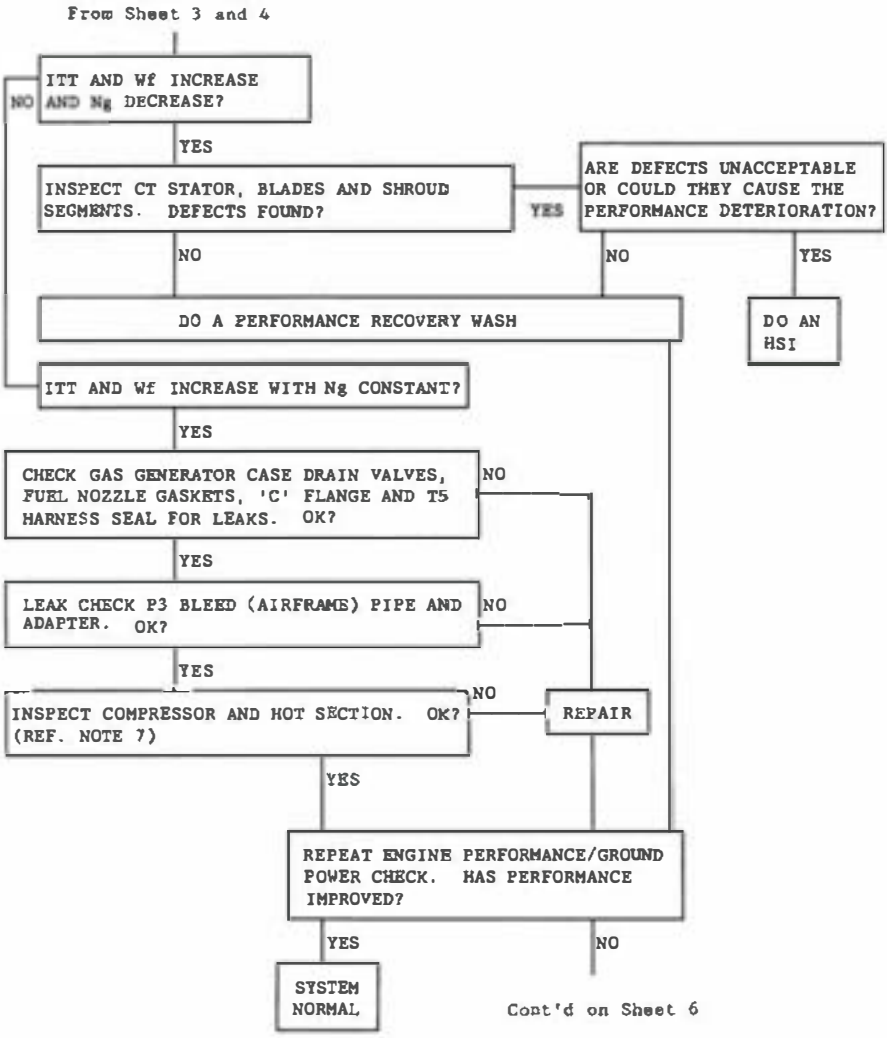


Figure 103 Engine Performance Fault Isolation Chart (sheet 6 of 9)

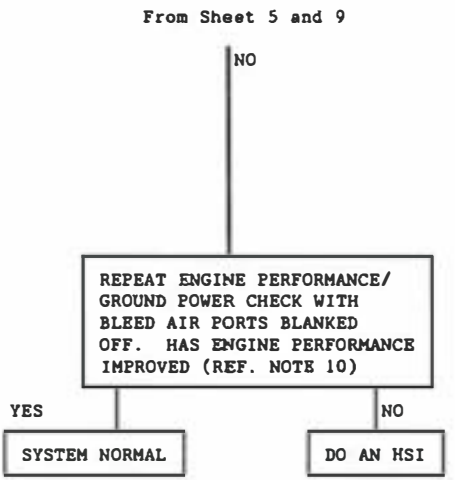


Figure 103 Engine Performance Fault Isolation Chart (sheet 7 of 9)

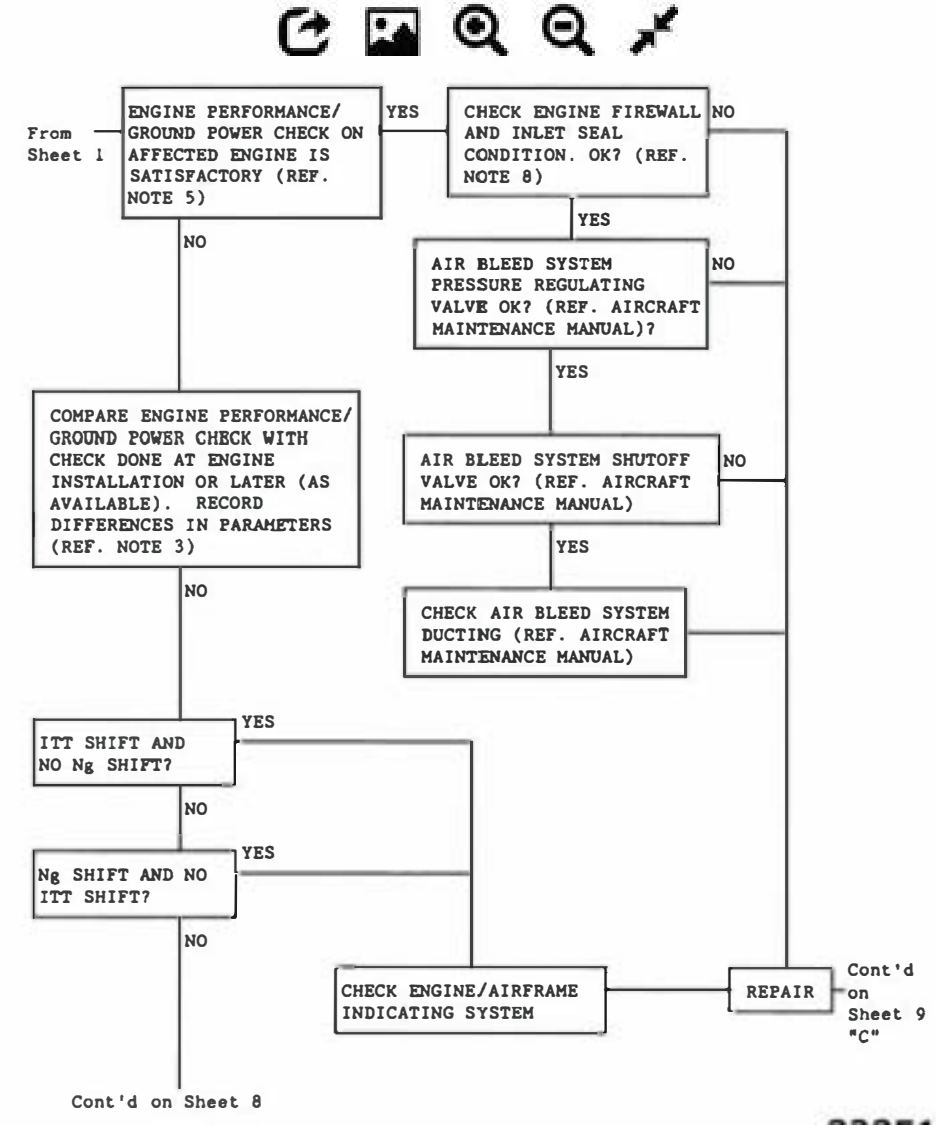


Figure 103 Engine Performance Fault Isolation Chart (sheet 8 of 9)

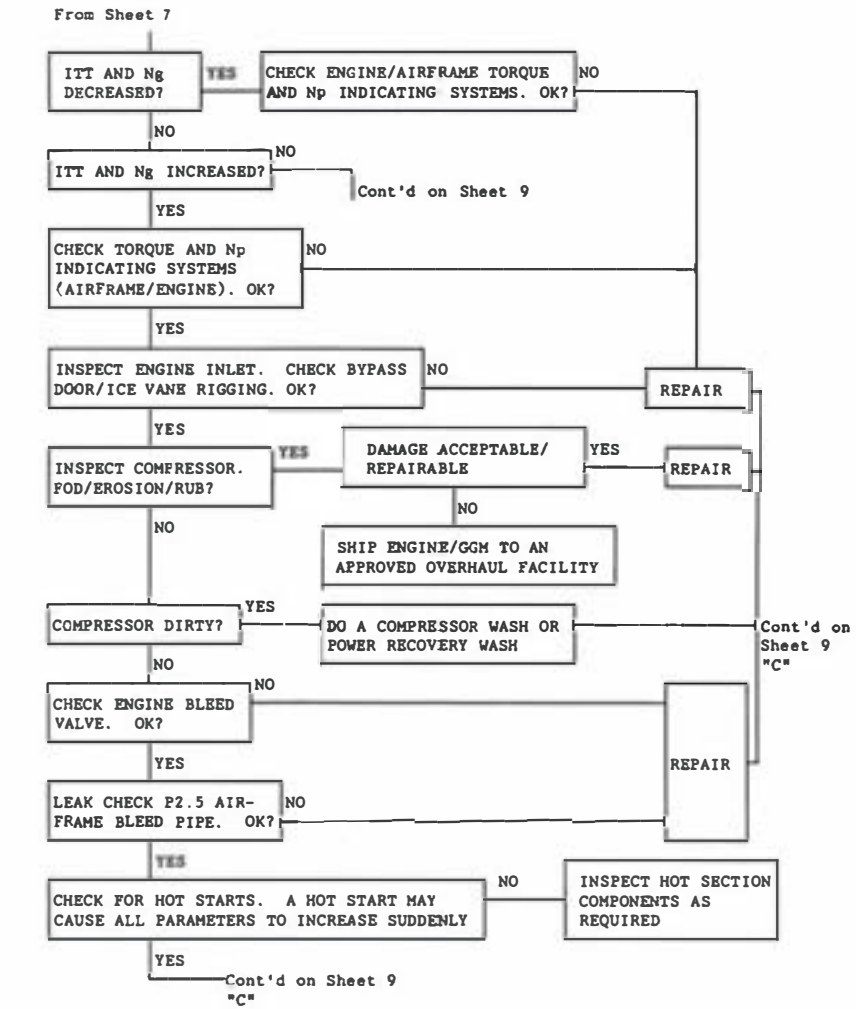


Figure 103 Engine Performance Fault Isolation Chart (sheet 9 of 9)

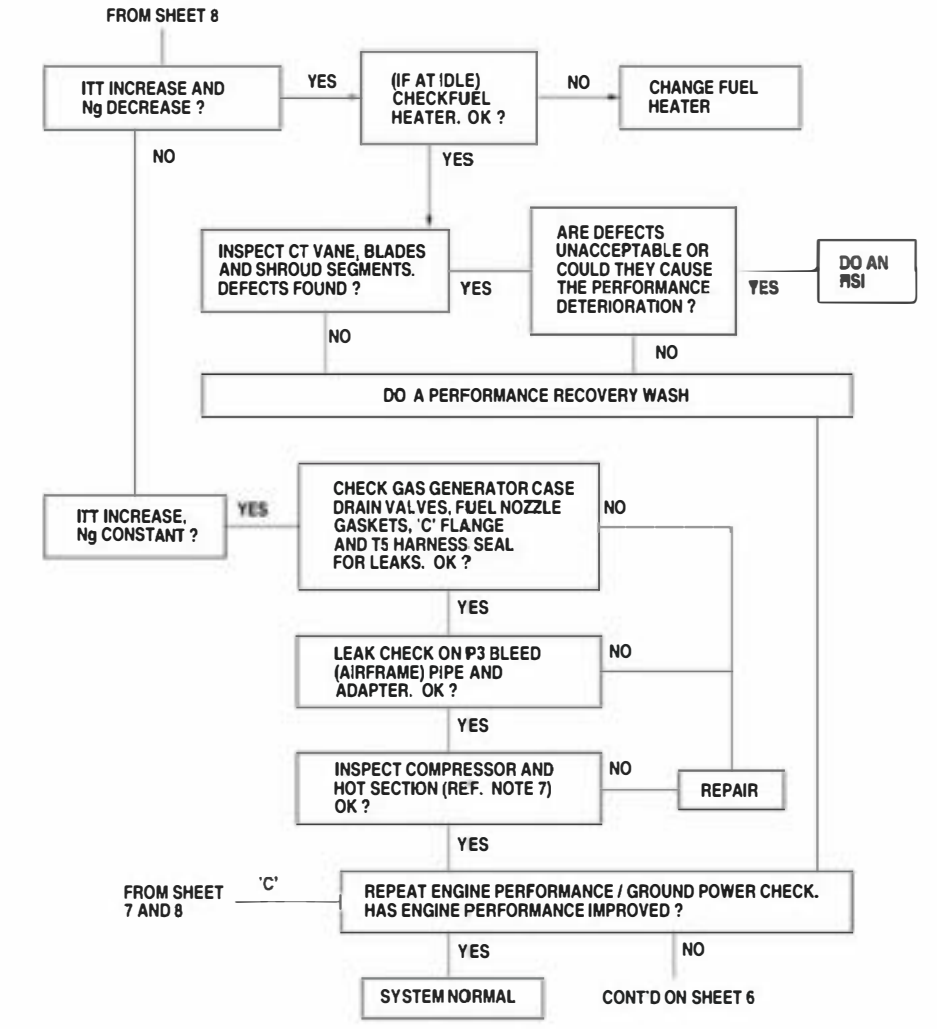


Figure 103 Engine Performance Fault Isolation Chart (sheet 1 of 9)

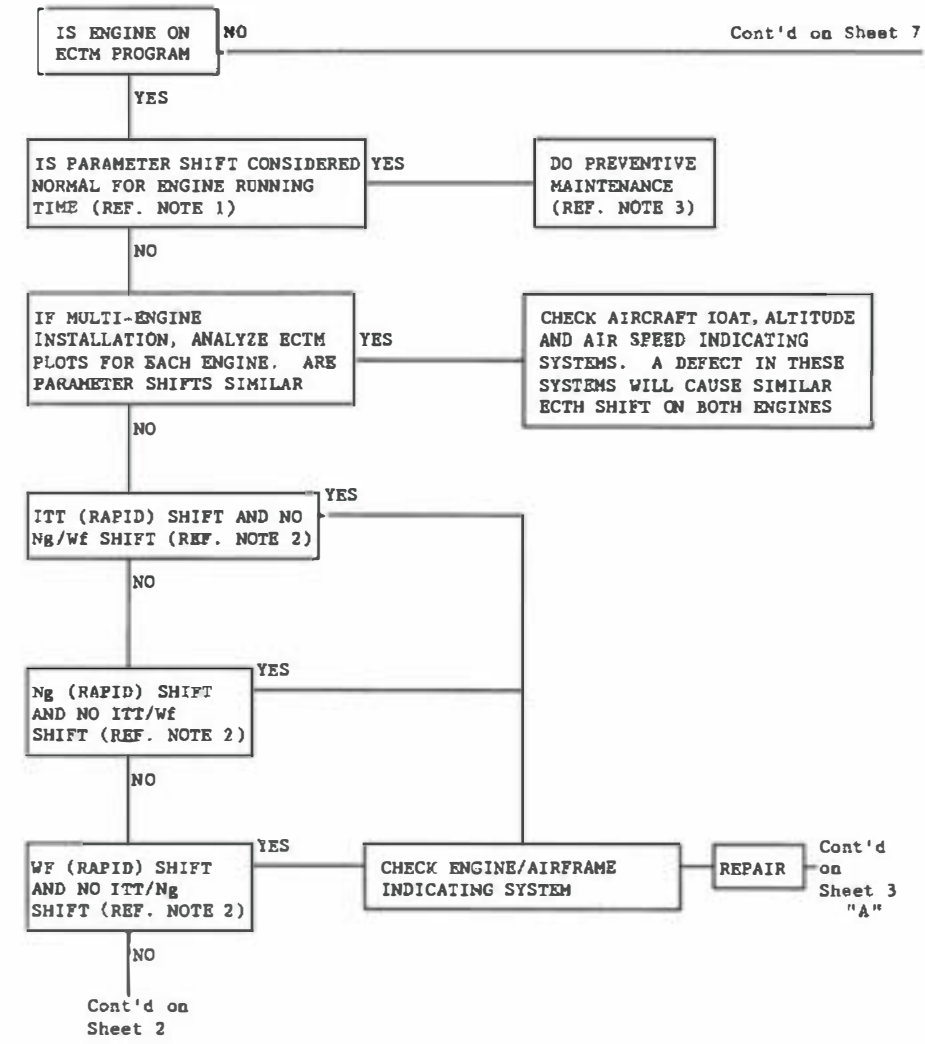


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 2 of 9)

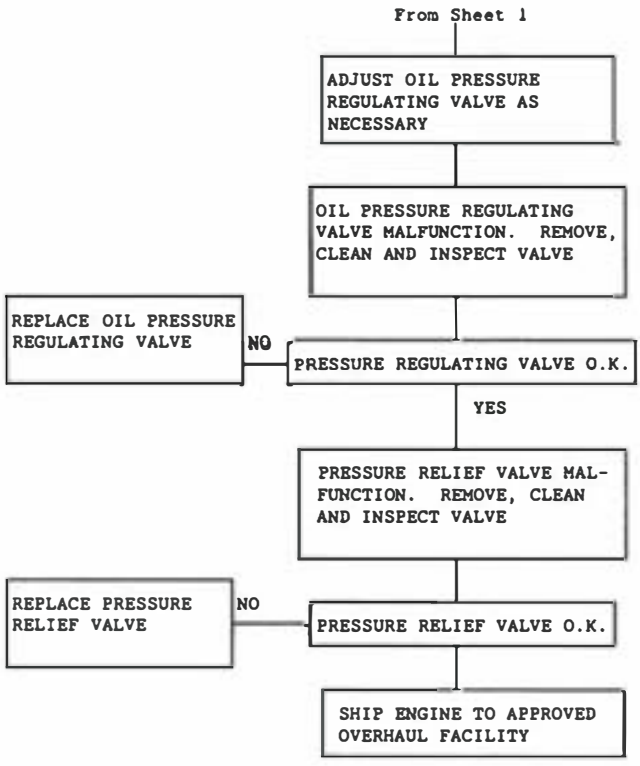


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 3 of 9)

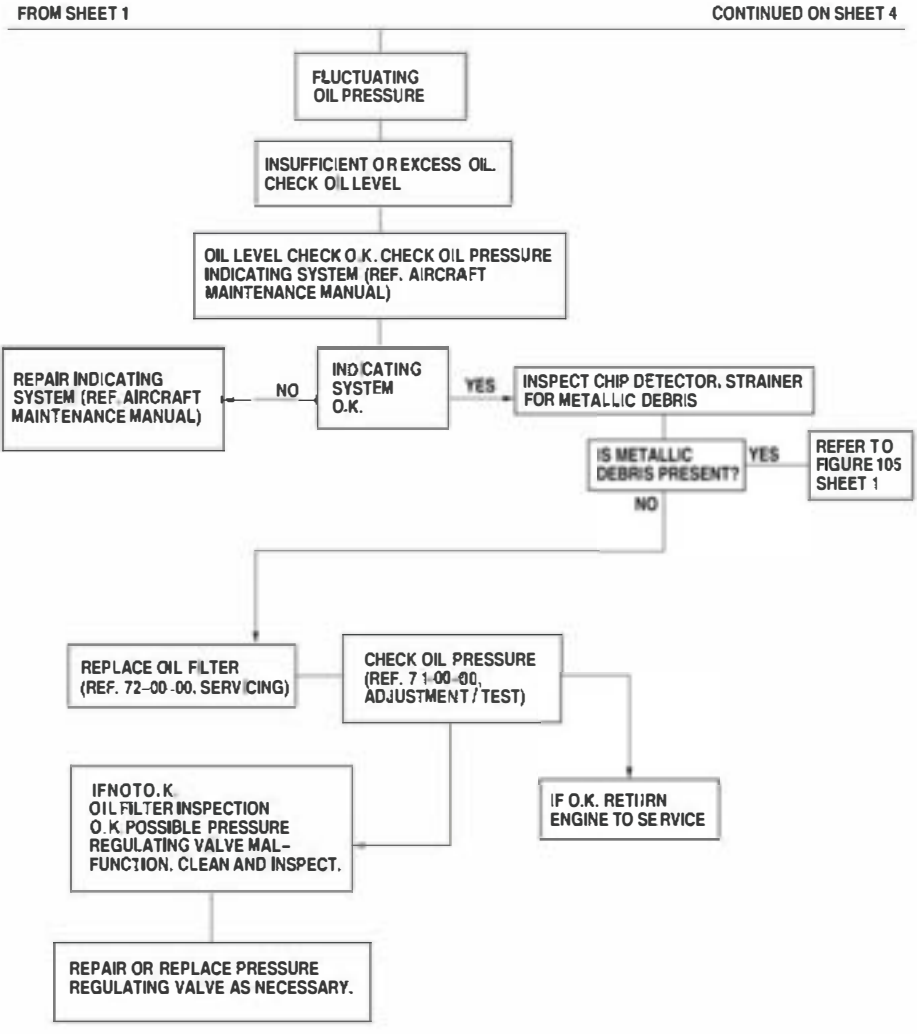


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 4 of 9)

NOTES:

1. EXCESSIVE IDLING IN FEATHER COULD CAUSE OVERHEATING INDICATION. RESTRICT IDLING TIME IN FEATHER.
2. IF THE ENGINE HAS BEEN OPERATED FOR AN EXTENDED PERIOD (REF. 71-00-00, POWER PLANT - ADJUSTMENT/TEST FOR TIME LIMIT) ABOVE OIL TEMPERATURE LIMITS, THEN DO AN UNSCHEDULED INSPECTION FOR SUSTAINED RUNNING AT OIL TEMPERATURE OUTSIDE LIMITS (REF. INSPECTION).

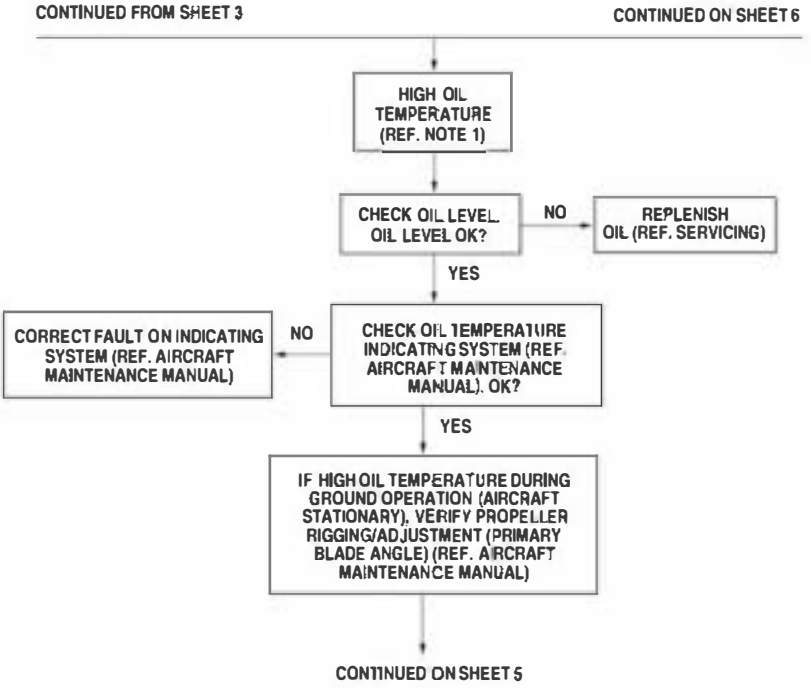


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 5 of 9)

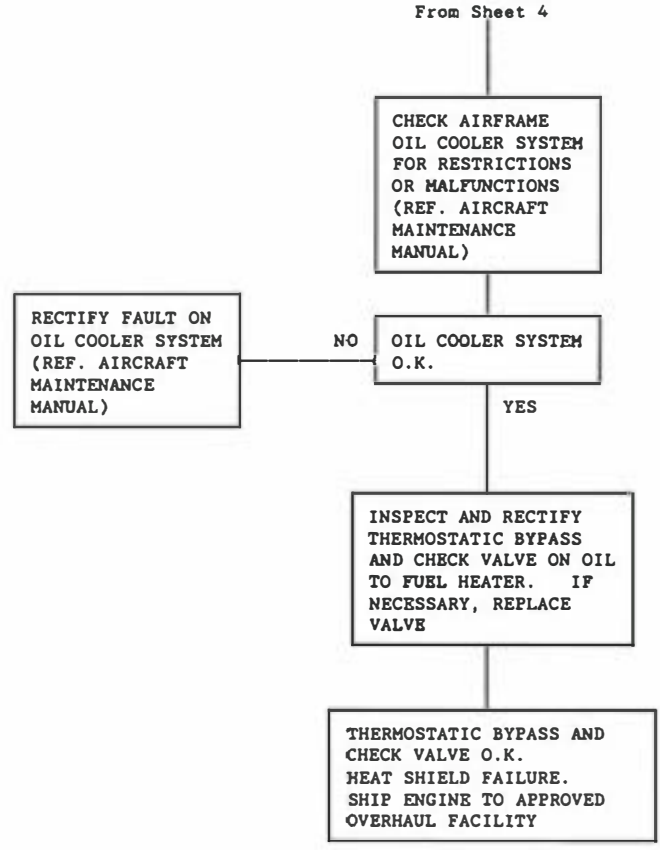


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 6 of 9)

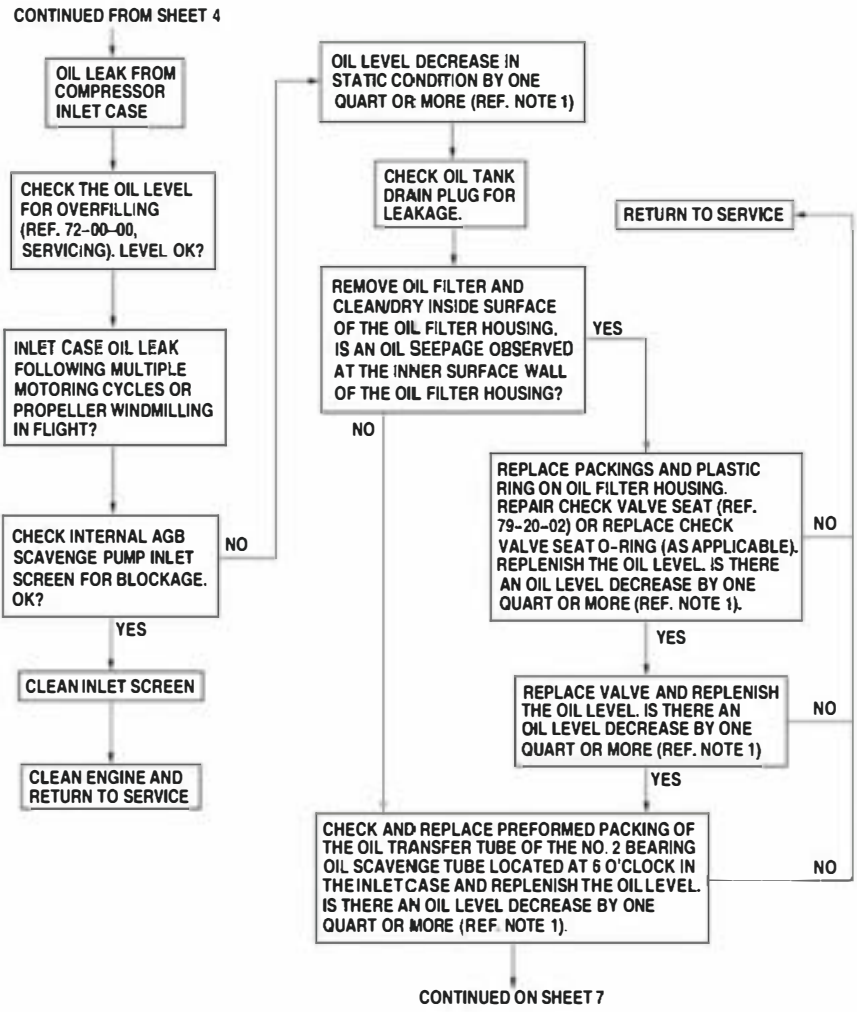
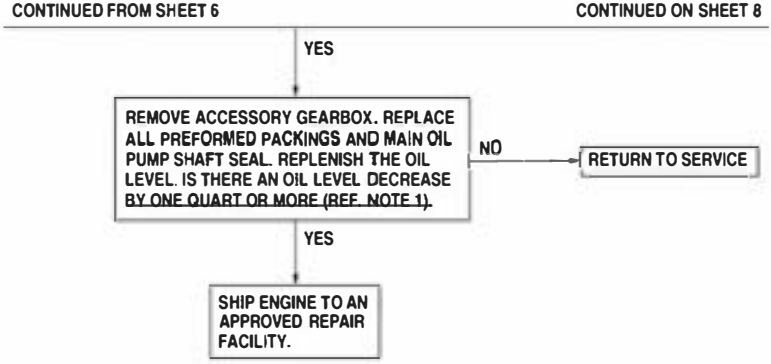


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 7 of 9)



NOTE 1: A LEAK OF ONE QUART OR MORE AFTER 8 HOURS PERIOD (OVERNIGHT) MAY LEAD TO OIL OVER SERVICING AND ADDITIONAL OIL LEAKS ON VARIOUS LABYRINTH SEALS. FOR TROUBLESHOOTING PURPOSES AND FOR ACCURATE MEASUREMENT OF THE OIL STATIC LEAK, WE RECOMMEND TO PERFORM THE FOLLOWING STEPS:

(a) DRAIN THE ACCESSORY GEARBOX AND RGB CAVITIES. RE-INSTALL DRAIN PLUG.

(b) REPLENISH / SERVICE OIL LEVEL.

(c) VERIFY OR ESTABLISH BASELINE OIL LEVEL AFTER 15 MINUTES AND WAIT 8 HOURS TO VERIFY DECREASE OF OIL LEVEL.

(d) VERIFY THE OIL LEVEL TO IDENTIFY IF THE LEAKAGE IS STILL MORE THAN ONE QUART OVER 8 HOURS PERIOD.

Figure 104 Engine Lubrication Fault Isolation Chart (sheet 8 of 9)

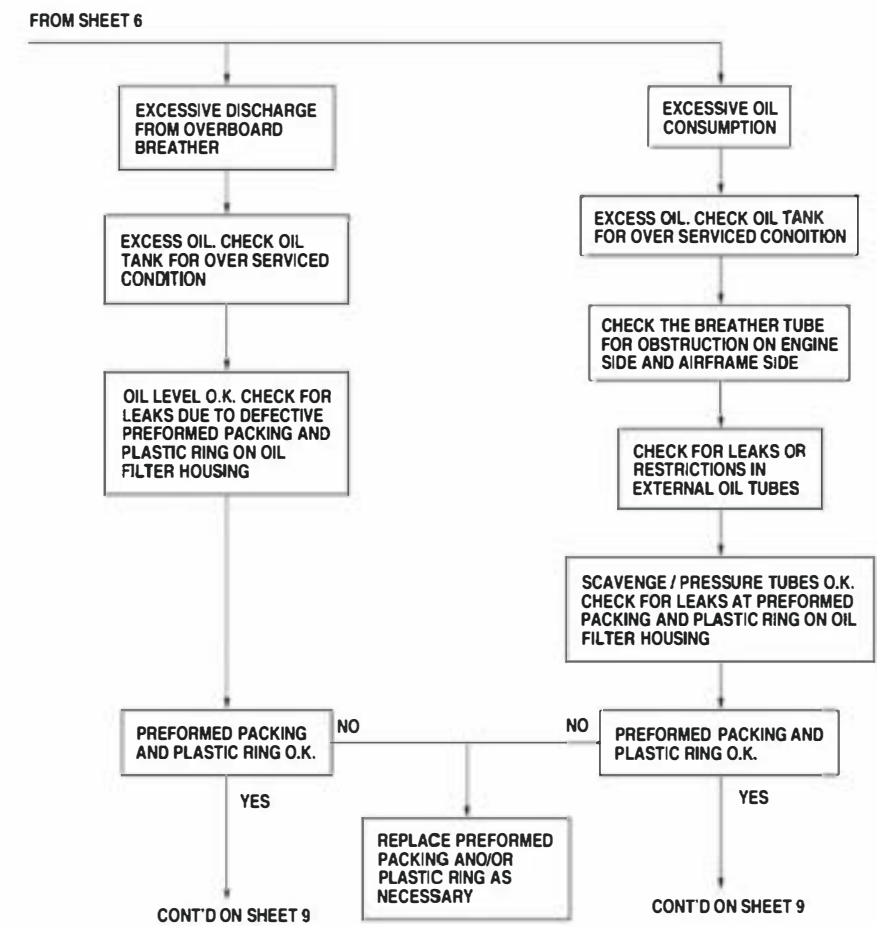


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 9 of 9)

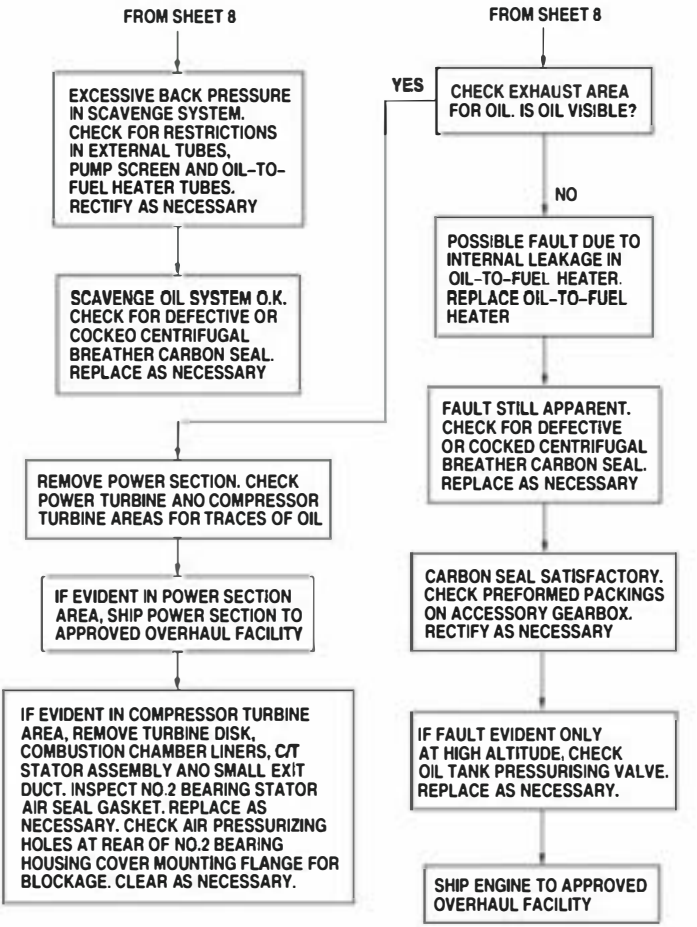


Figure 104 Engine Lubrication Fault Isolation Chart (sheet 1 of 9)

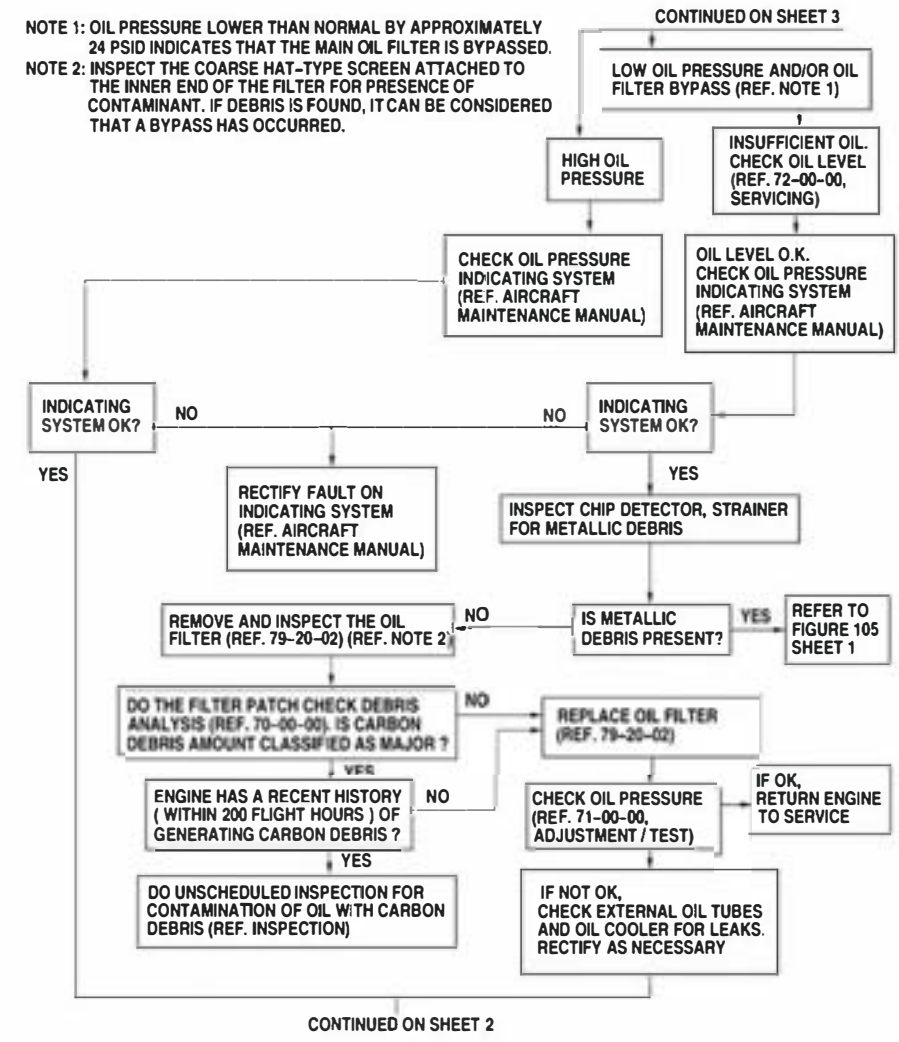


Figure 105 Engine Lubricating Oil Contamination Fault Isolation Chart (sheet 2 of 4)

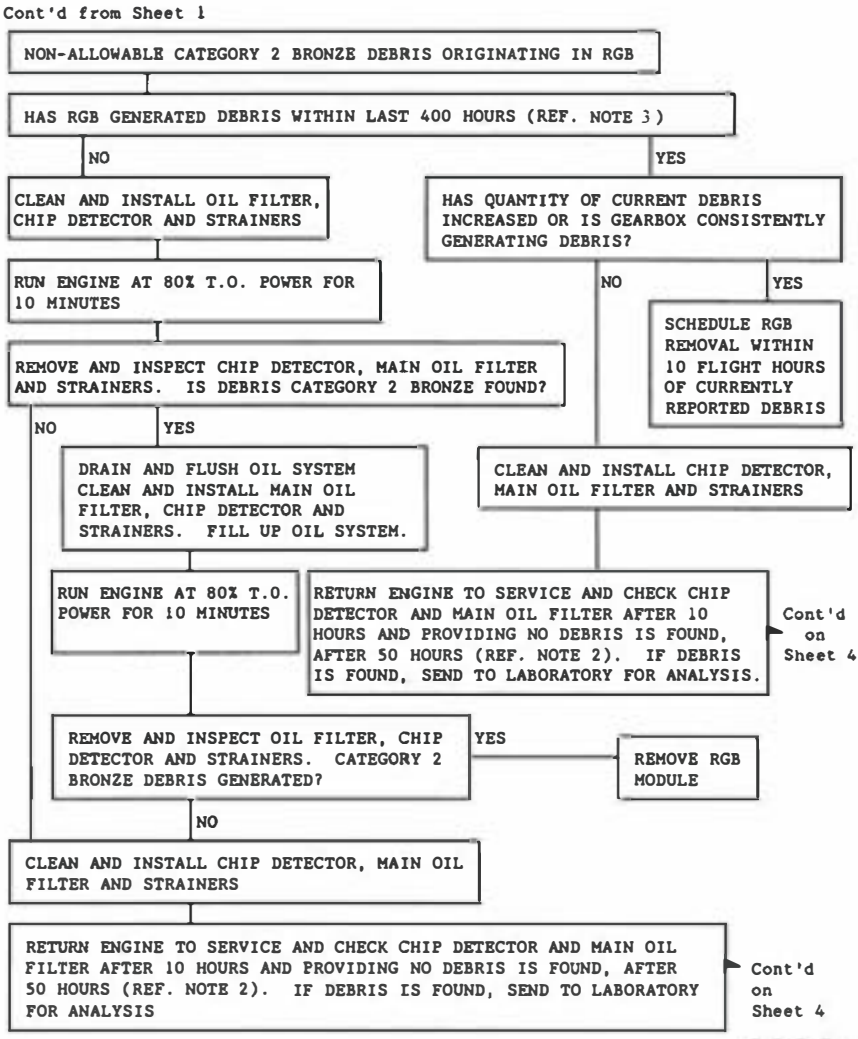


Figure 105 Engine Lubricating Oil Contamination Fault Isolation Chart (sheet 3 of 4)

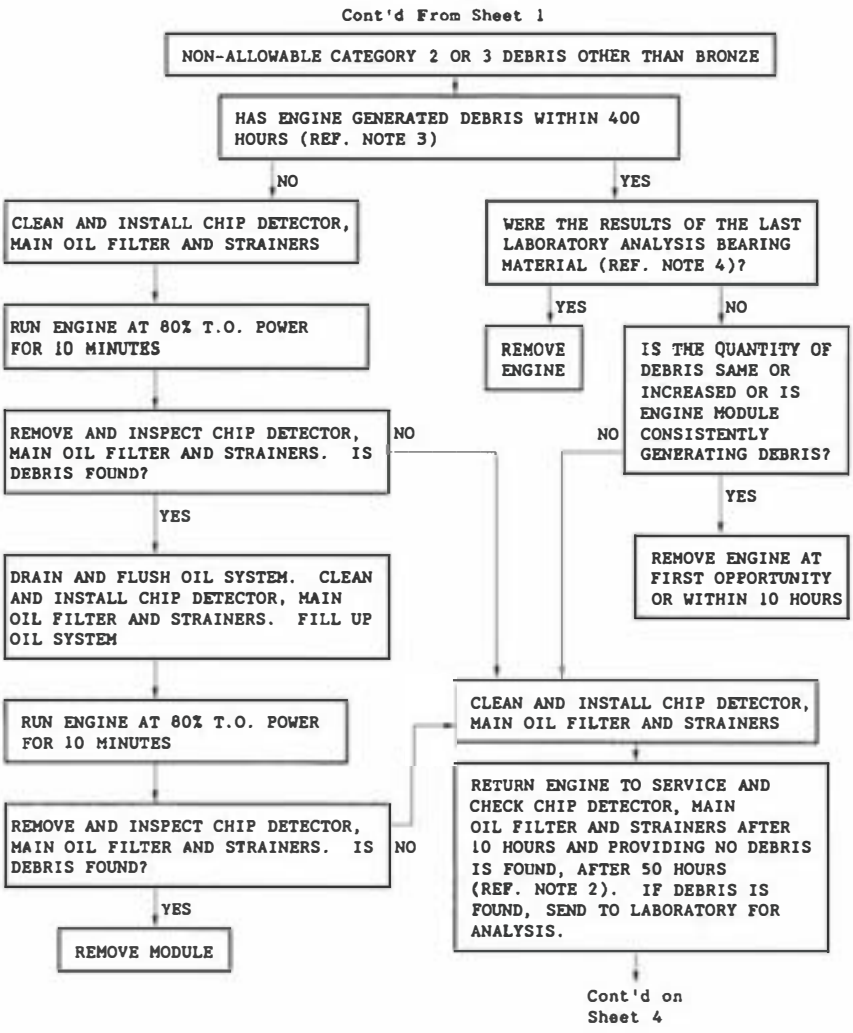


Figure 105 Engine Lubricating Oil Contamination Fault Isolation Chart (sheet 4 of 4)

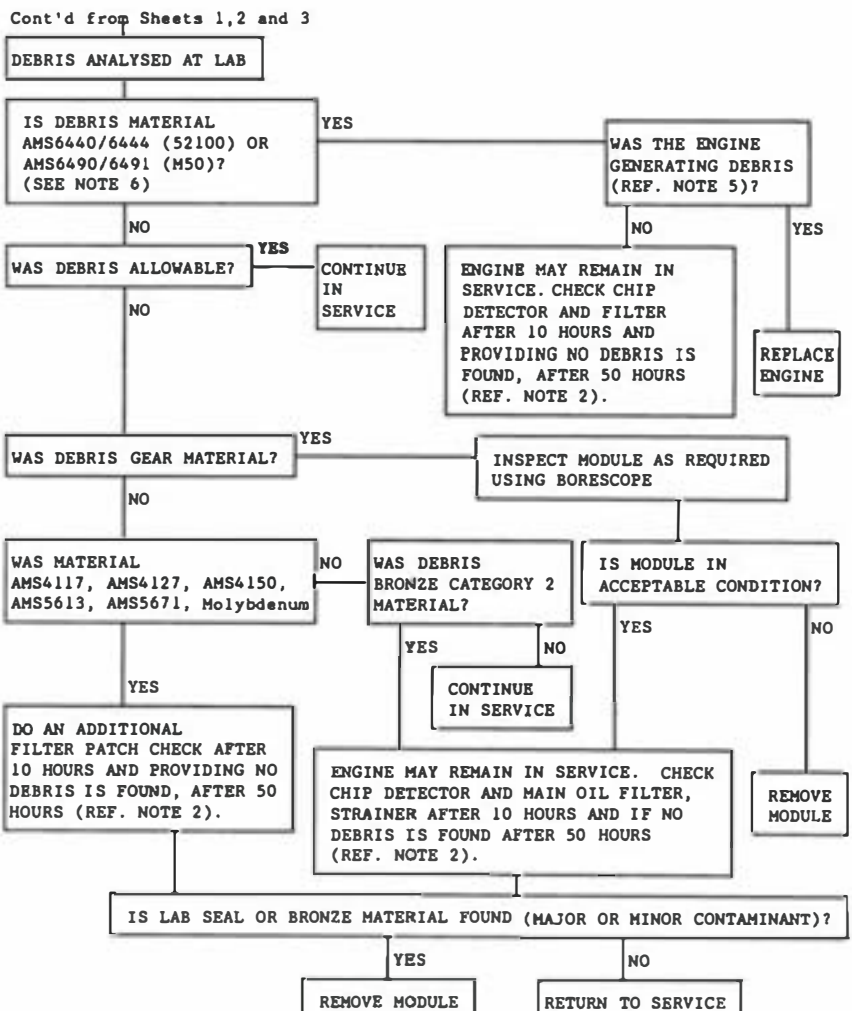


Figure 105 Engine Lubricating Oil Contamination Fault Isolation Chart (sheet 1 of 4)

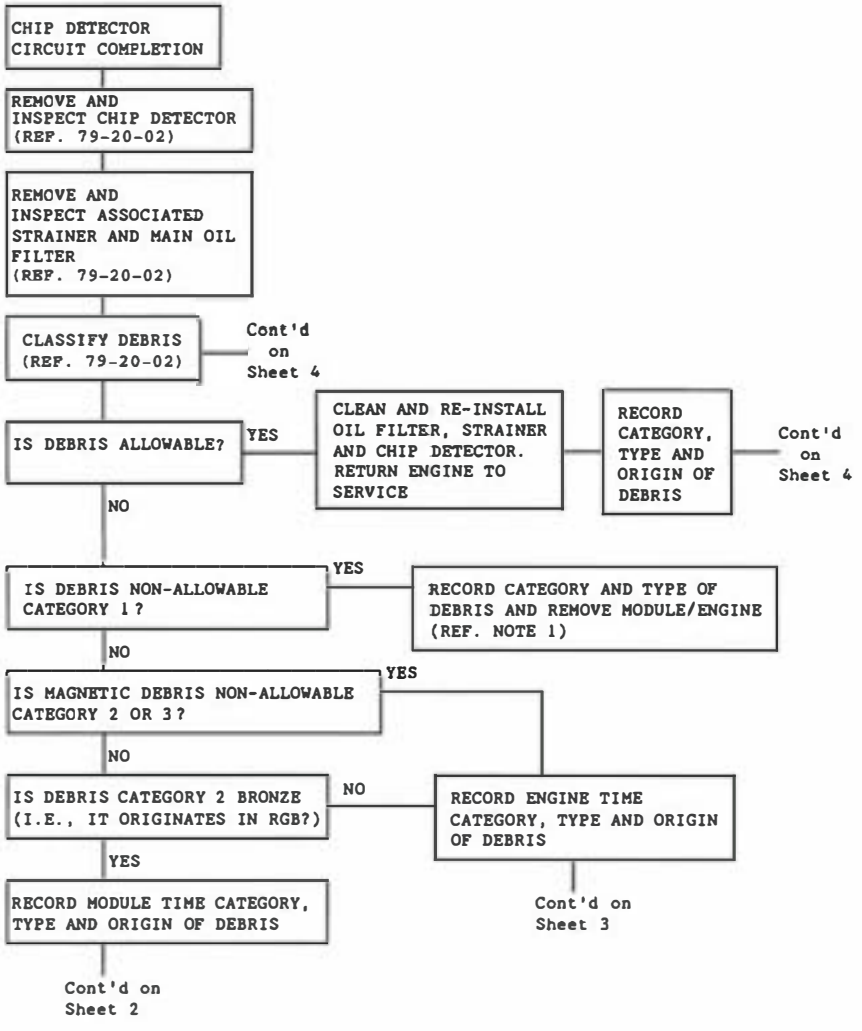
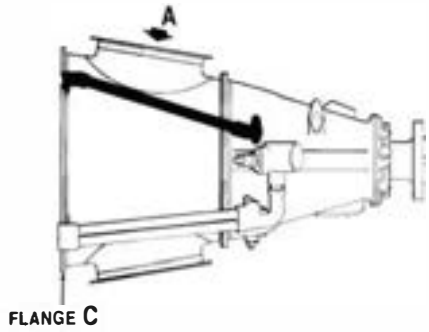
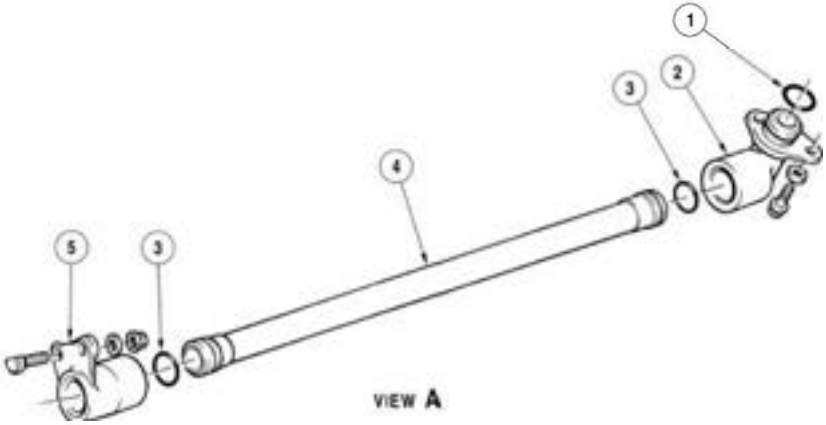


Figure 201 Removal/Installation of Front Pressure Oil Tube



POWER SECTION



VIEW A

Figure 201 Center Fireseal Mount RIng - Removal/Installation

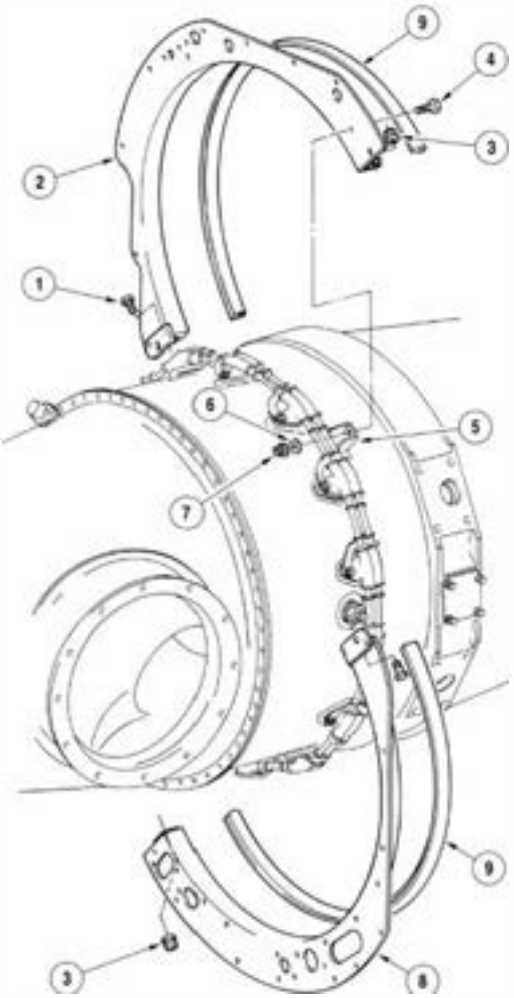


Figure 201 Compressor First-Stage Blades Inspection

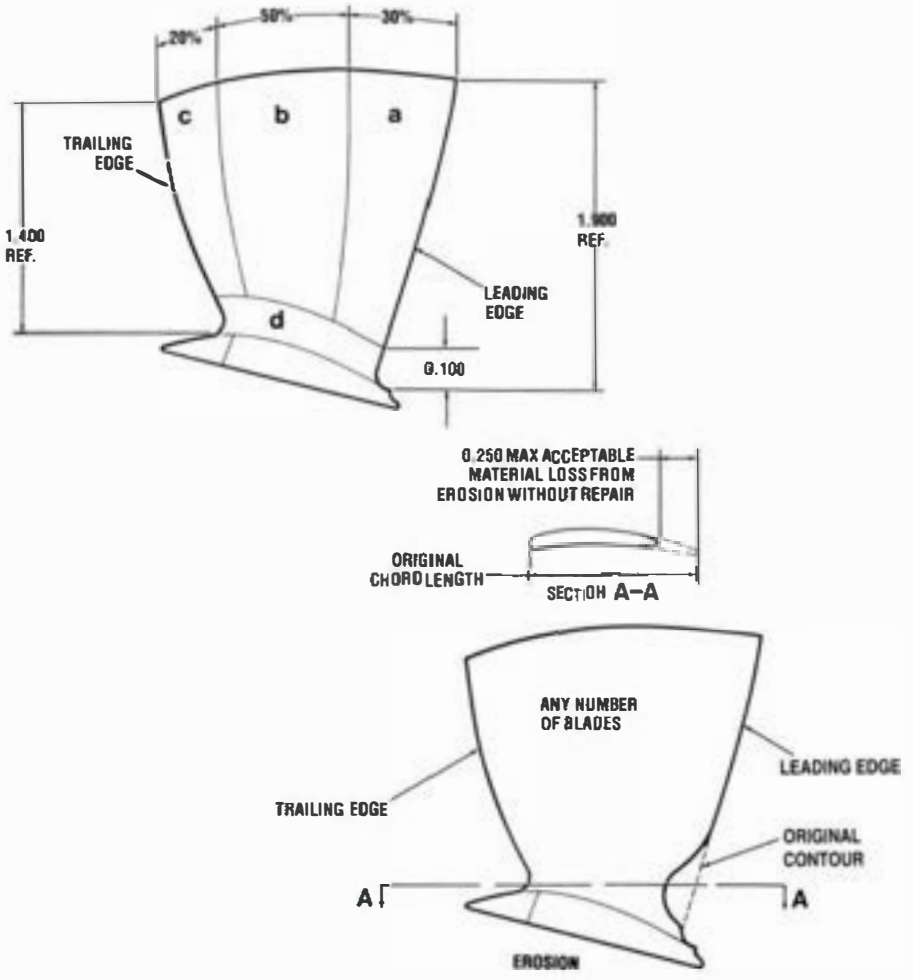


Figure 201 Removal/Installation of Accessory Gearbox

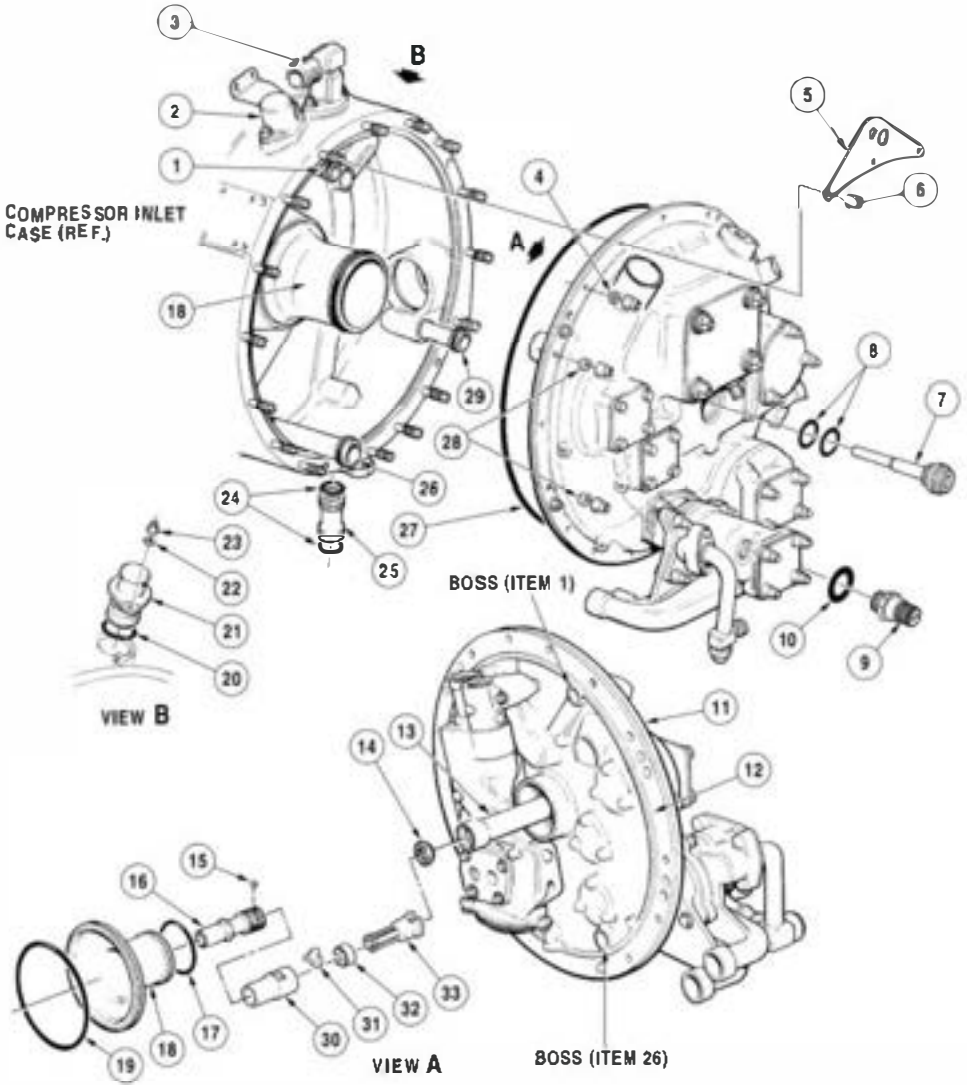


Figure 201 Removal/Installation of Air Inlet Screen

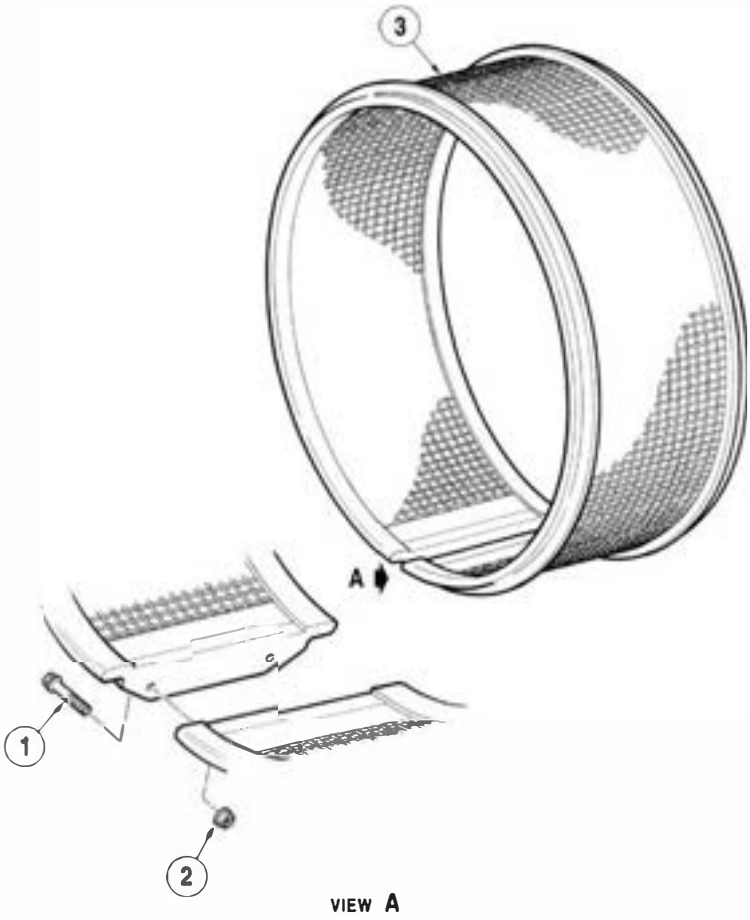


Figure 201 Removal/Installation of Combustion Chamber Inner Liner

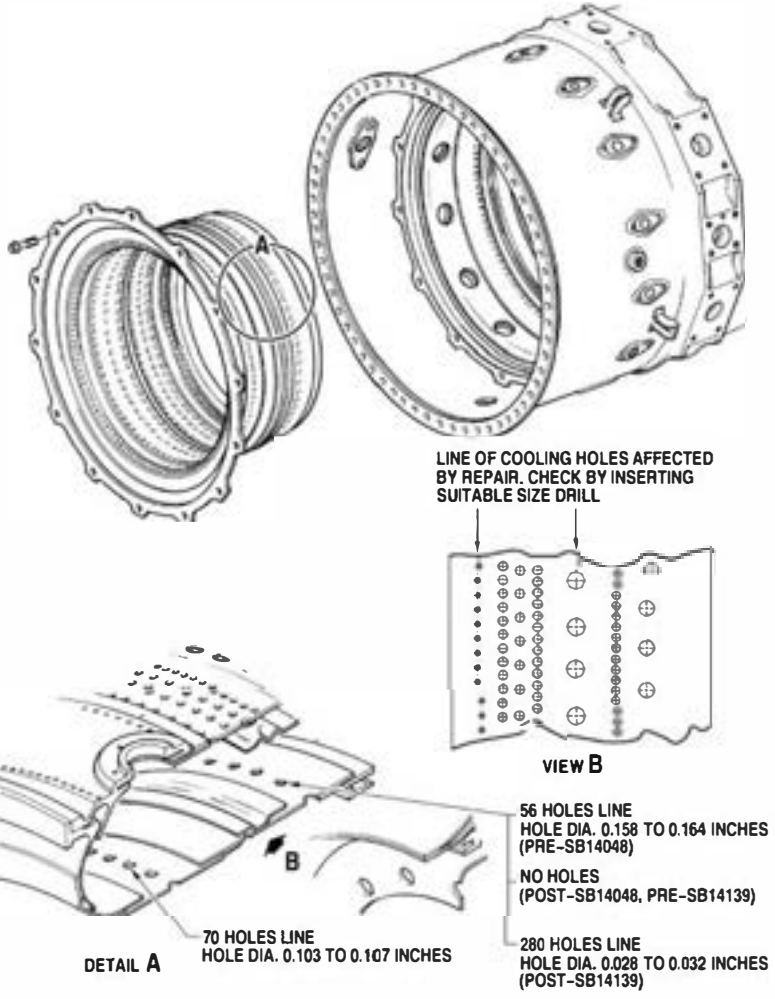


Figure 201 Removal/Installation of Compressor Bleed Valve

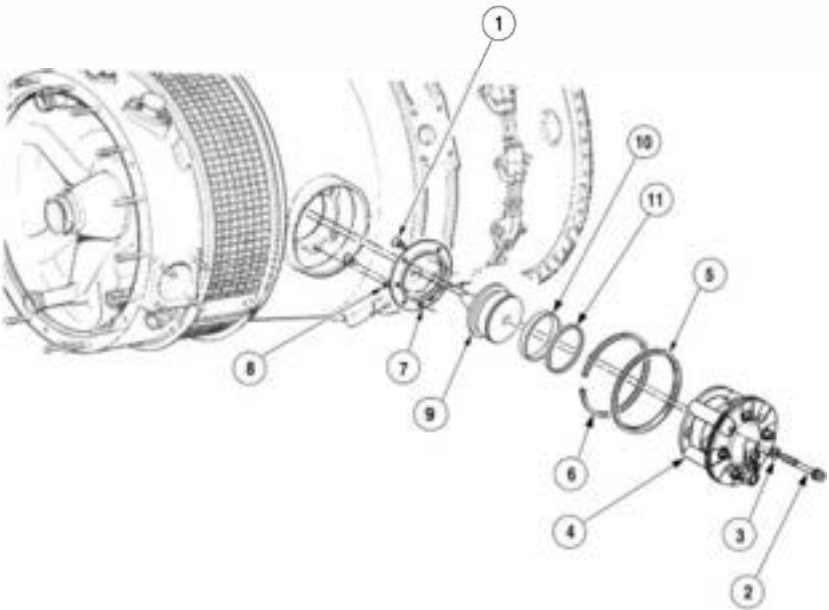
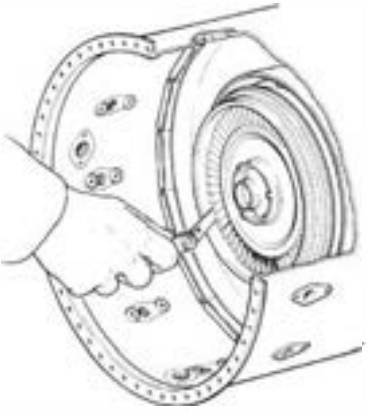


Figure 201 Removal/Installation of Compressor Turbine Assembly



COMPRESSOR TURBINE AND
TIP CLEARANCE CHECK – TYPICAL

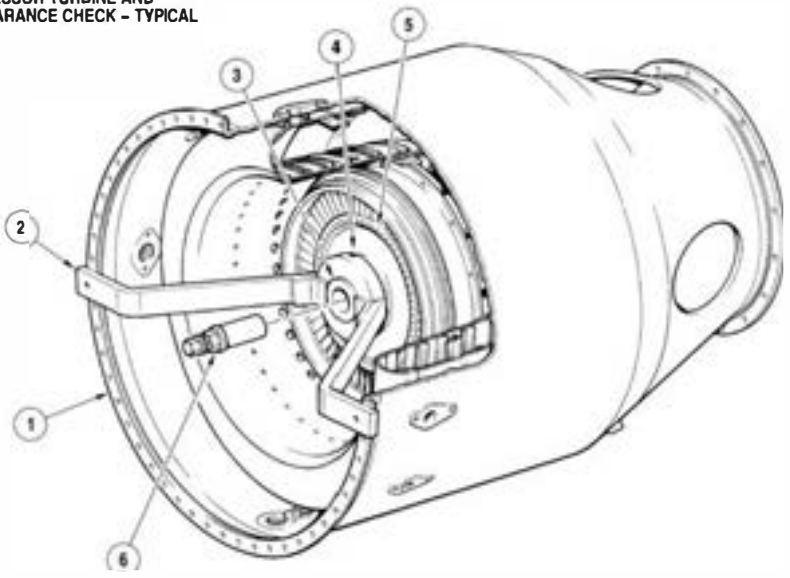


Figure 201 Removal/Installation of Compressor Wash Ring

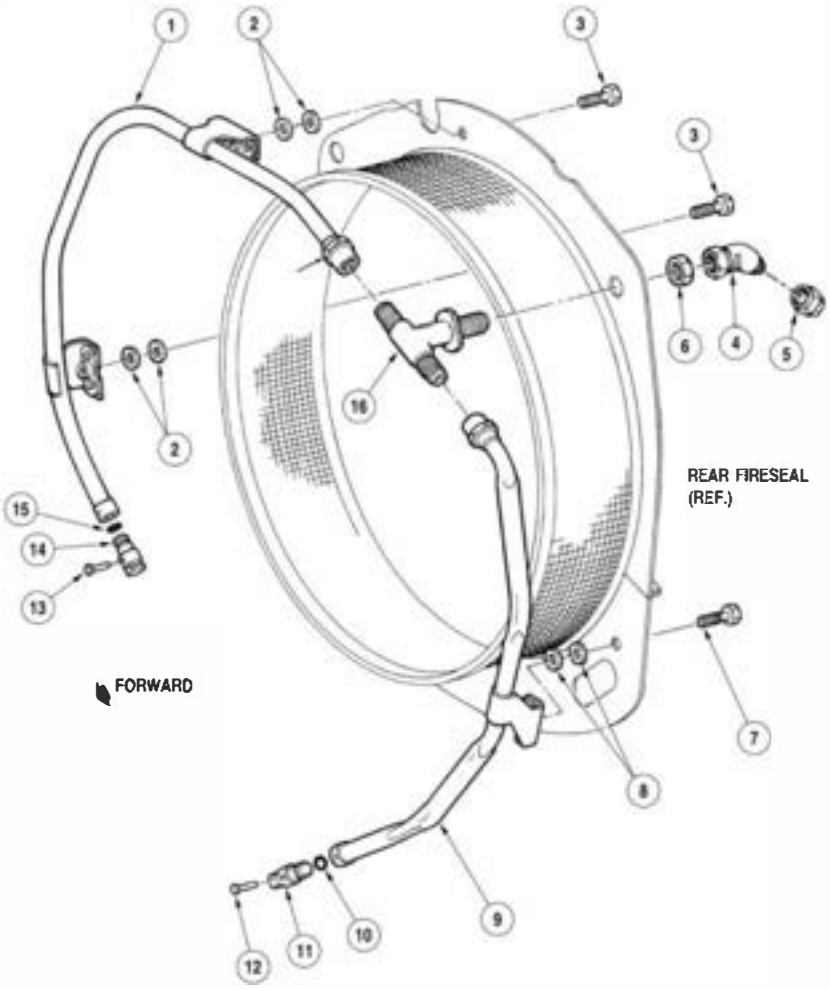


Figure 201 Removal/Installation of CT Stator Assembly

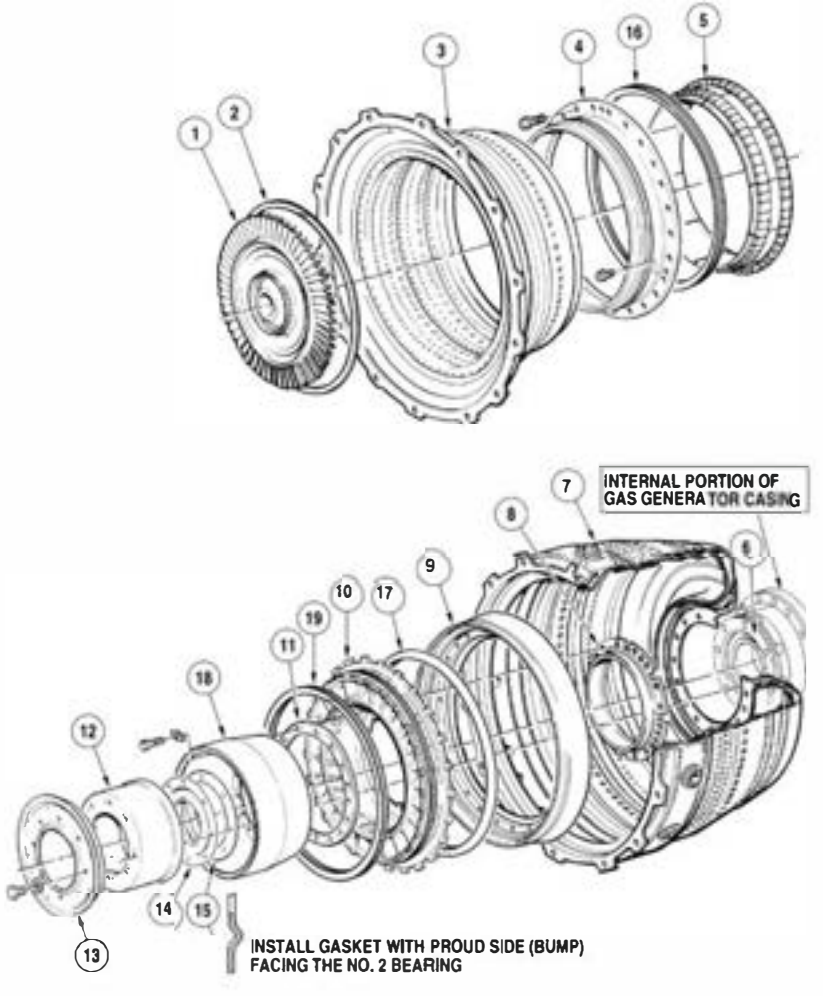


Figure 201 Removal/Installation of Flow Divider

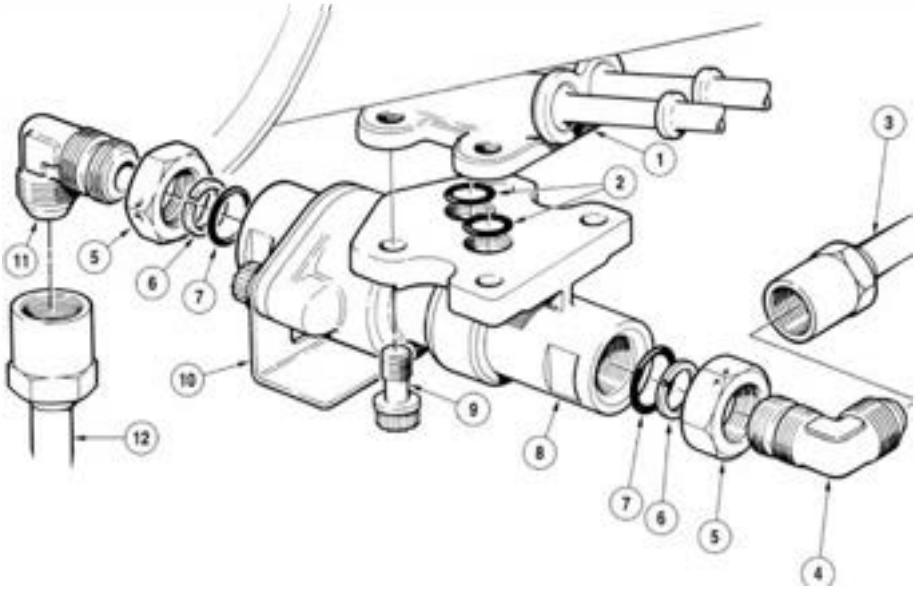
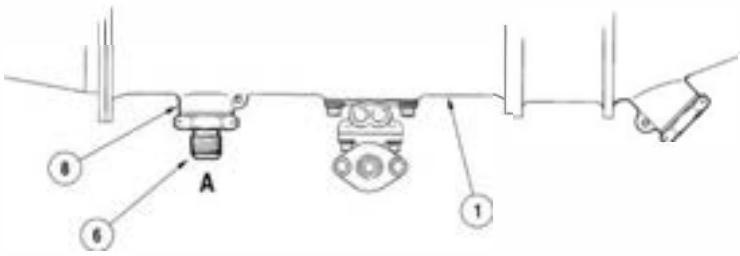
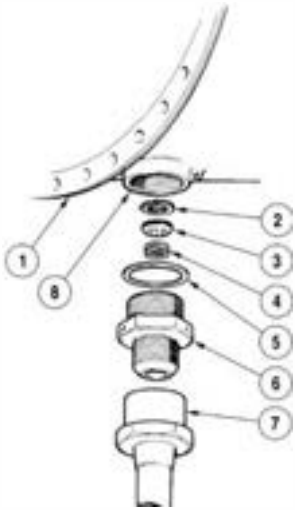


Figure 201 Removal/Installation of Fuel Drain Valves





VIEW A

Figure 201 Removal/Installation of Fuel Manifold Adapters (sheet 2 of 2)

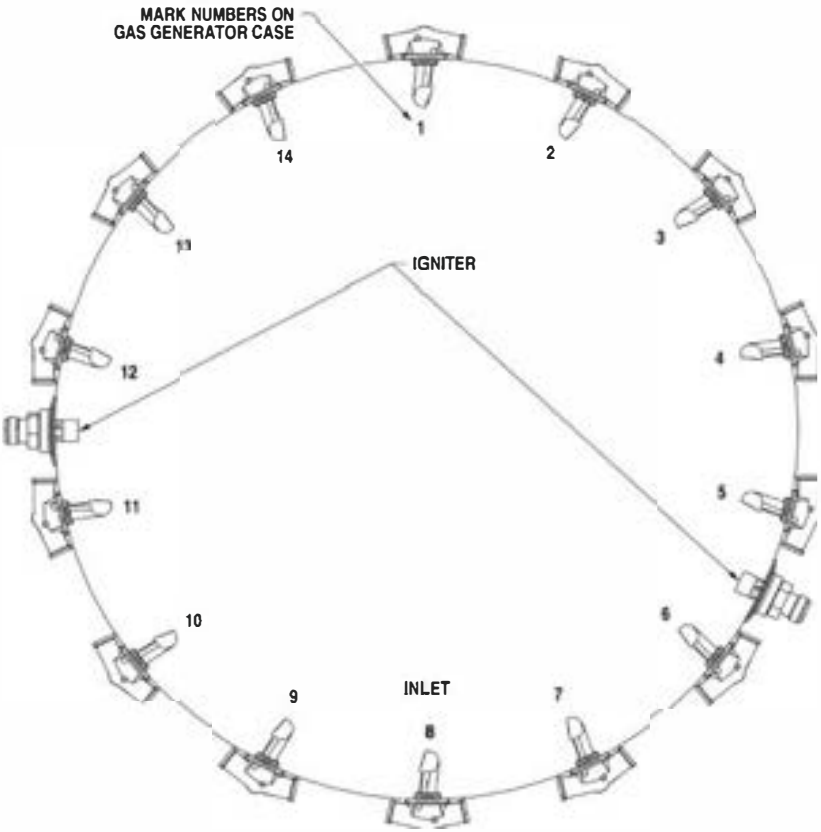
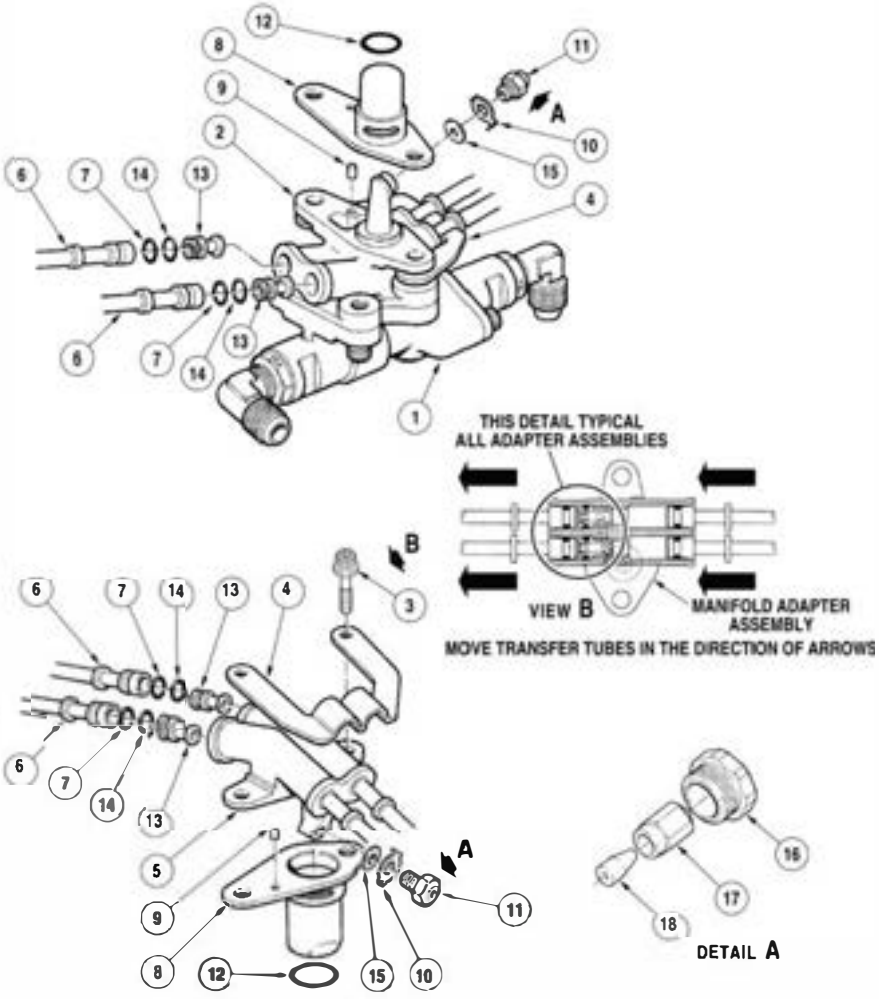


Figure 201 Removal/Installation of Fuel Manifold Adapters (sheet 1 of 2)



c239180

Figure 201 Removal/Installation of Ignition Cables

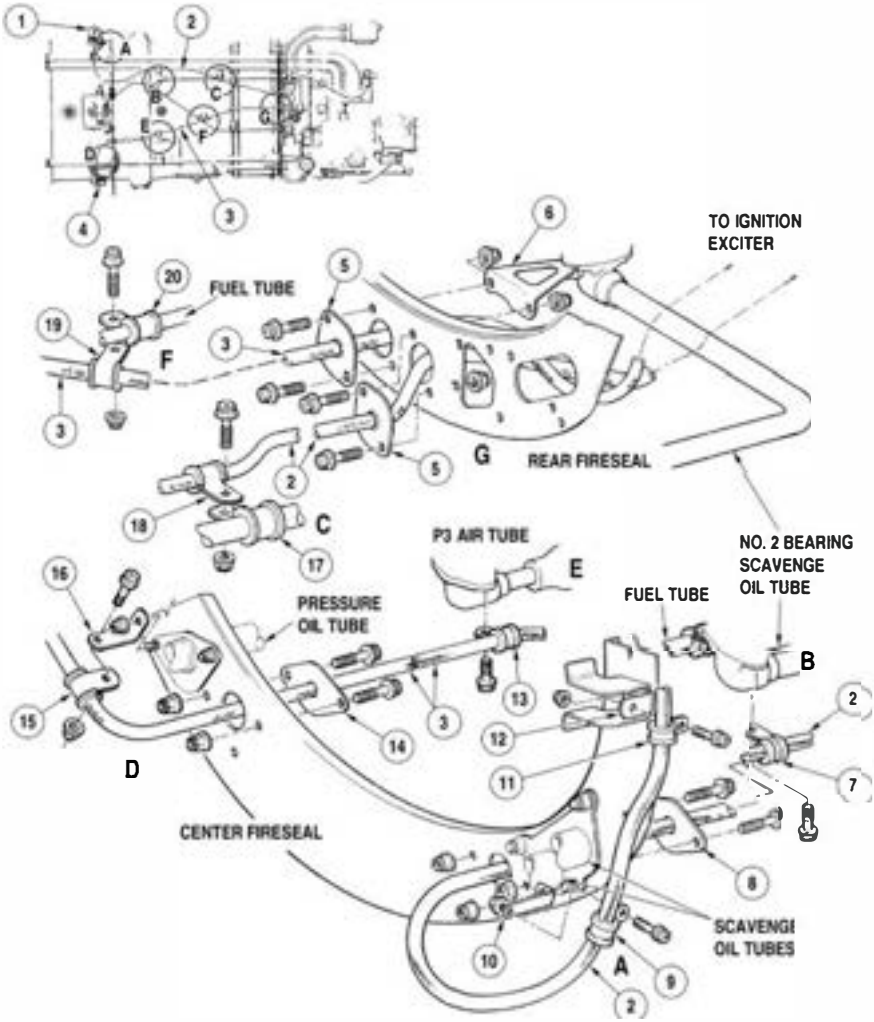


Figure 201 Removal/Installation of Ignition Exciter

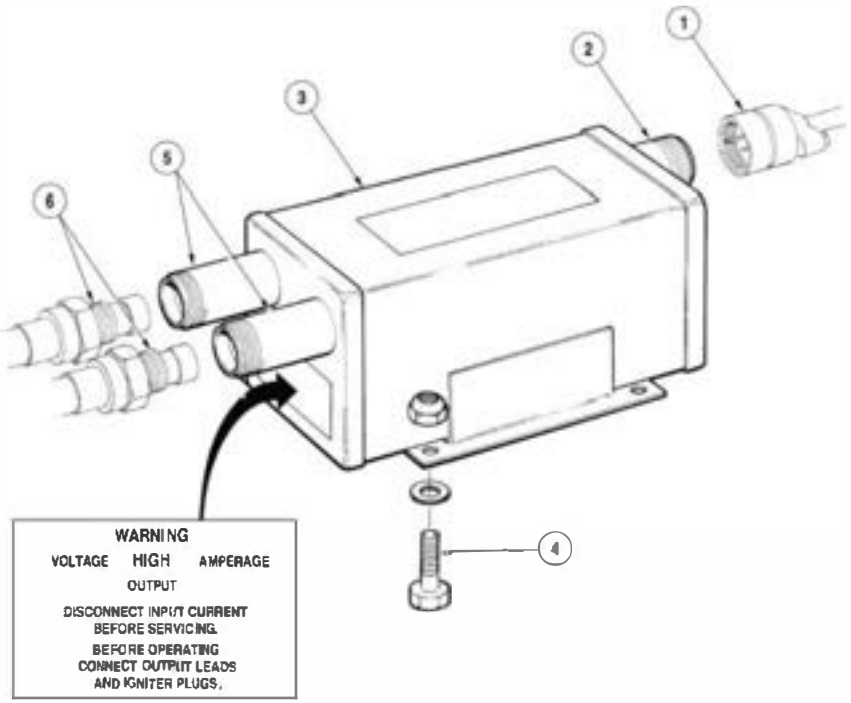


Figure 201 Removal/Installation of Oil Filter Element

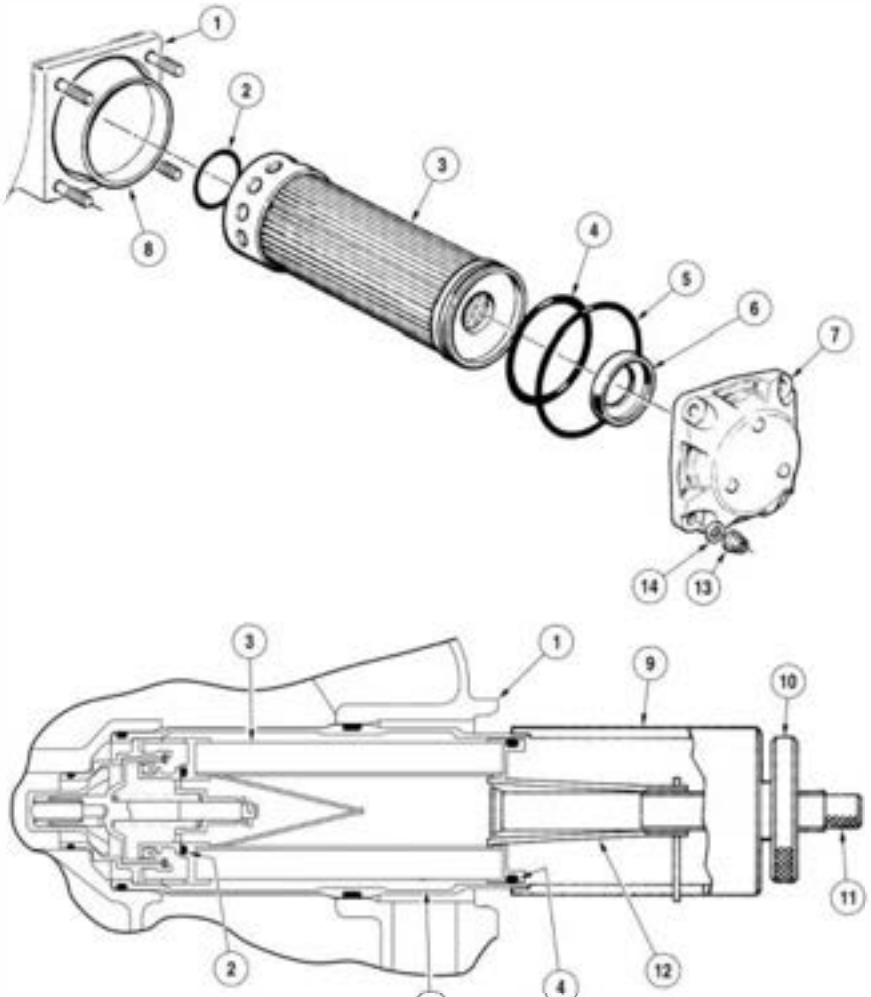


Figure 201 Removal/Installation of Oil-to-Fuel Heater

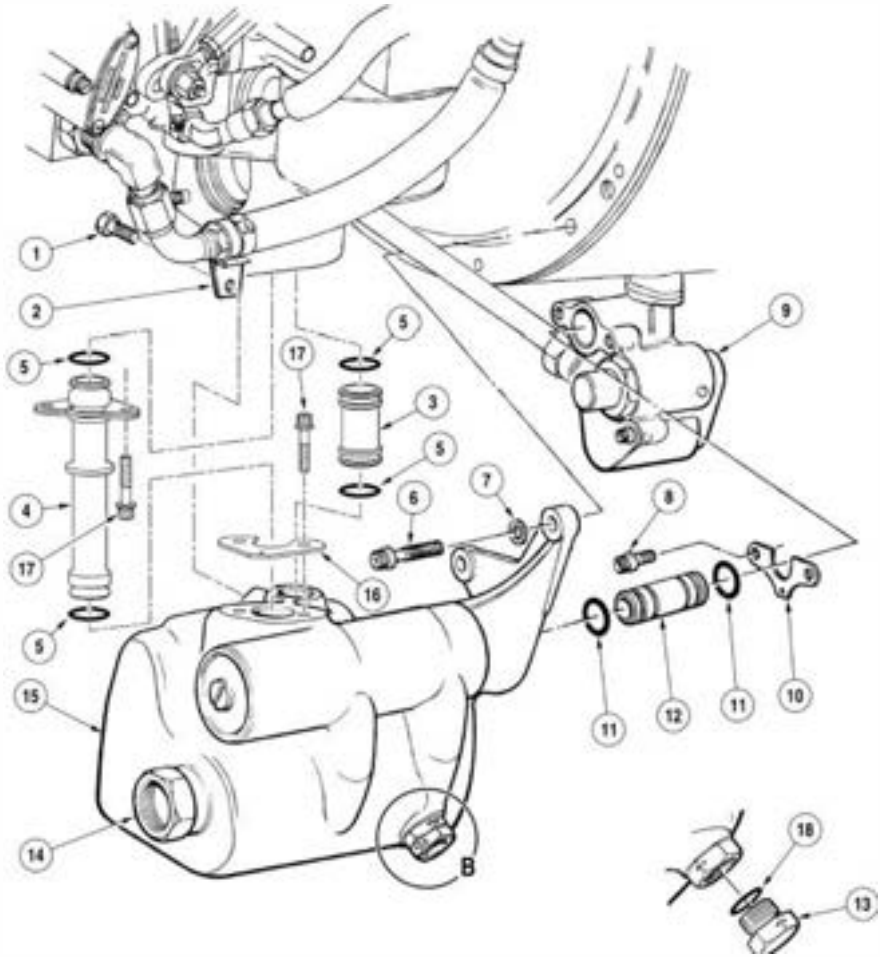


Figure 201 Removal/Installation of P2.5 and P3 Adapters

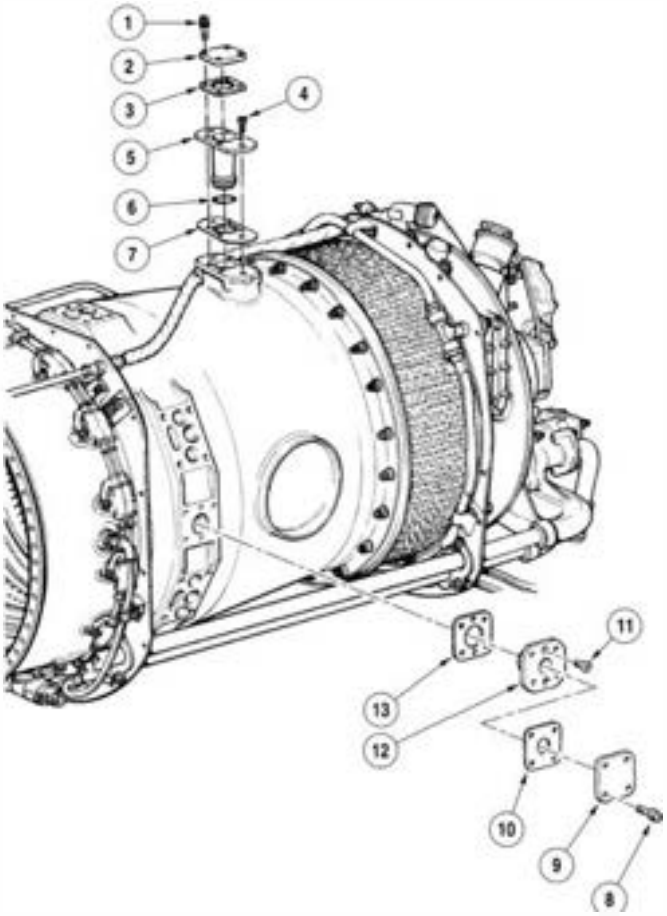


Figure 201 Removal/Installation of P3 Air Filter Element

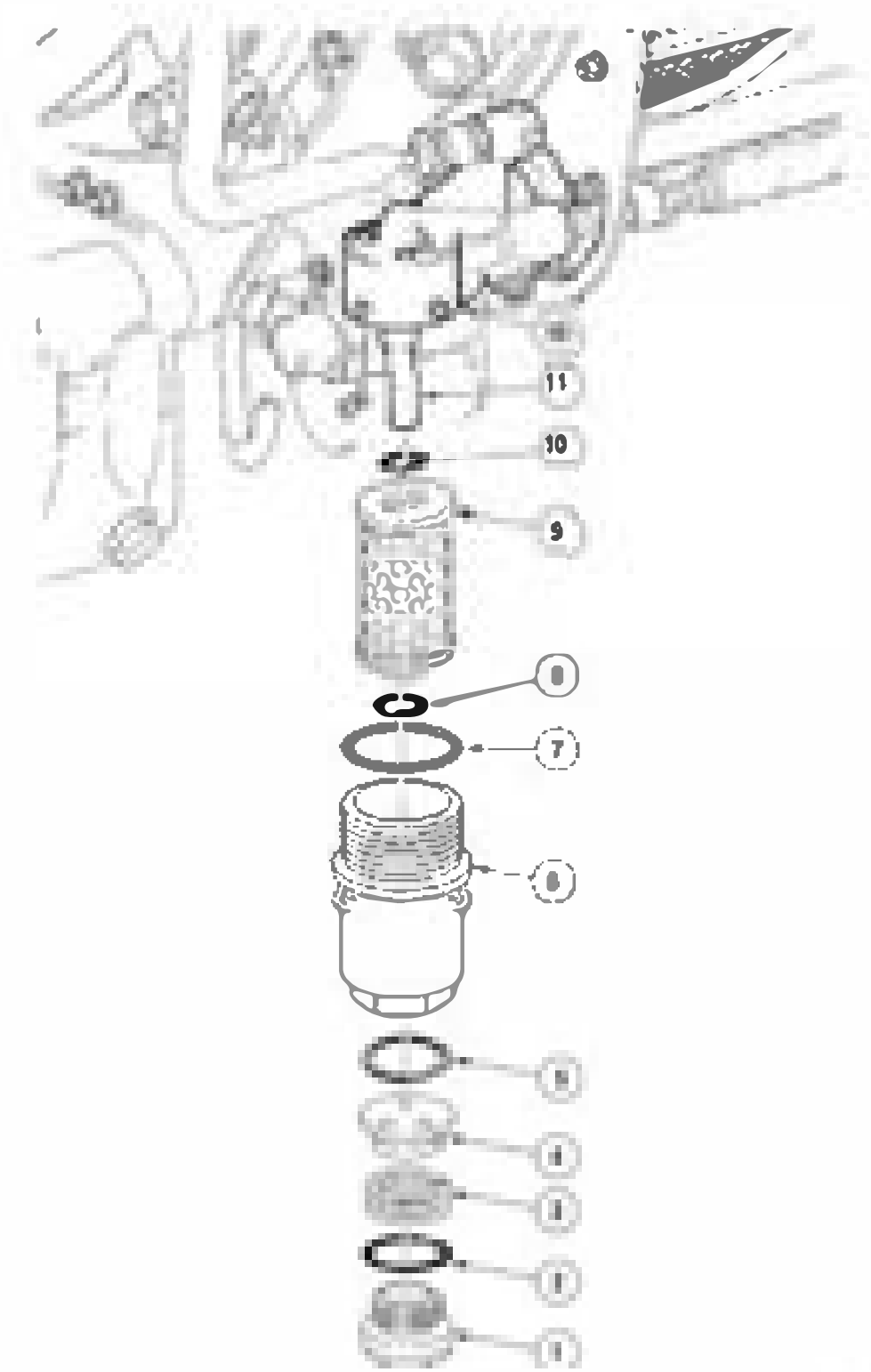


Figure 201 Removal/Installation of Power Turbine and Interstage Stator

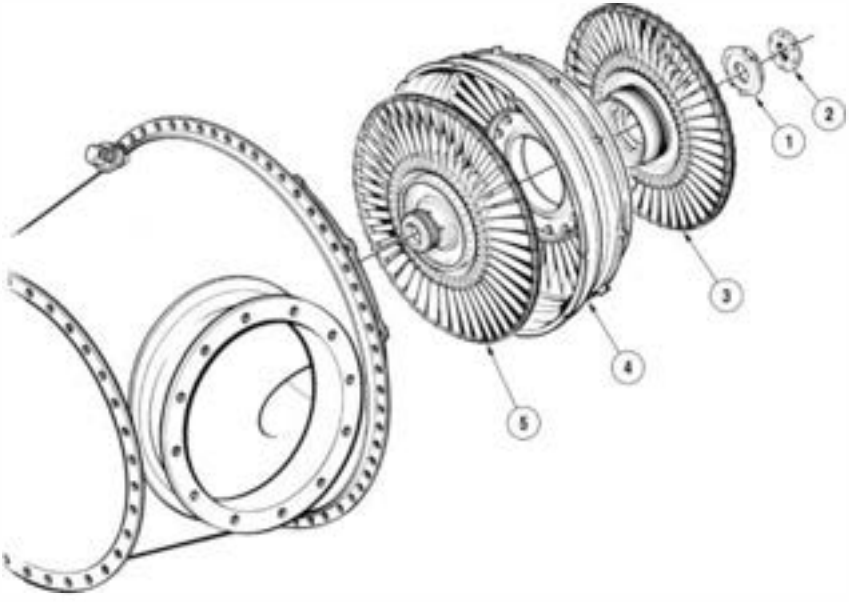


Figure 201 Removal/Installation of Power Turbine Stator

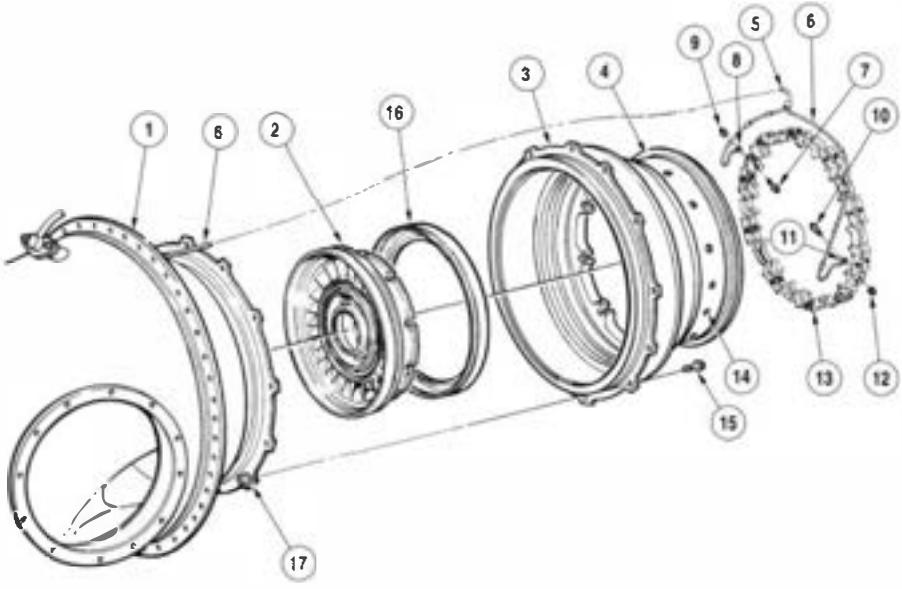


Figure 201 Removal/Installation of Propeller Reversing Linkage - Rear

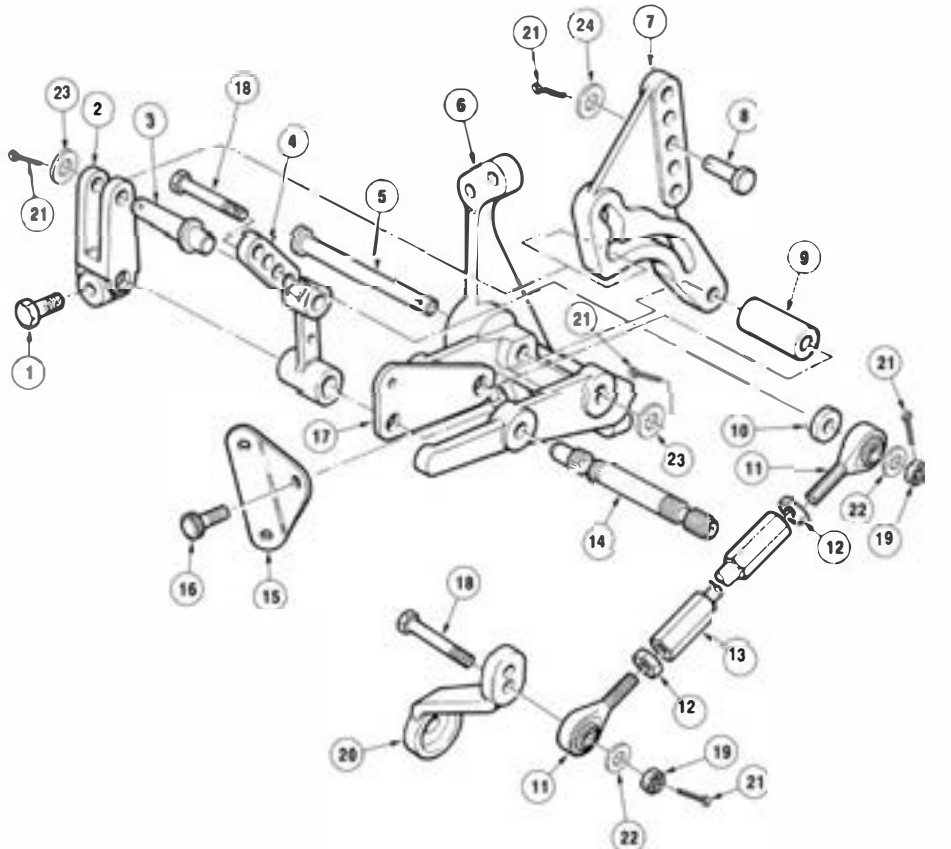
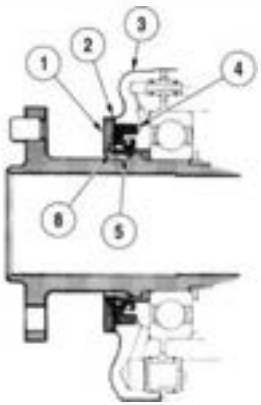
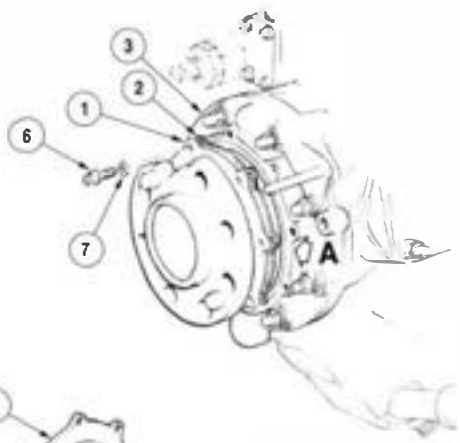
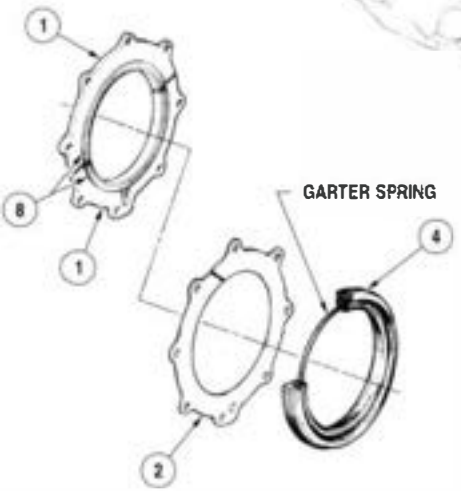


Figure 201 Removal/Installation of Propeller Shaft Oil Seal







VIEW A

Figure 201 Removal/Installation of Thermostatic Bypass and Check Valve

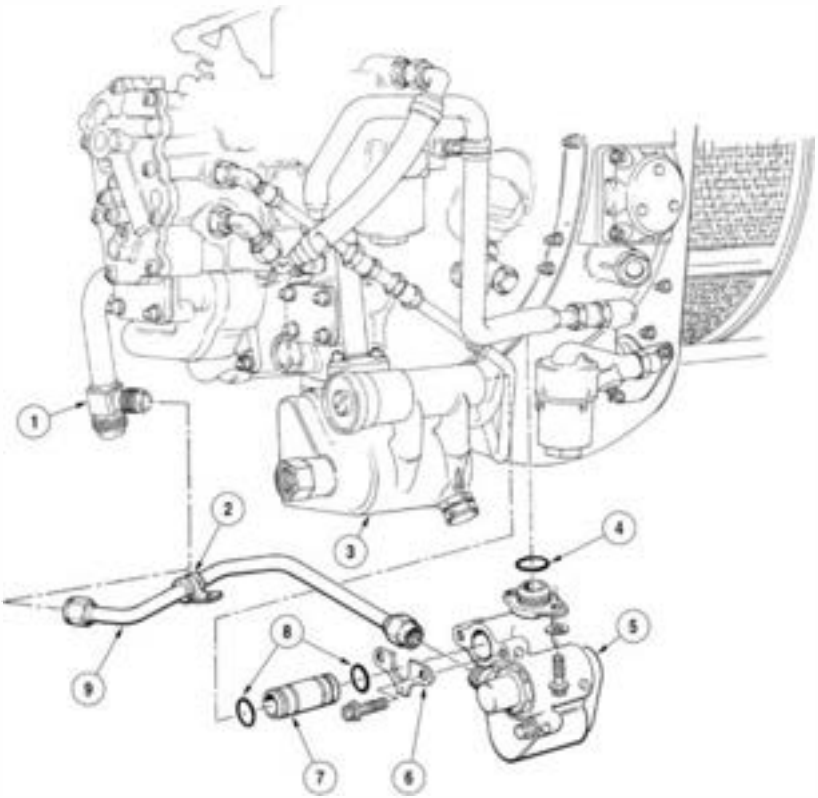


Figure 201 Removal/Installation of Trim Thermocouple and Terminal Block

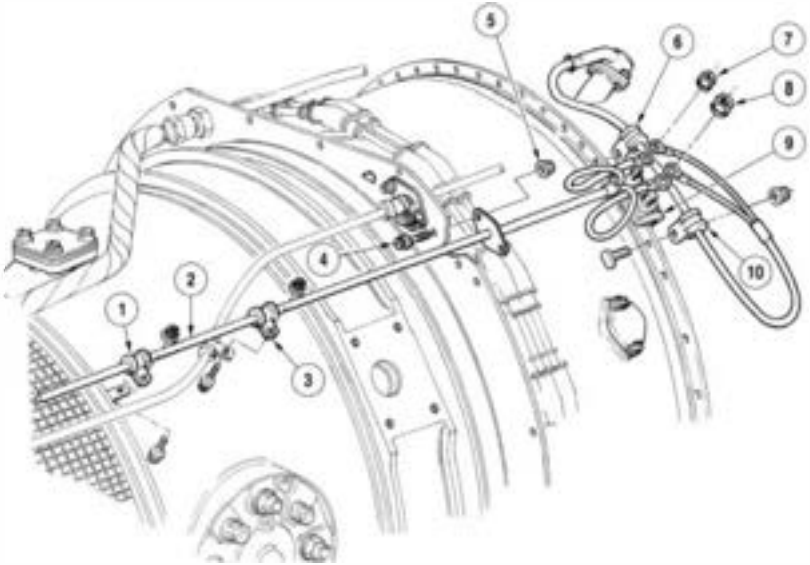


Figure 201 Replacement of Fuel Pump Filters

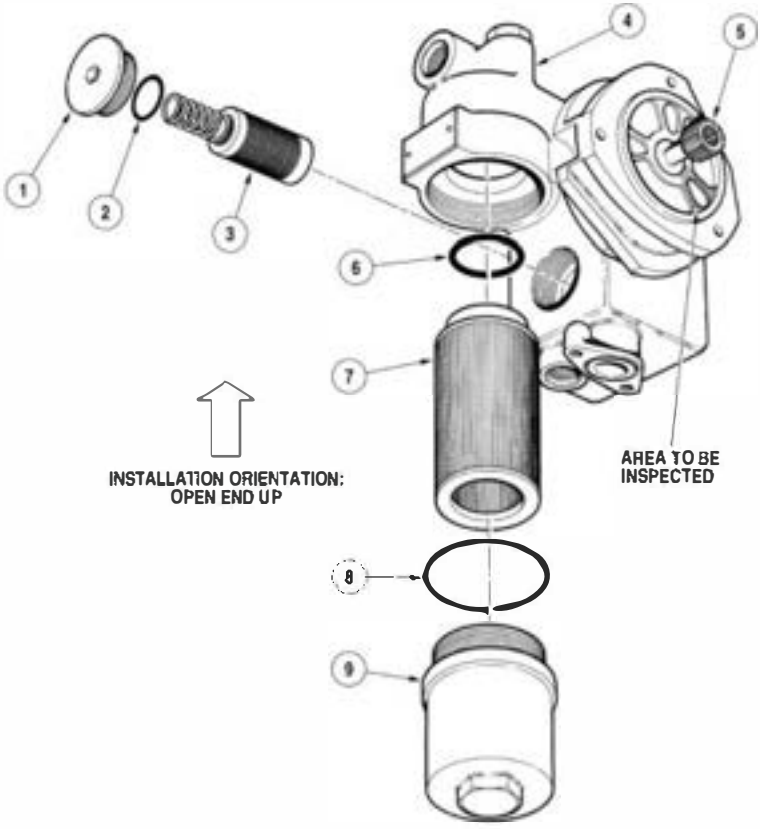


Figure 201 Torque Limiter

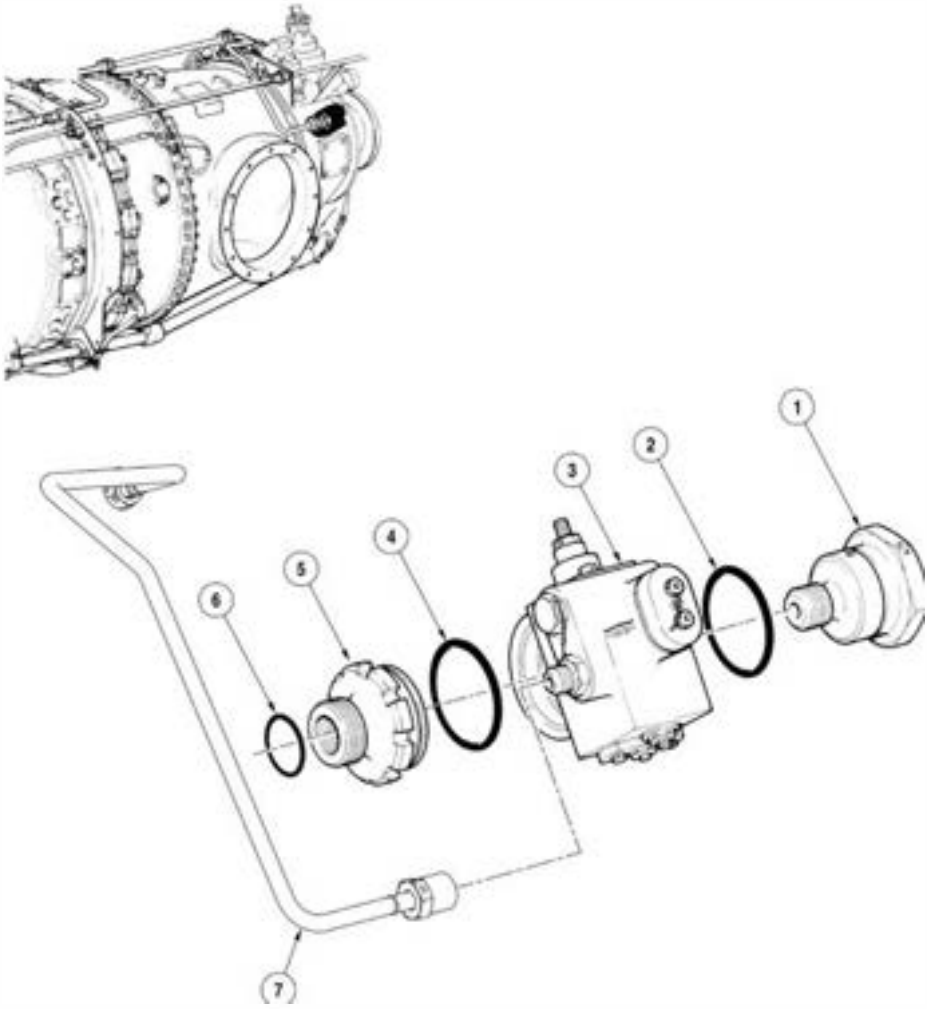


Figure 201 Installation of Typical Elbow Fitting

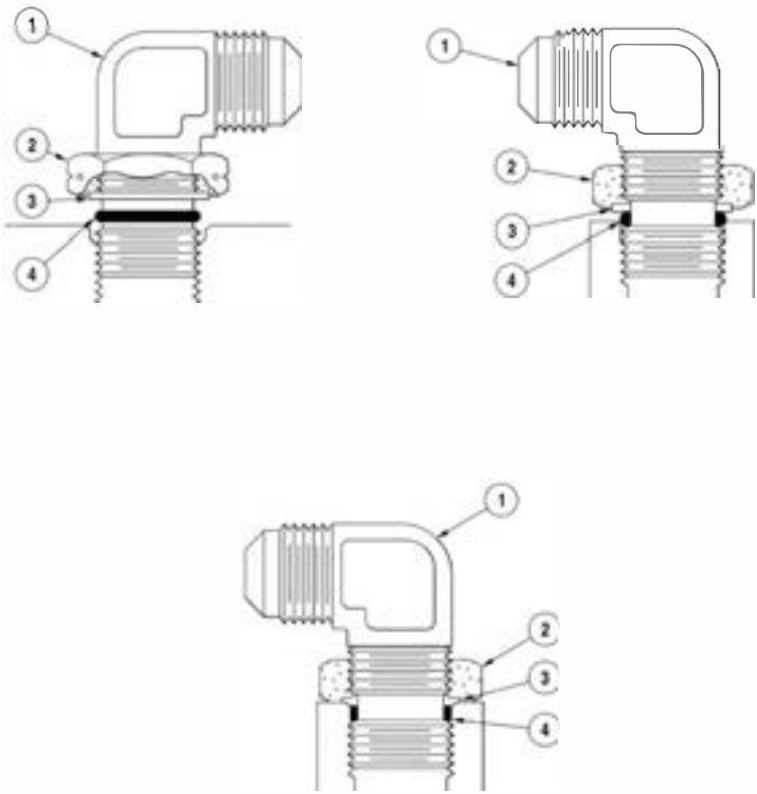
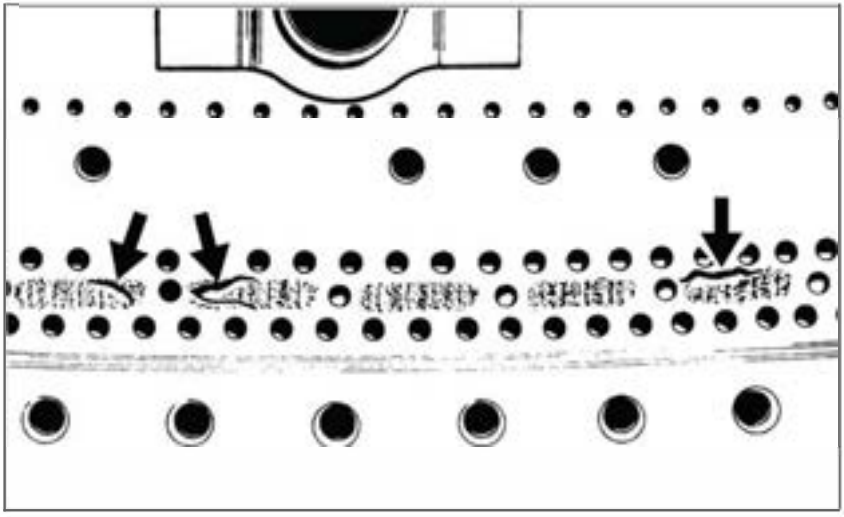


Figure 202 Acceptable Cracks in Louvered Cooling Ring Seam Weld



CRACKS OF THIS NATURE ARE ACCEPTABLE, PROVIDED THEY DO NOT EXCEED 0.300 INCH IN LENGTH AND ARE STOP-DRILLED USING 1/16 DRILL.

Figure 202 Center Fireseal Mount Ring - Insulating Strip Replacement

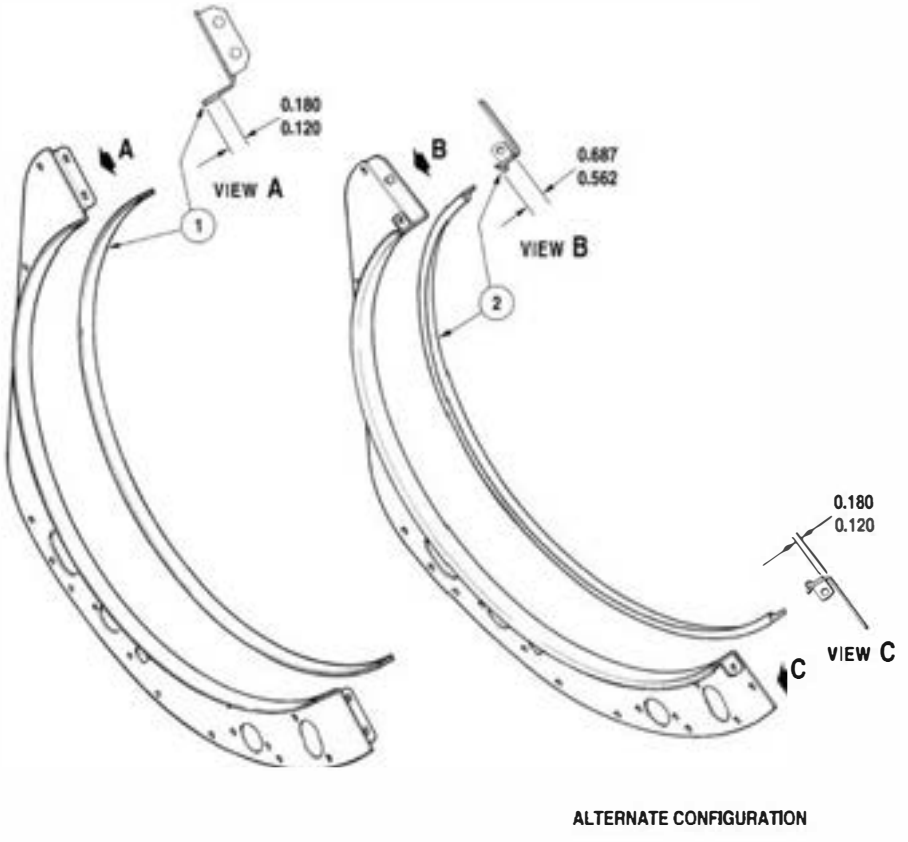


Figure 202 Compressor Turbine Stator Inspection (Typical)

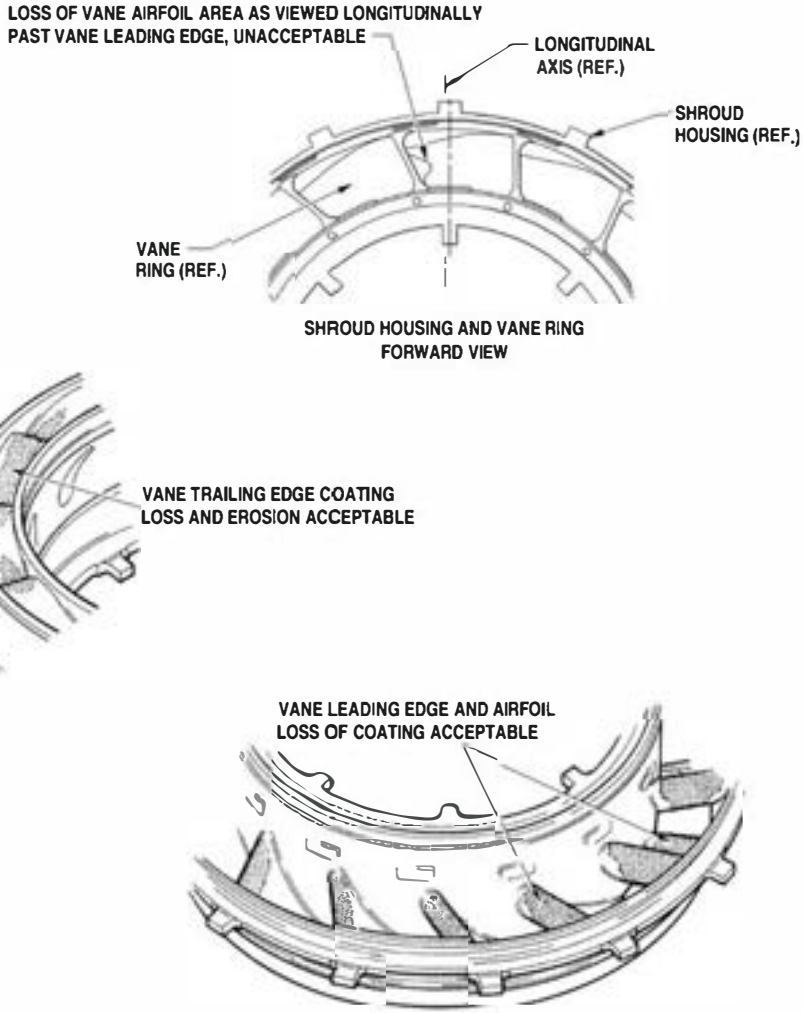


Figure 202 Example of Damage Removal (sheet 2 of 3)

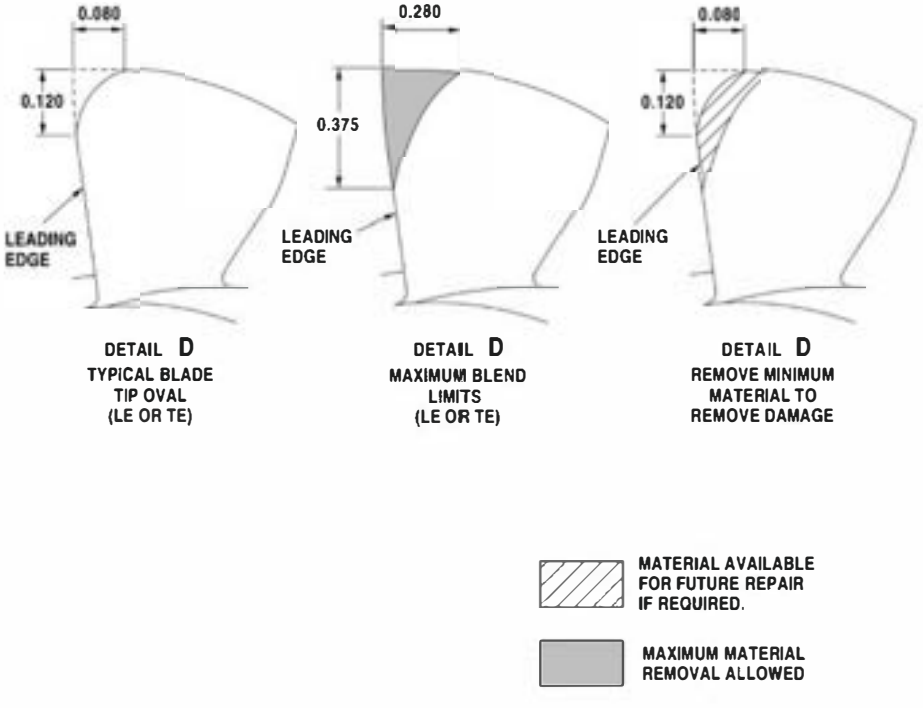


Figure 202 Example of Damage Removal (sheet 3 of 3)

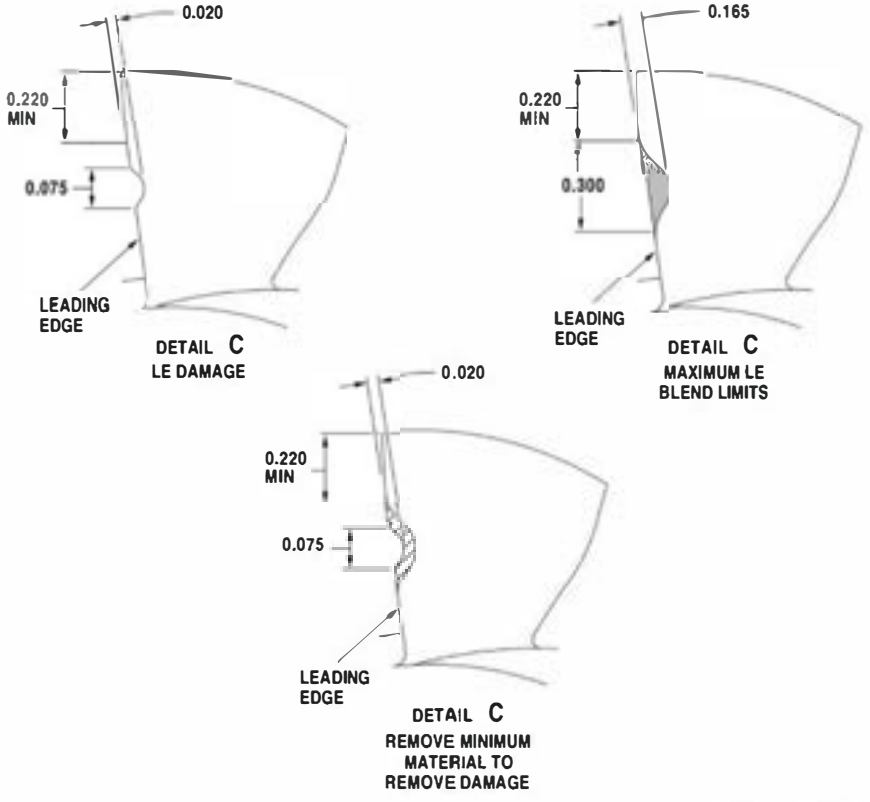


Figure 202 Example of Damage Removal (sheet 1 of 3)

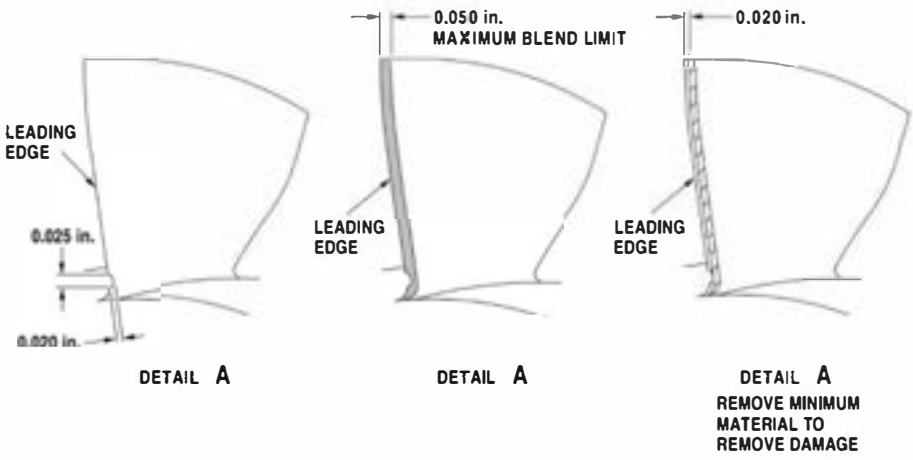


Figure 202 Inspection and Identification of Compressor Bleed Valve Classified Seat

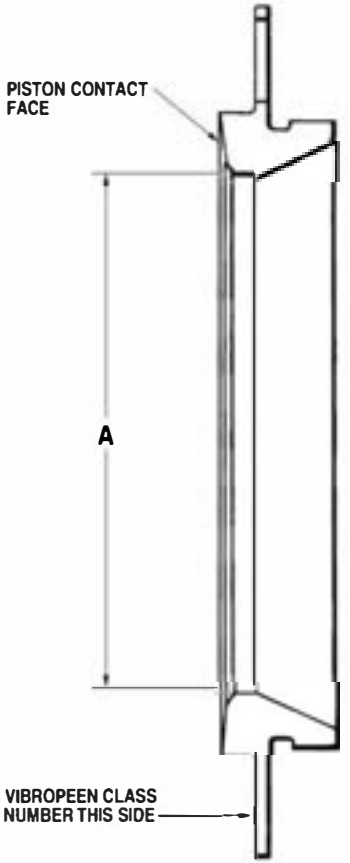


Figure 202 Inspection of Fuel Nozzle Concentricity

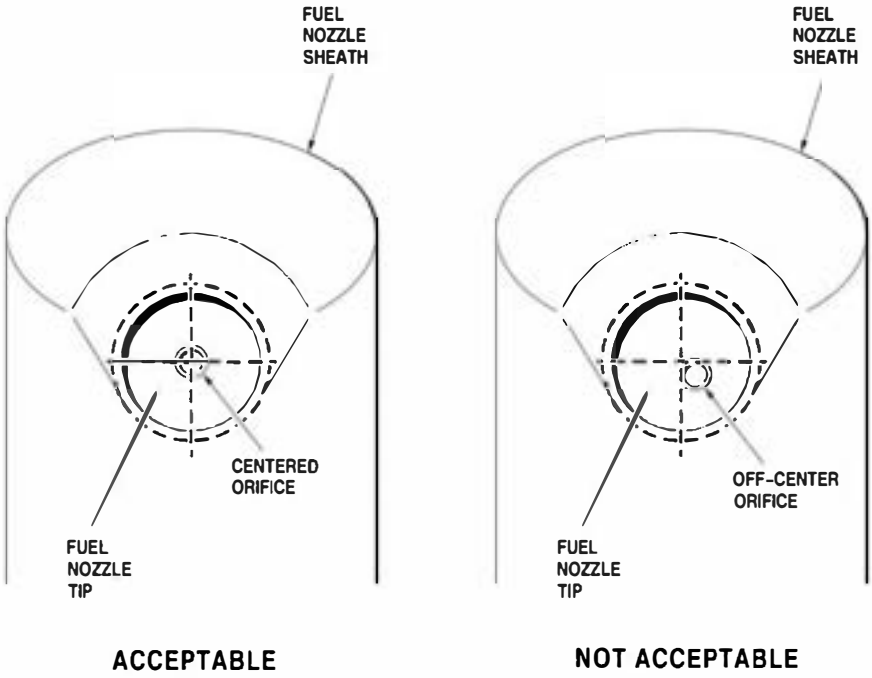


Figure 202 Metal Buildup on CT Shroud Segments (Typical)

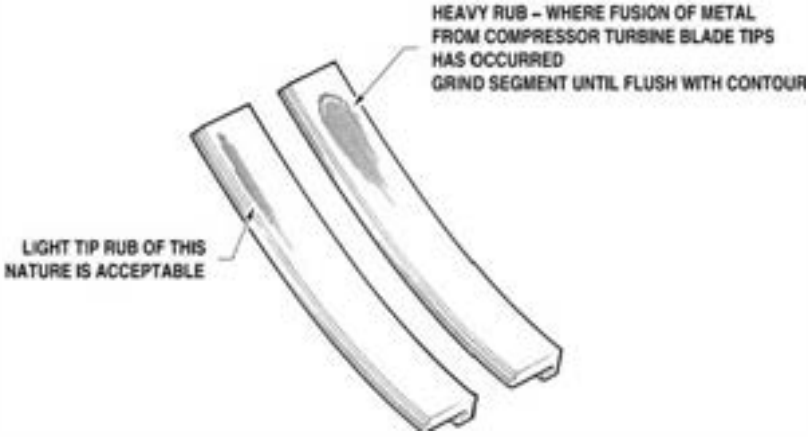


Figure 202 Rear Fireseal Mount RIng - Removal/Installation

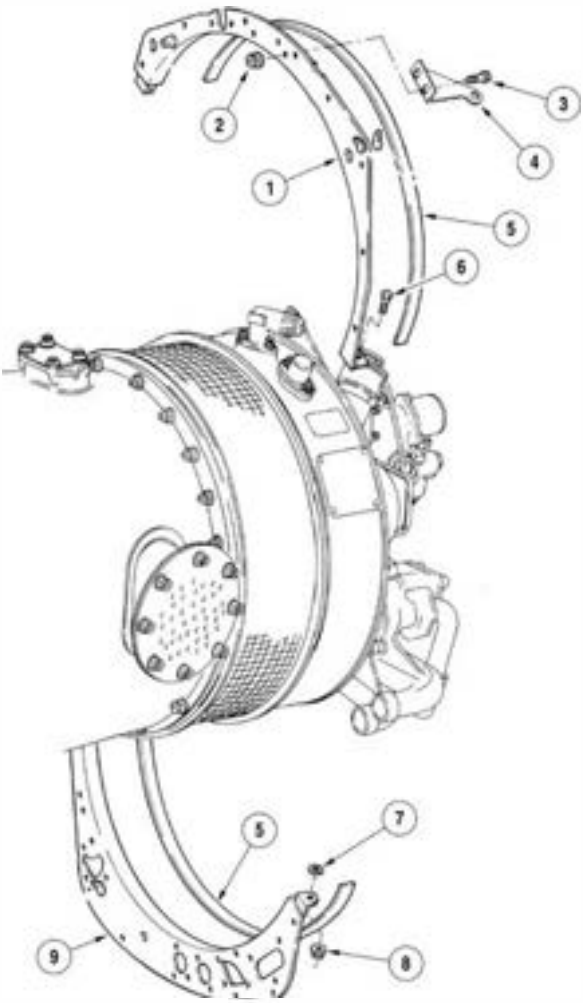


Figure 202 Removal of Power Turbine Stator Housing

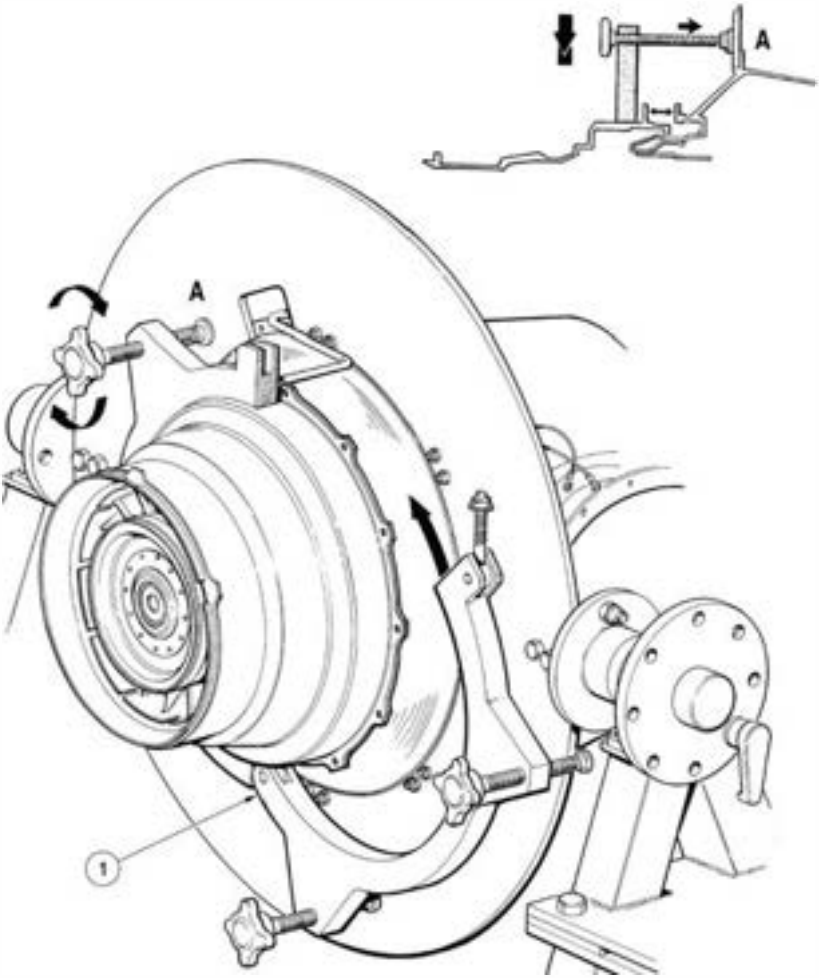
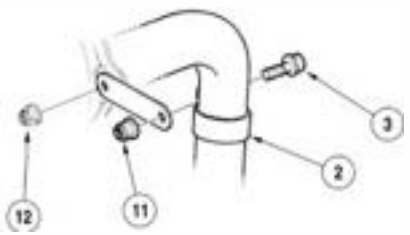


Figure 202 Removal/Installation of Compressor Delivery Air Lines



DETAIL A

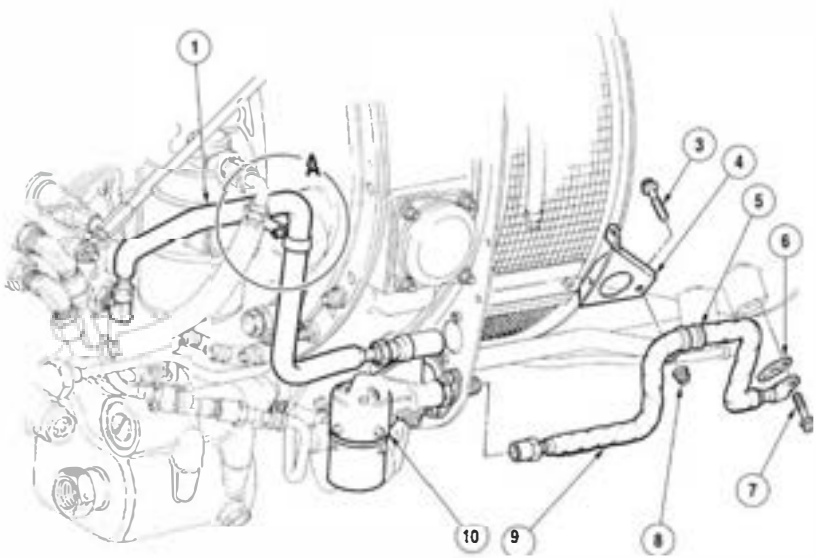


Figure 202 Removal/Installation of External Scavenge Pump

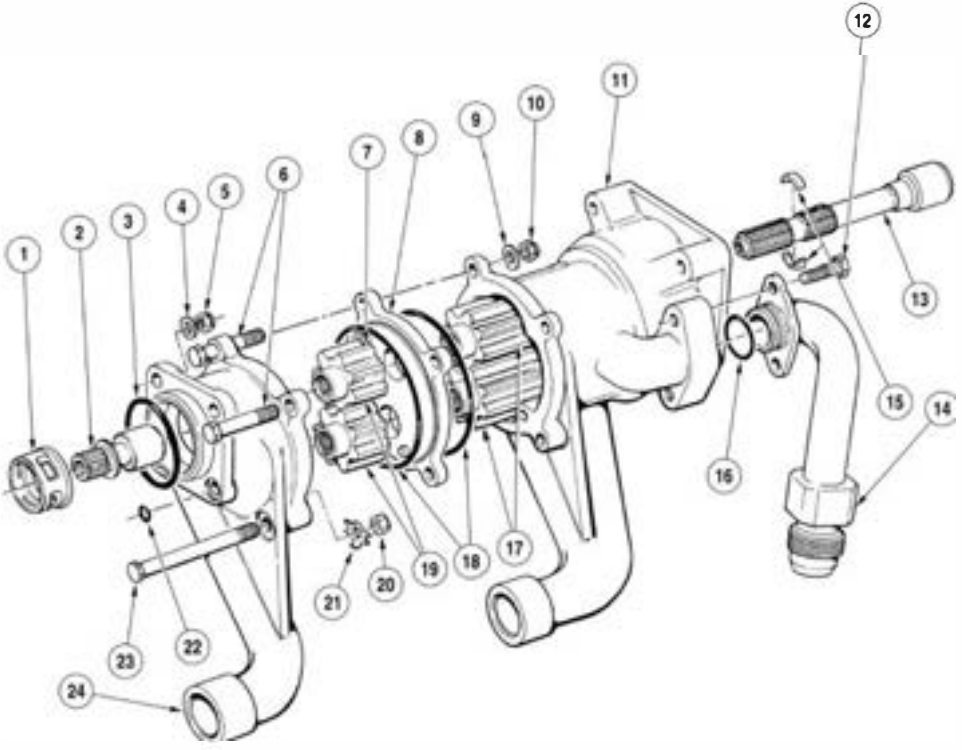


Figure 202 Removal/Installation of Fuel Pump

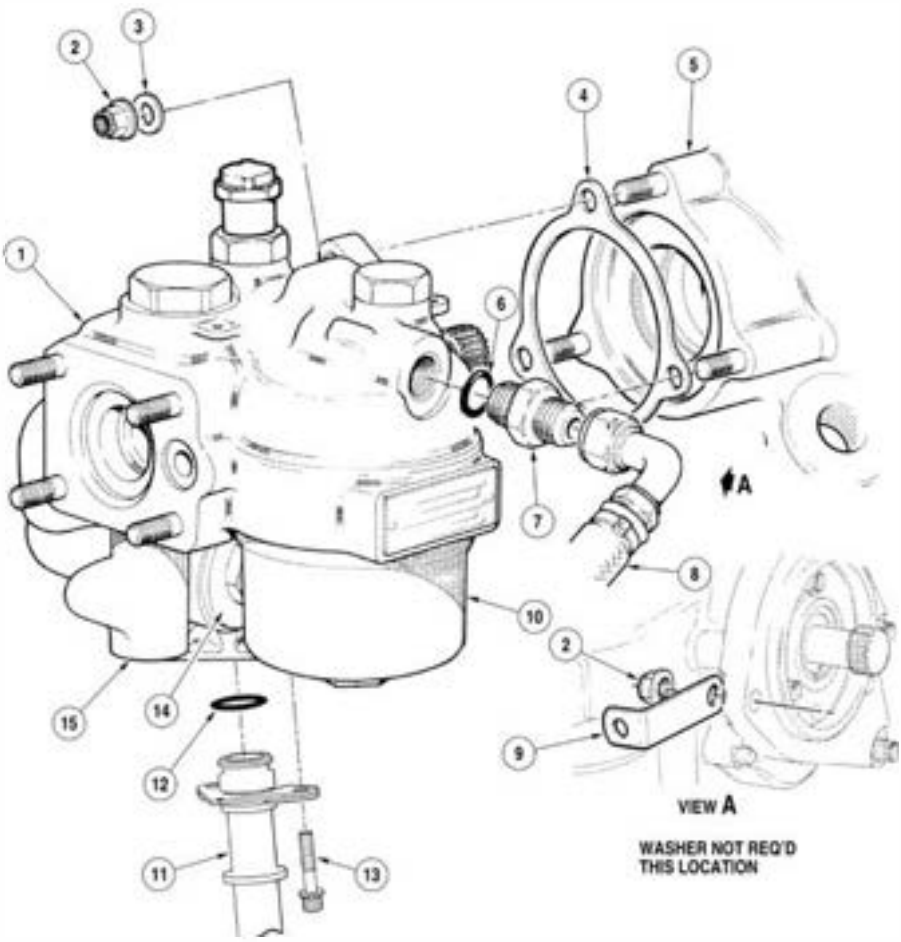


Figure 202 Removal/Installation of Oil Filter Housing

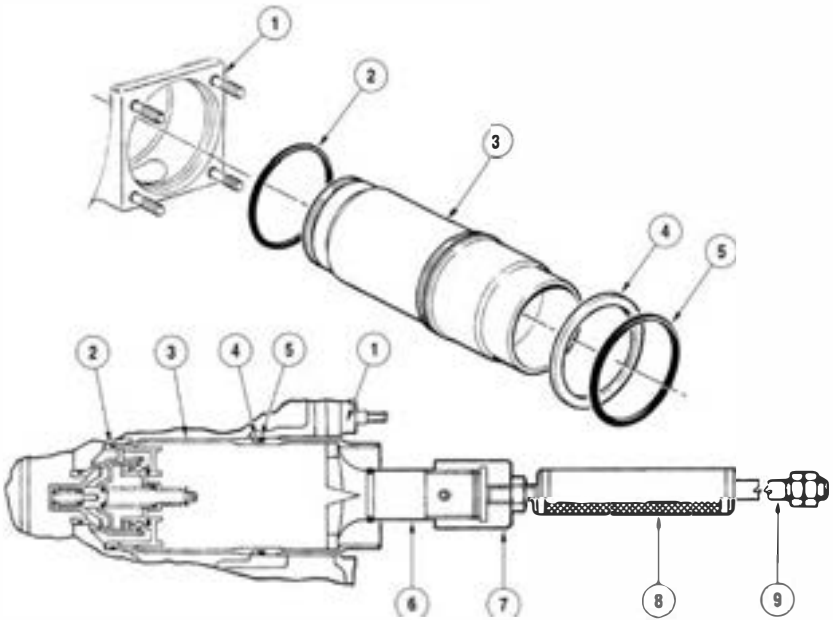


Figure 202 Removal/Installation of Oil Level Sight Gage

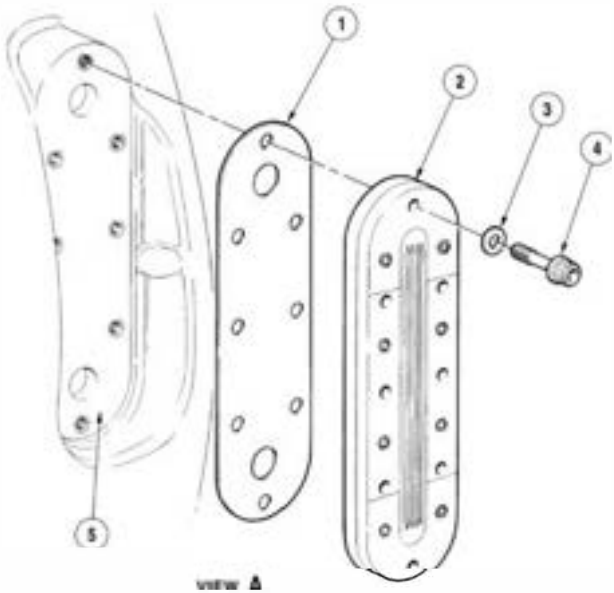


Figure 202 Removal/Installation of Power Turbine Nut

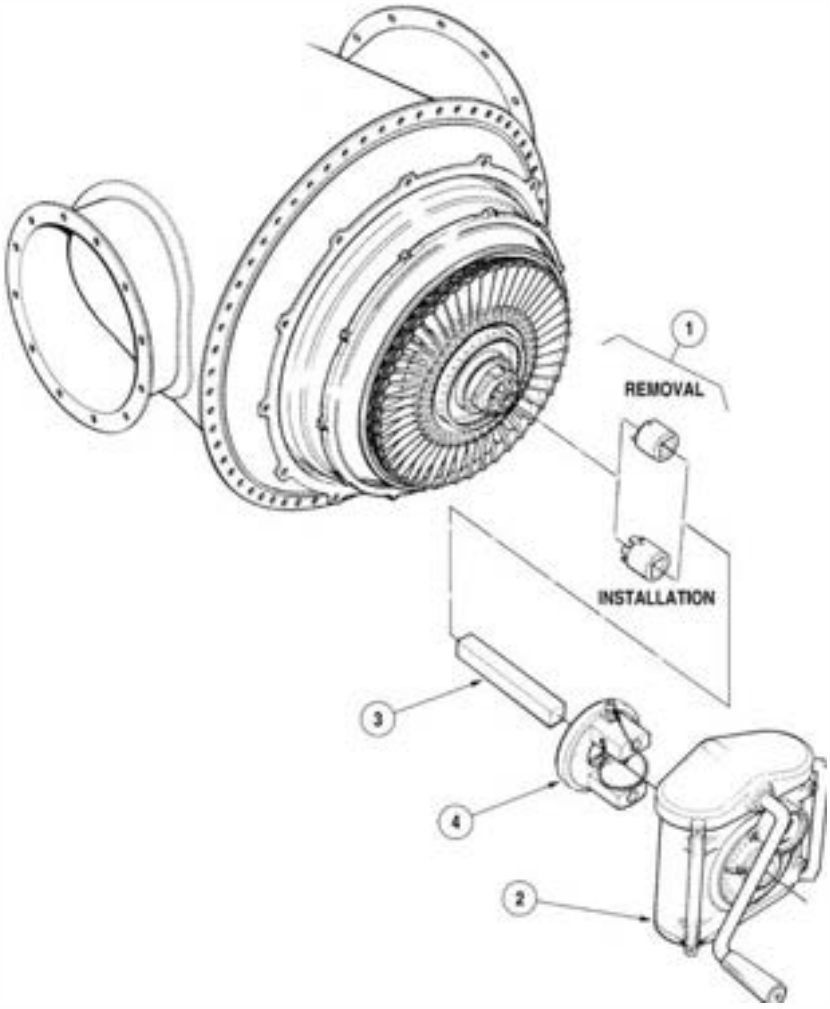


Figure 202 Removal/Installation of Propeller Reversing Linkage - Front (sheet 2 of 2)

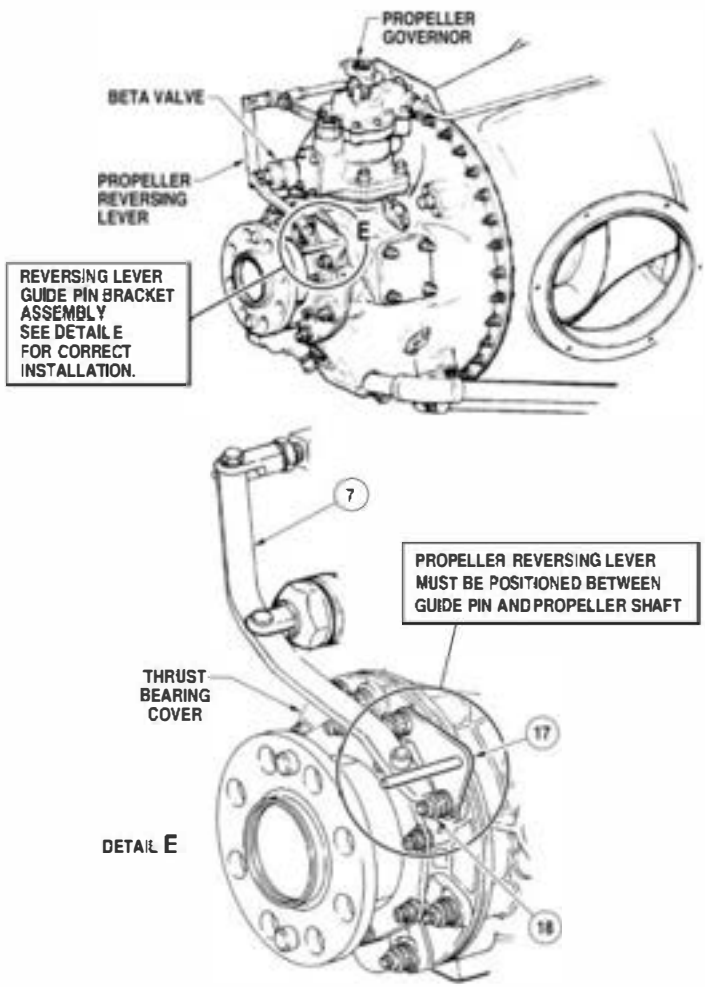


Figure 202 Removal/Installation of Propeller Reversing Linkage - Front (sheet 1 of 2)

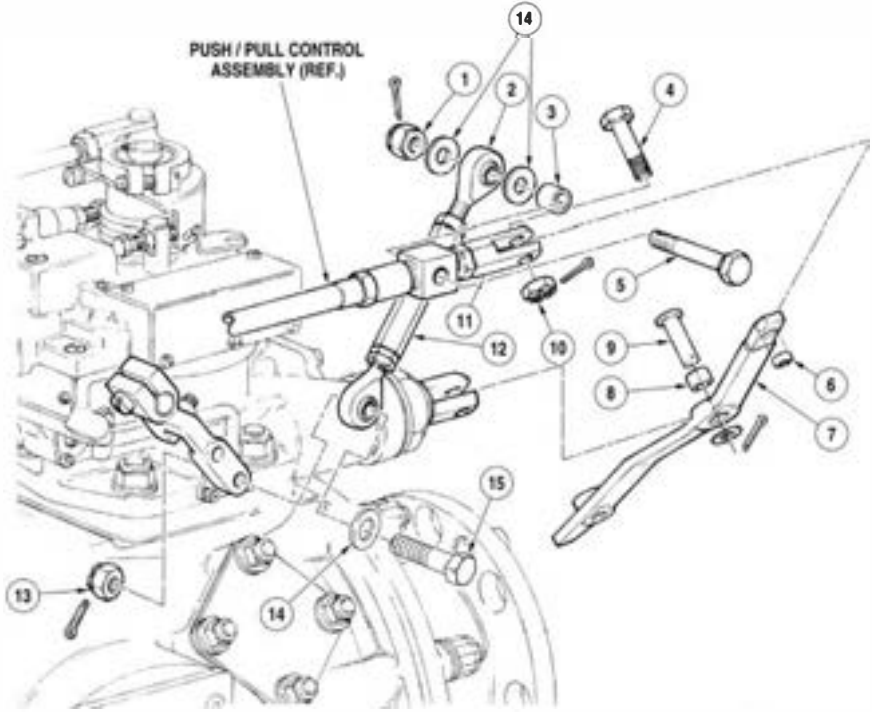
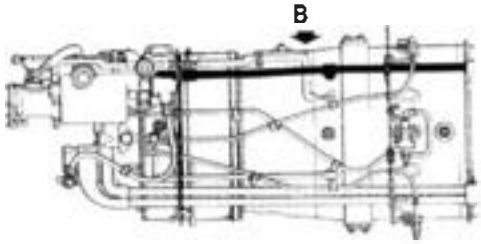


Figure 202 Removal/Installation of Rear Pressure Oil Tubes



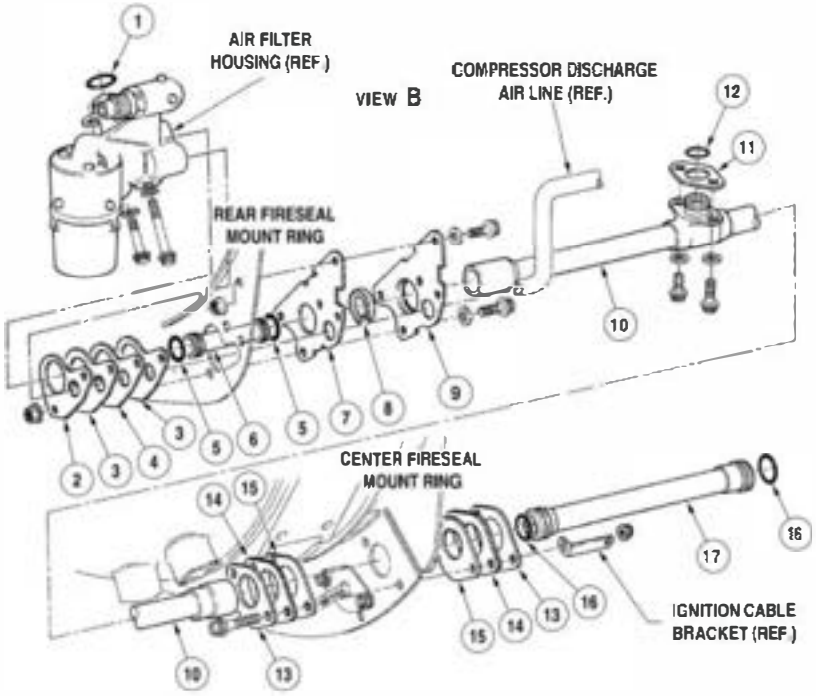


Figure 202 Removal/Installation of Scavenge Oil Strainer Assembly and Magnetic Chip Detector

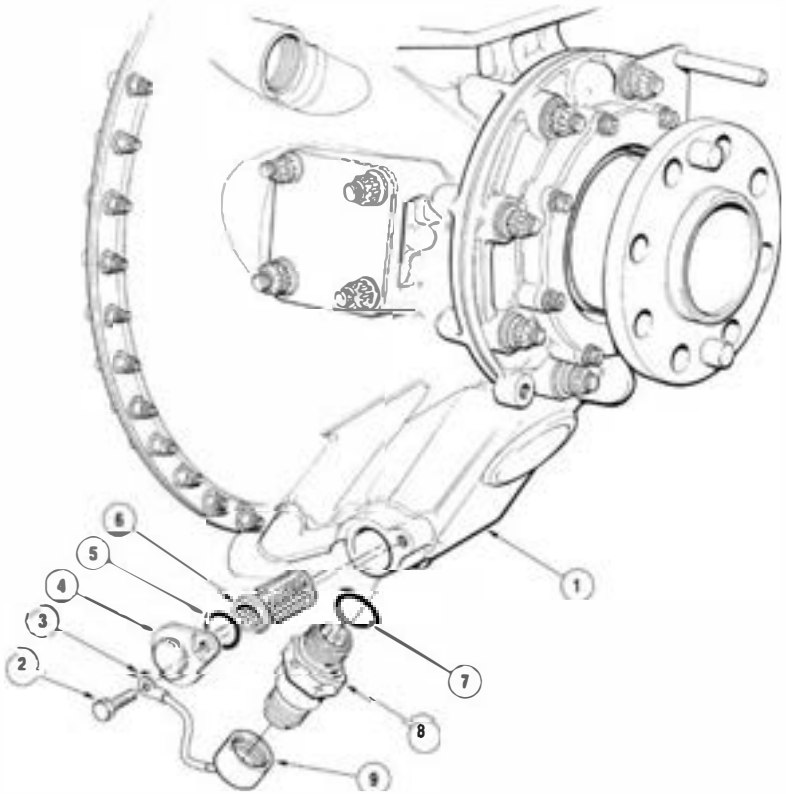
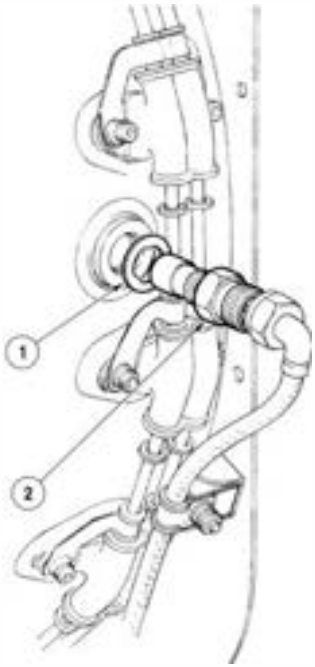


Figure 202 Removal/Installation of Spark Igniters



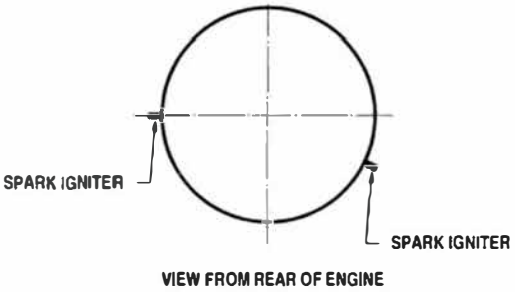
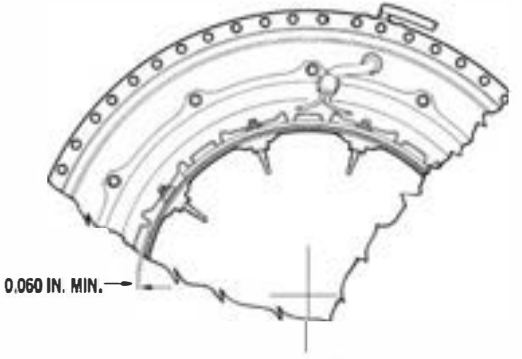
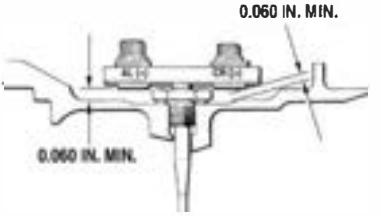


Figure 202 Removal/Installation of Temperature Indicating Components (sheet 2 of 2)



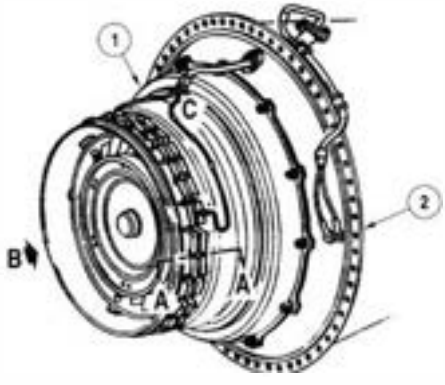
VIEW B

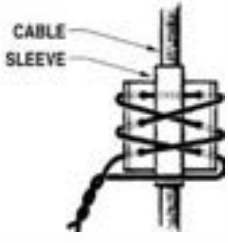
CHECK MINIMUM CLEARANCE AS SHOWN (40 PLACES)



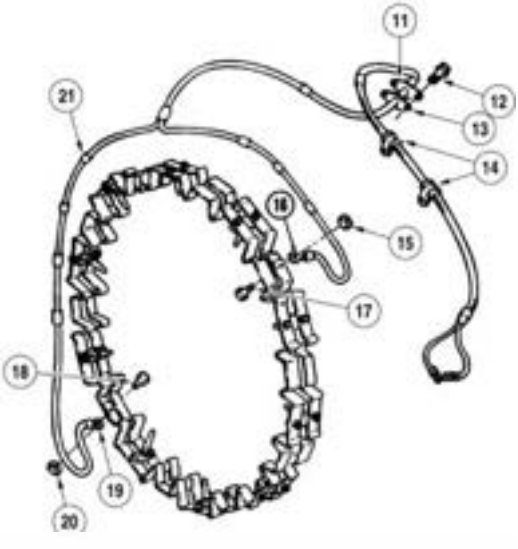
SECTION A-A

Figure 202 Removal/Installation of Temperature Indicating Components (sheet 1 of 2)





CORRECT LACING OF HARNESS TO CLIP
DETAIL C



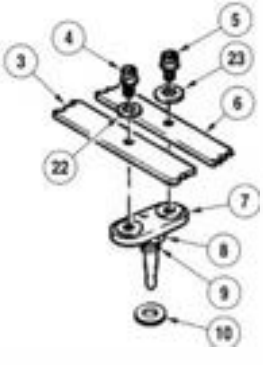


Figure 202 Repair of Gas Generator Case

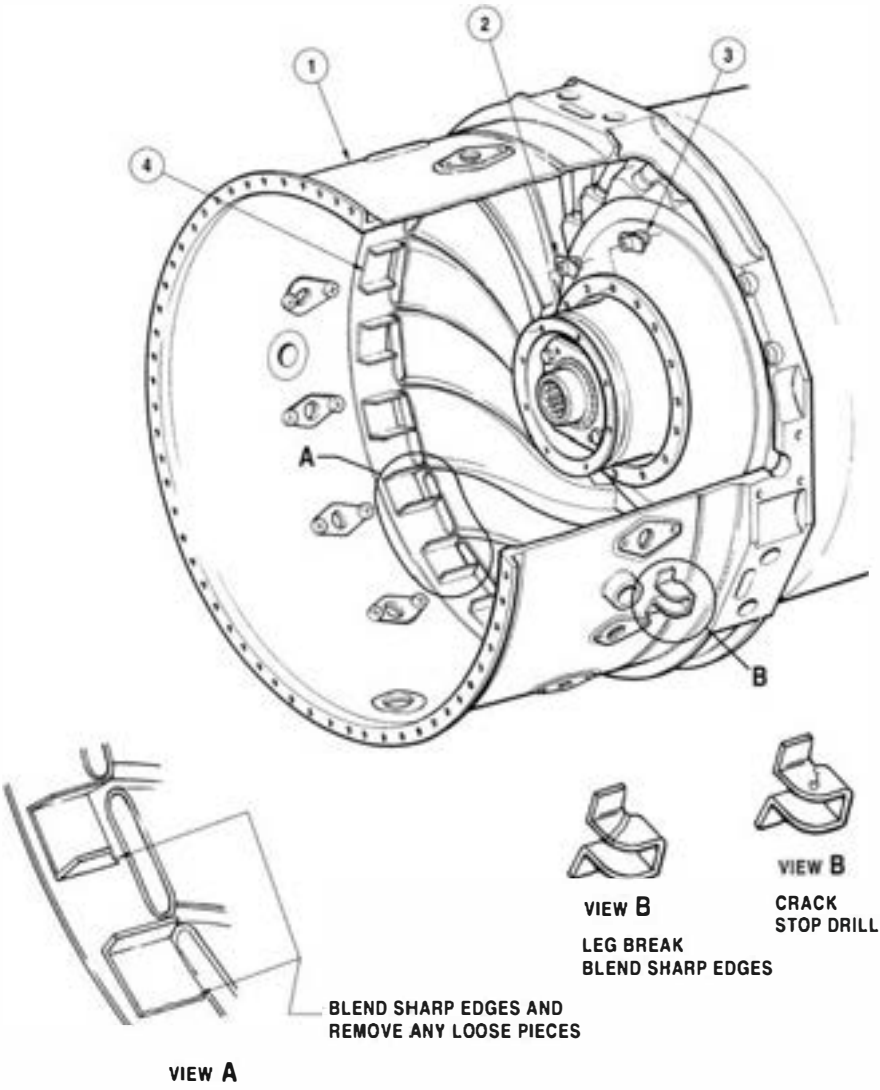


Figure 202 Thermostatic Bypass and Check Valve - Replacement and Repair

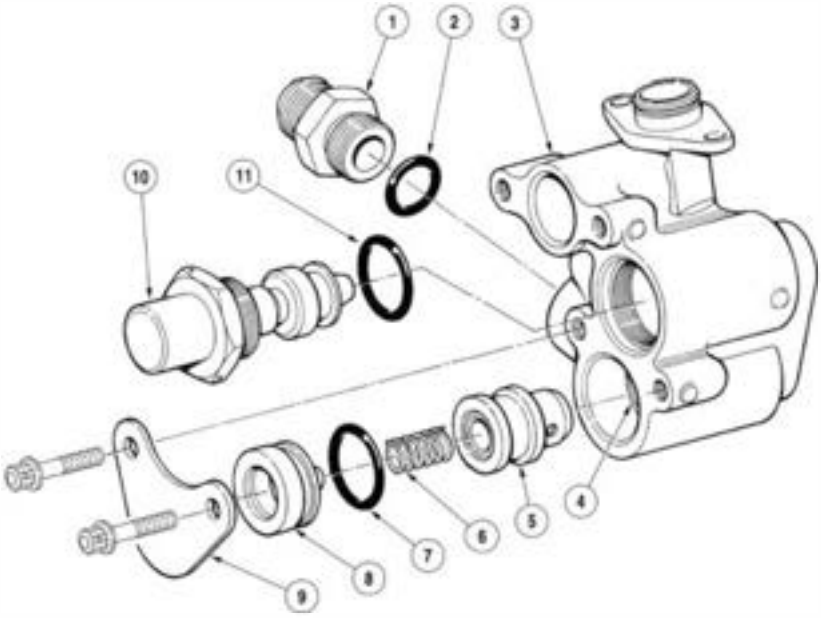


Figure 202 Six-point Crowfoot Adapter

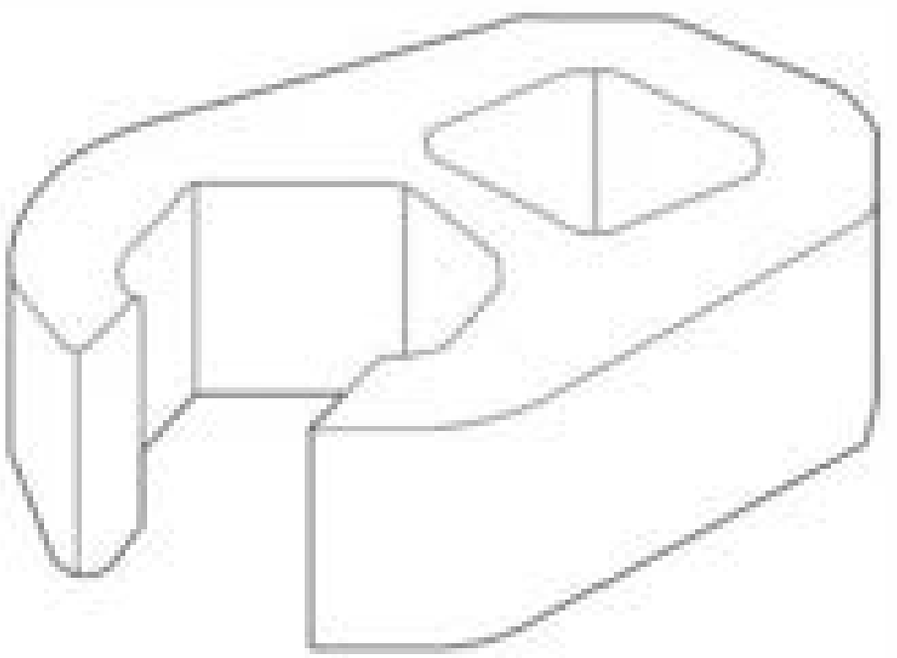
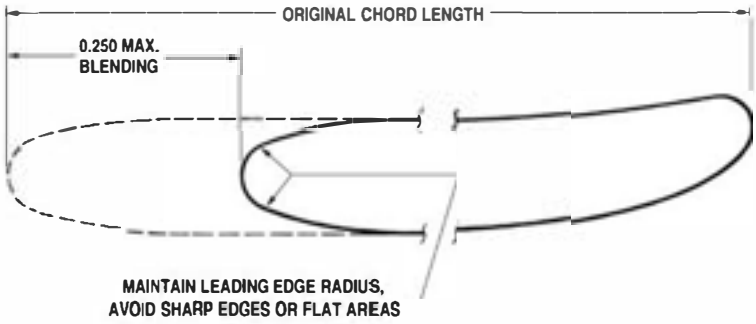
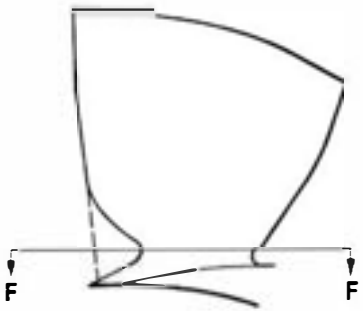


Figure 203 Compressor First-Stage Blades Repair Limits (sheet 2 of 2)



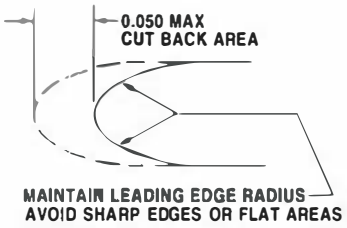
ENLARGED SECTION F–F

NOTE: THE MAXIMUM PERMITTED MATERIAL REMOVAL IS SHOWN. ONLY REMOVE THE MINIMUM MATERIAL NECESSARY TO BLEND OUT DAMAGE.

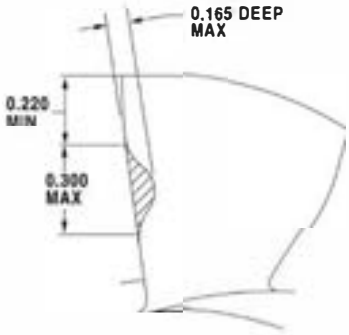


DETAIL E

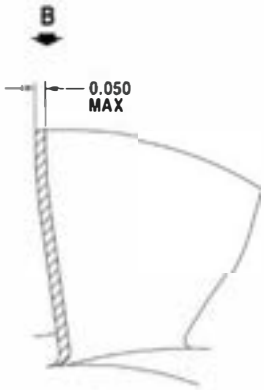
Figure 203 Compressor First-Stage Blades Repair Limits (sheet 1 of 2)



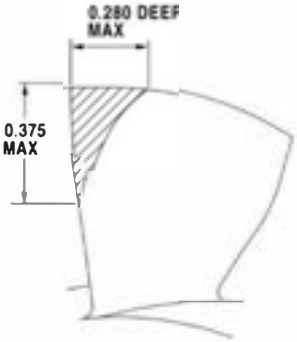
ENLARGED VIEW B



DETAIL C



DETAIL A



DETAIL D

NOTE: THE MAXIMUM PERMITTED MATERIAL REMOVAL IS SHOWN. ONLY REMOVE THE MINIMUM MATERIAL NECESSARY TO BLEND OUT DAMAGE.

Figure 203 Cleaning of P3 Air Filter Element

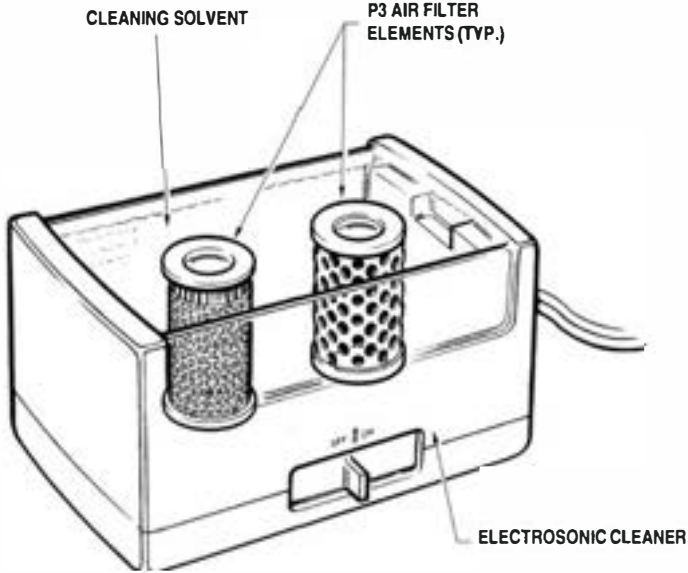
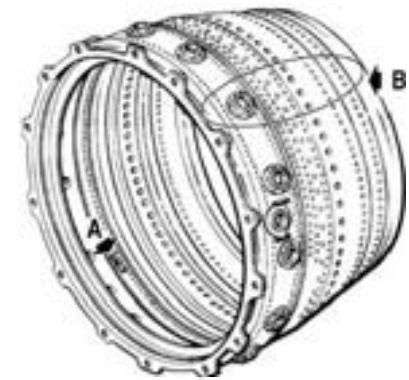
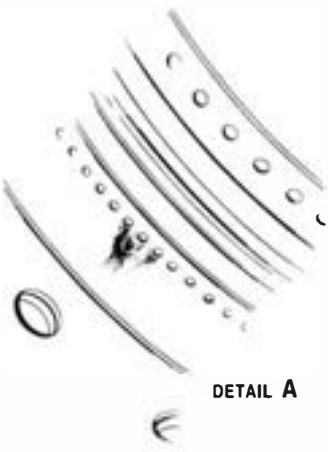


Figure 203 Combustion Chamber Outer Liner (sheet 2 of 4)





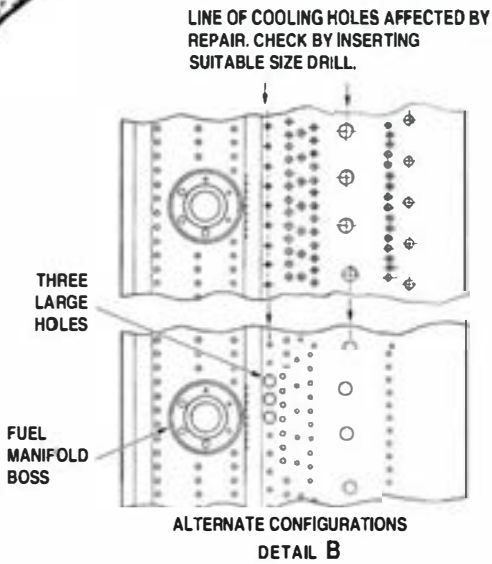
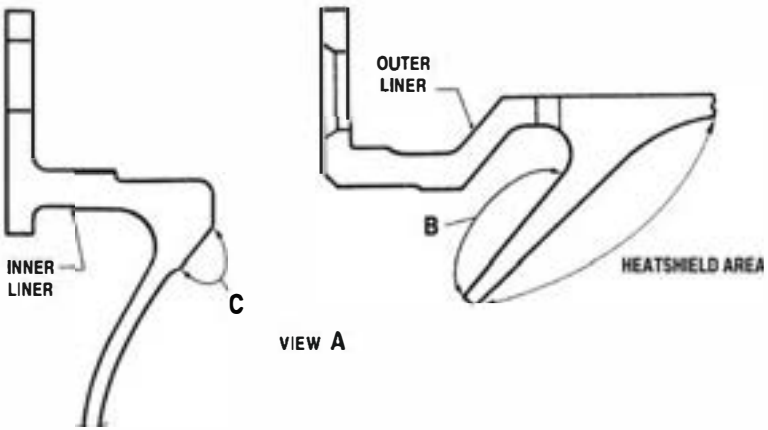


Figure 203 Combustion Chamber Outer Liner
(sheet 3 of 4)



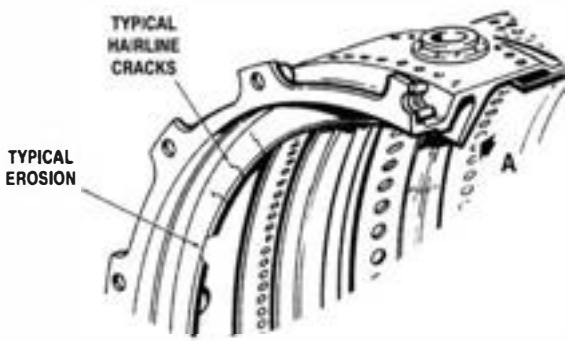


Figure 203 Combustion Chamber Outer Liner
(sheet 4 of 4)

Figure 203 Combustion Chamber Outer Liner (sheet 1 of 4)

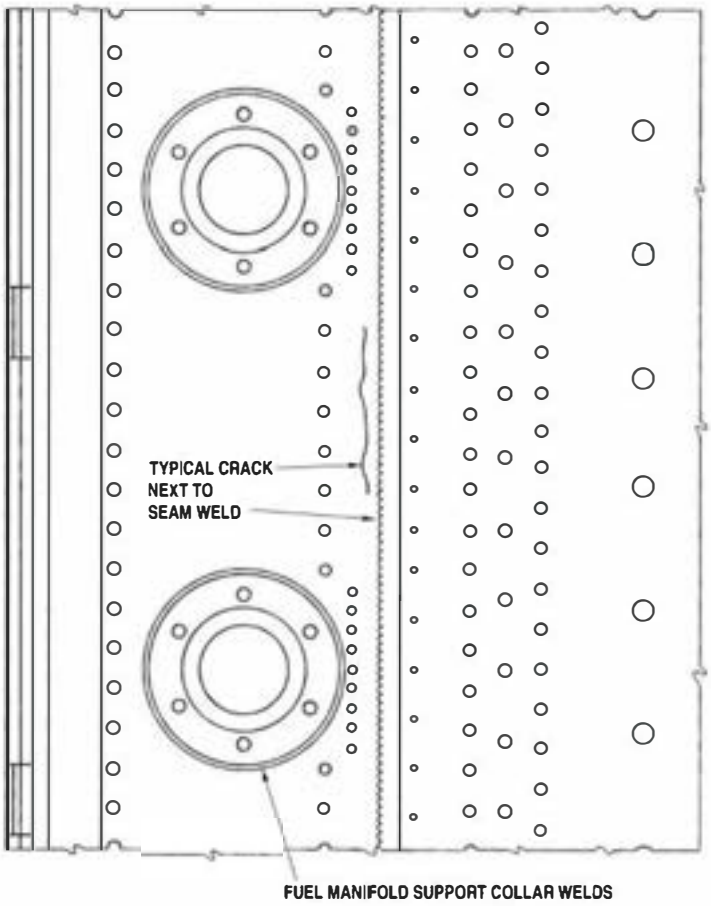
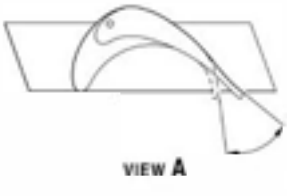
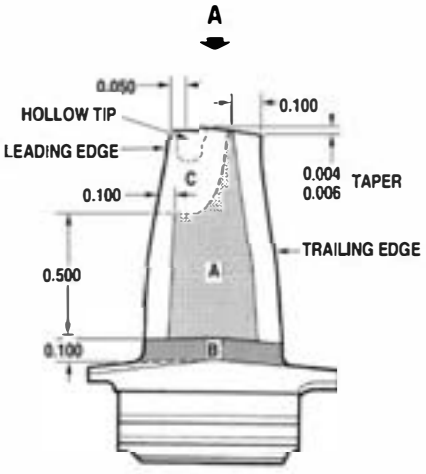
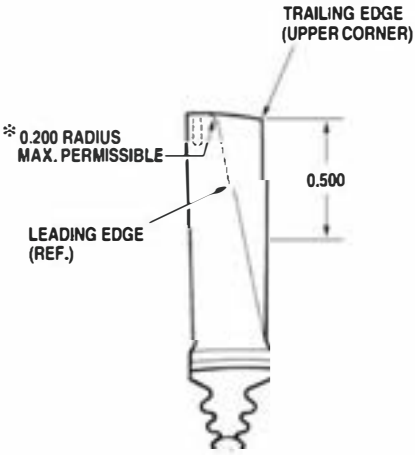


Figure 203 Compressor Turbine Blade Inspection







TIP RADIUS EROSION LIMITS

* PROVIDED ENGINE PERFORMANCE IS SATISFACTORY

BLADES HAVING THINNED OR FEATHERED LEADING EDGES DUE TO EROSION ARE NOT ACCEPTABLE

Figure 203 First and Second-stage Power Turbine Disks

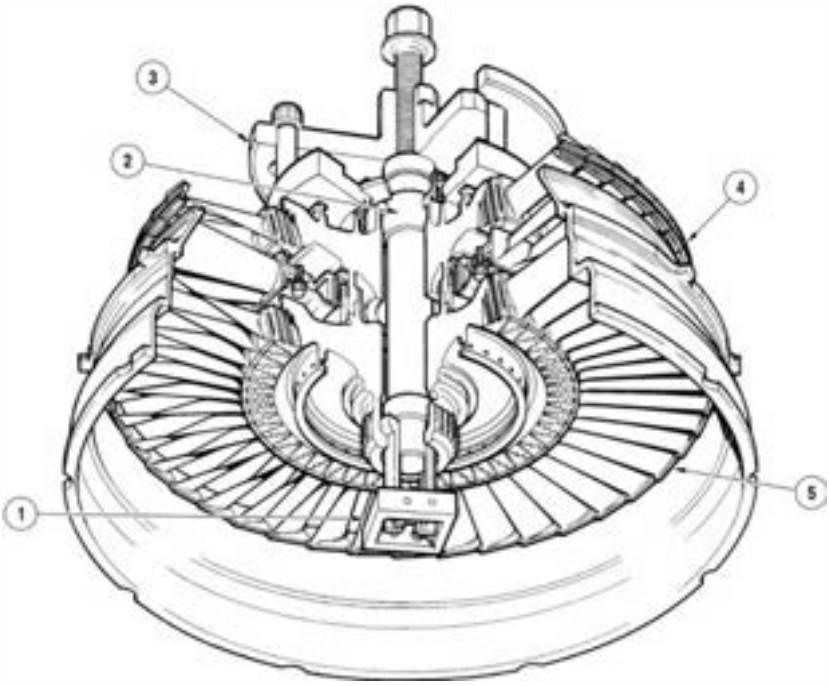


Figure 203 Fuel Nozzle Gasket Installation

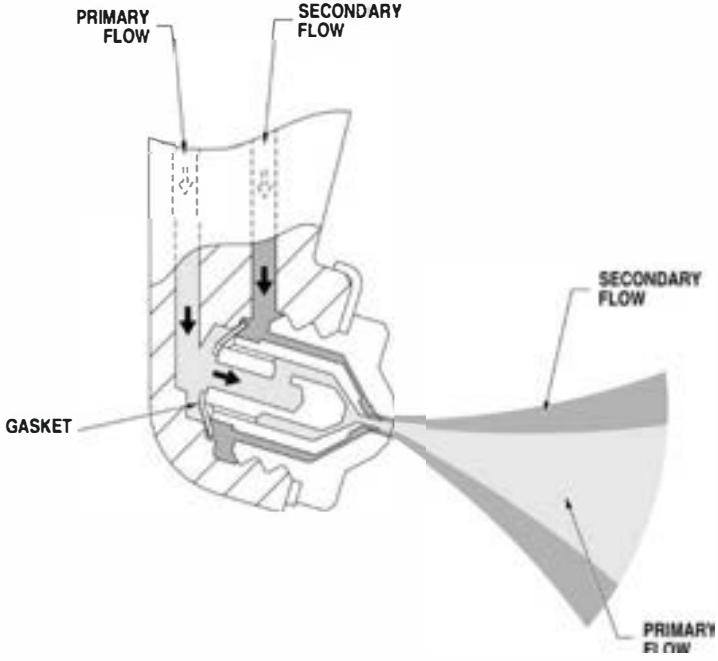


Figure 203 Fuel Pump In-situ Inspection

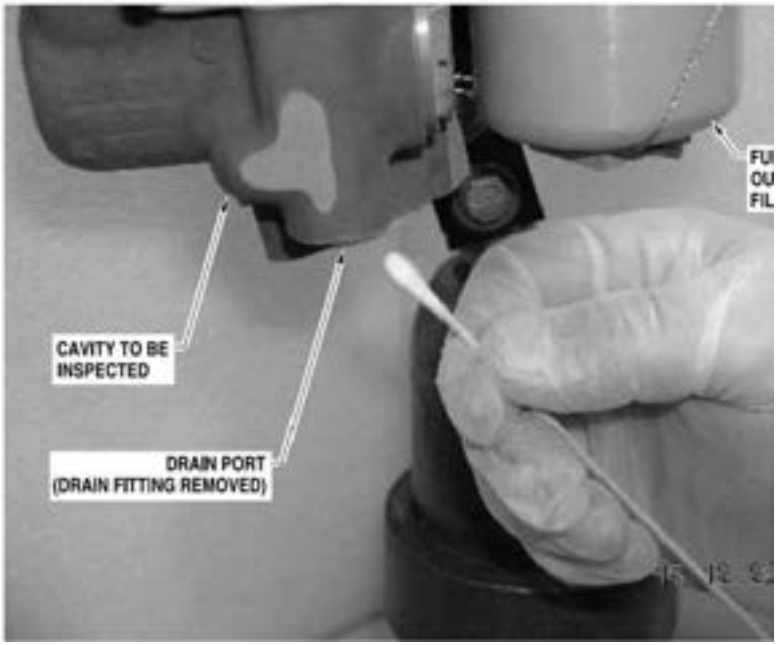


Figure 203 Inspection of Diffuser Exit Ducts

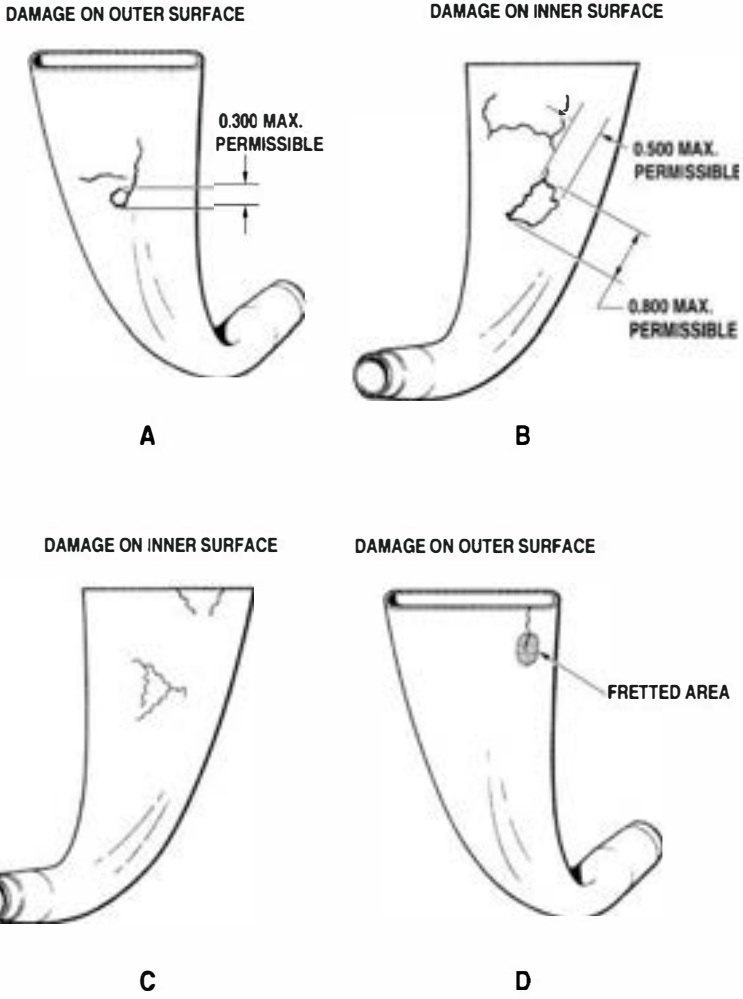


Figure 203 Power Turbine Stator Assembly - Inspection

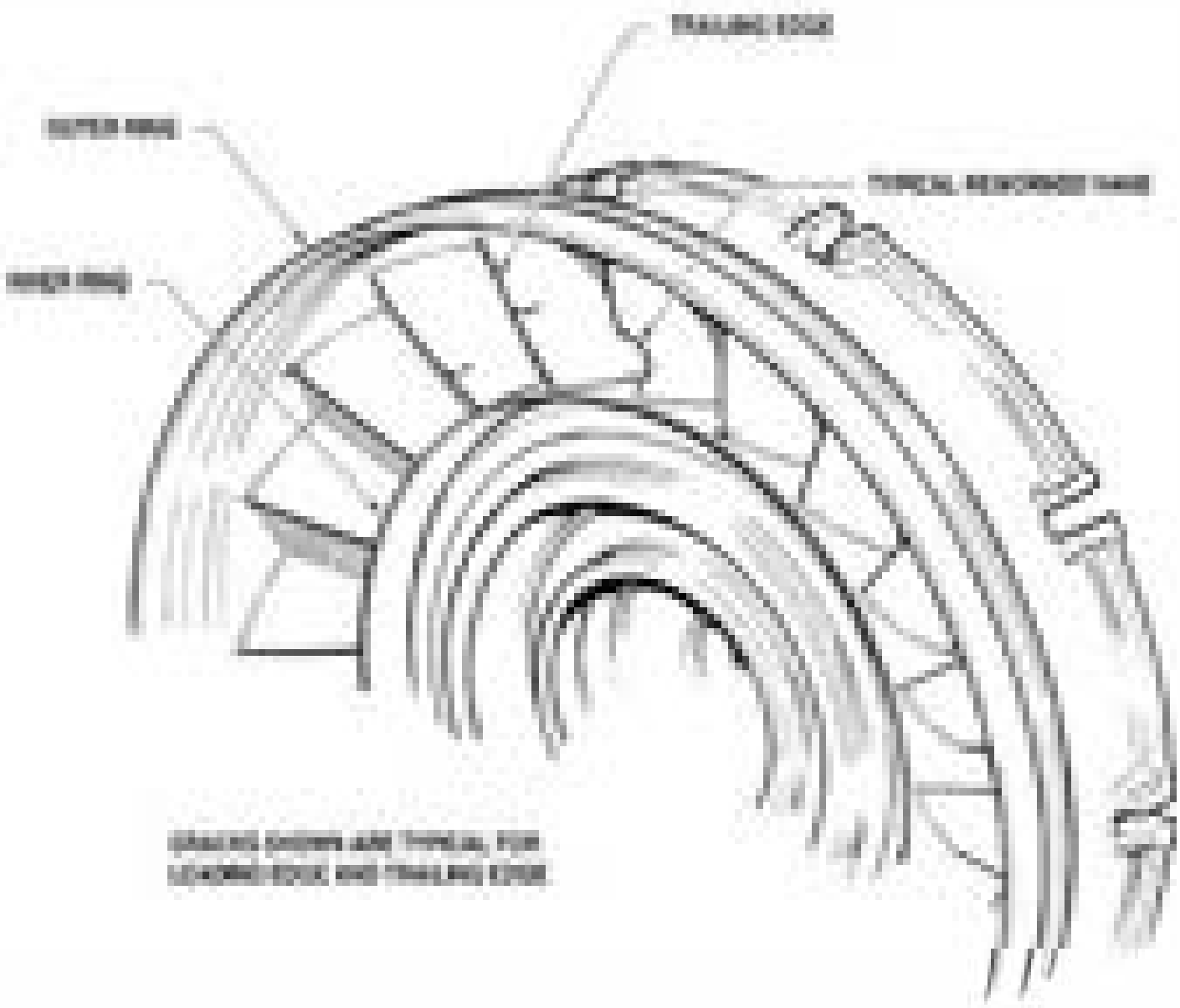


Figure 203 Propeller Shaft Oil Seal Garter Spring

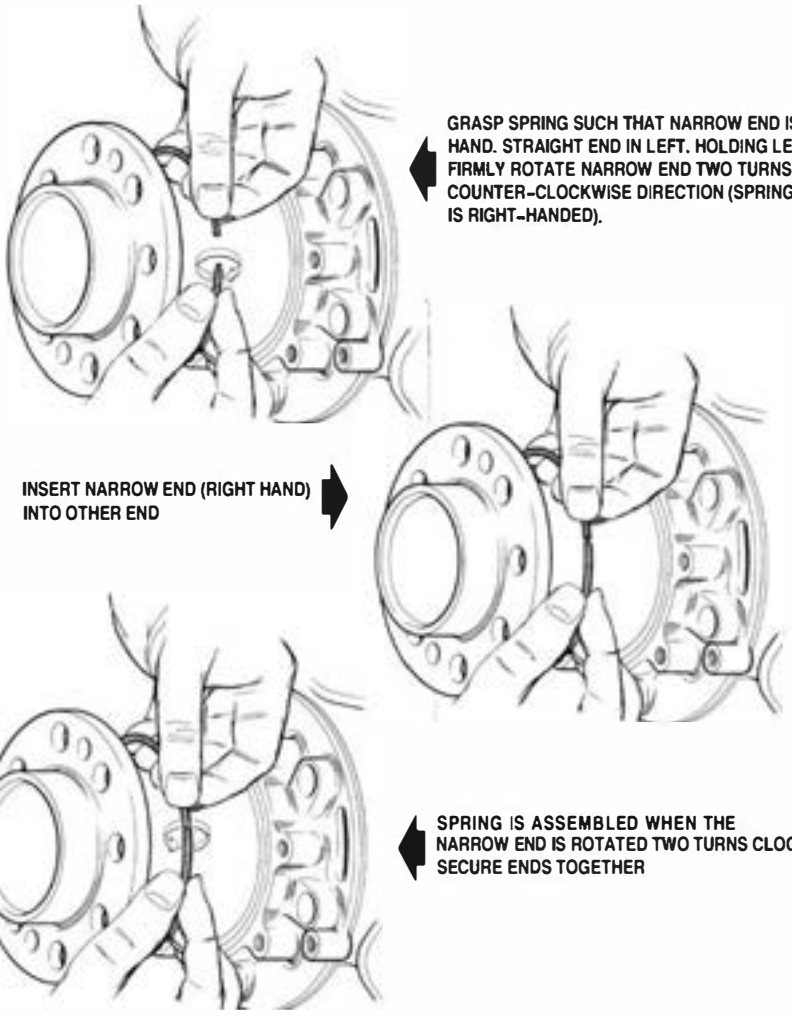


Figure 203 Rear Fireseal Mount Ring - Insulating Strip Replacement

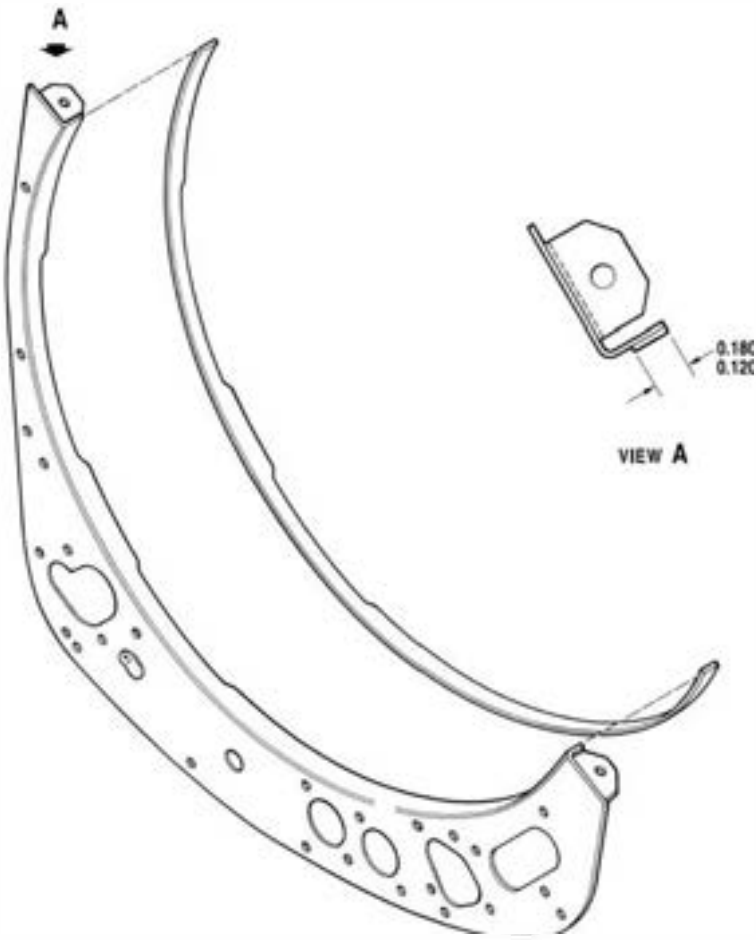


Figure 203 Removal/Installation of Accessory Gearbox Diaphragm

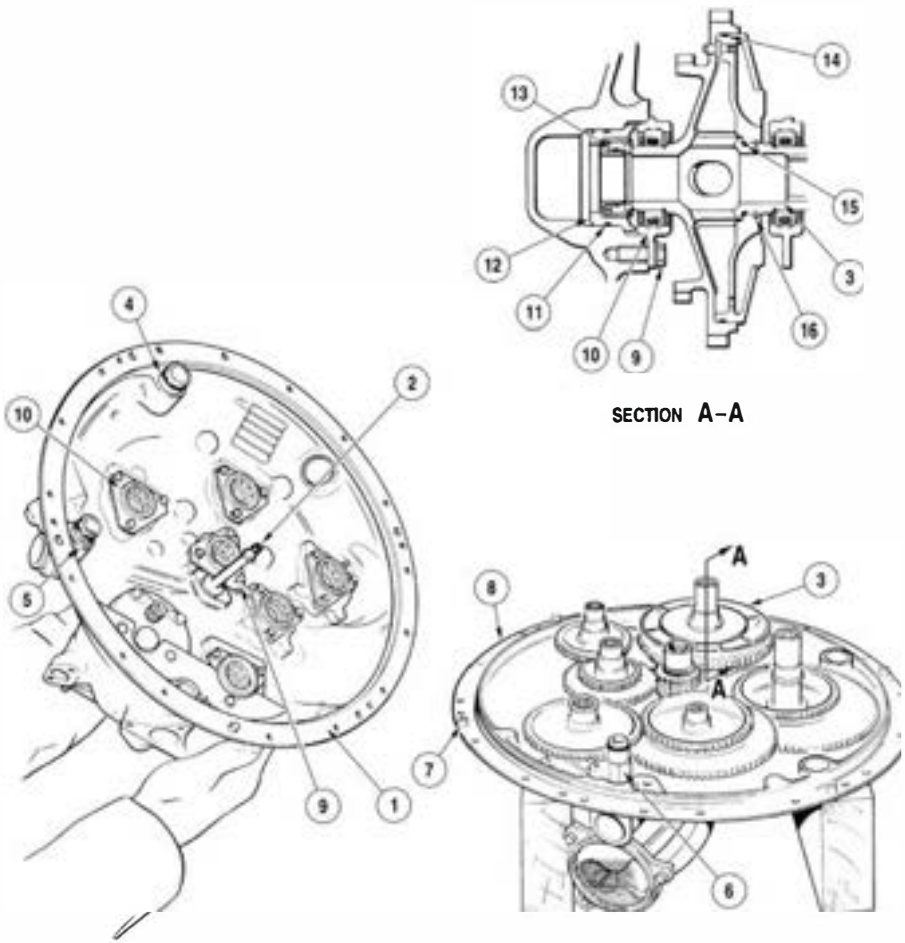


Figure 203 Removal/Installation of No. 2 Bearing Scavenge Oil Tube

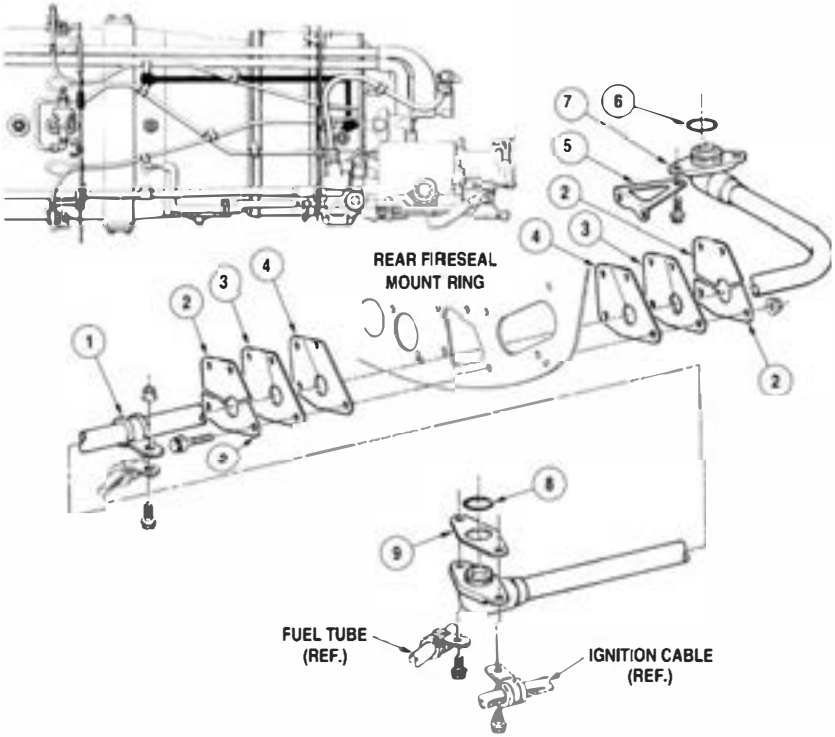


Figure 203 Removal/Installation of Oil Filter Element, Housing and Bypass/Check Valve

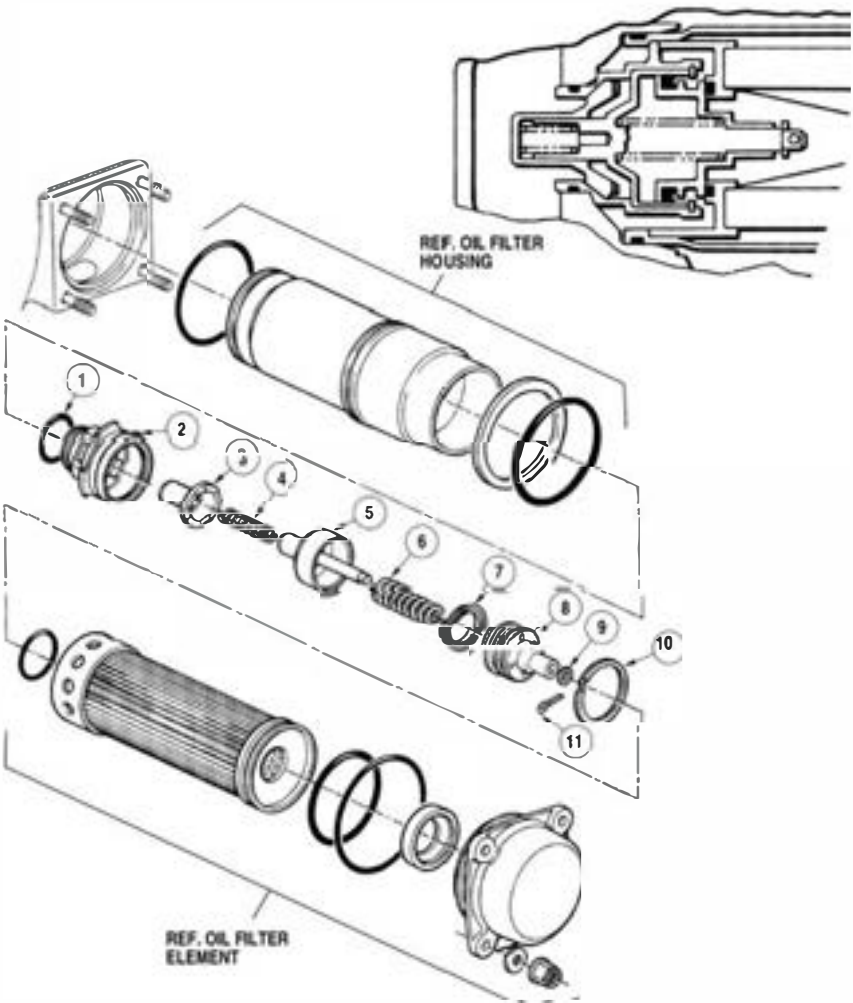


Figure 203 Removal/Installation of Oil Tank Pressurizing Valve

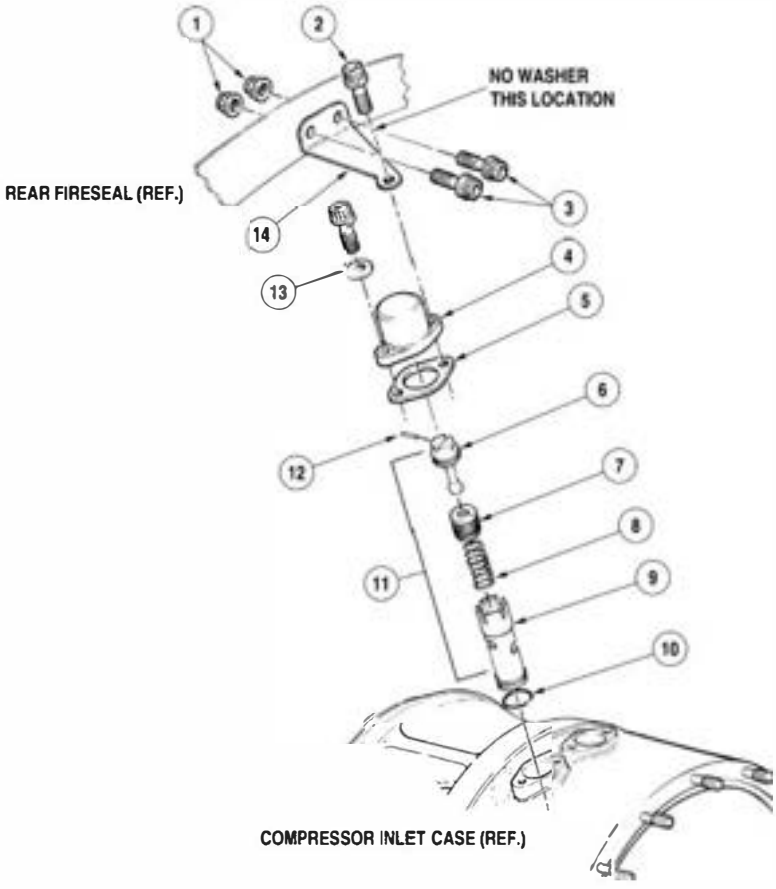


Figure 203 Removal/Installation of Push/Pull Control Assembly

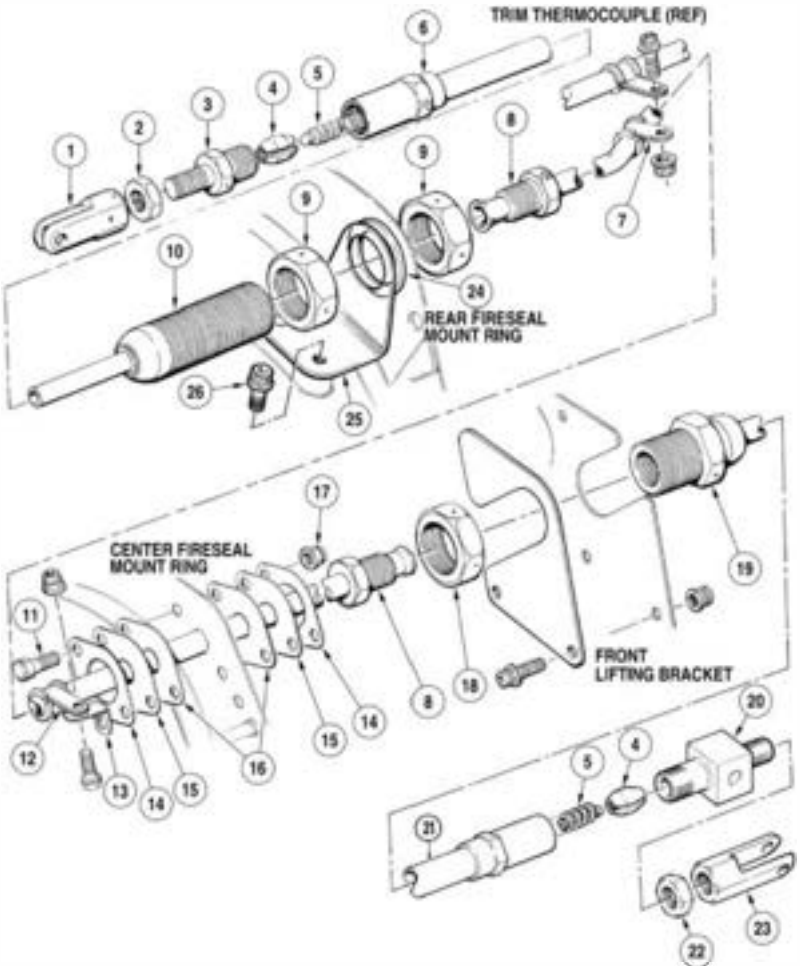
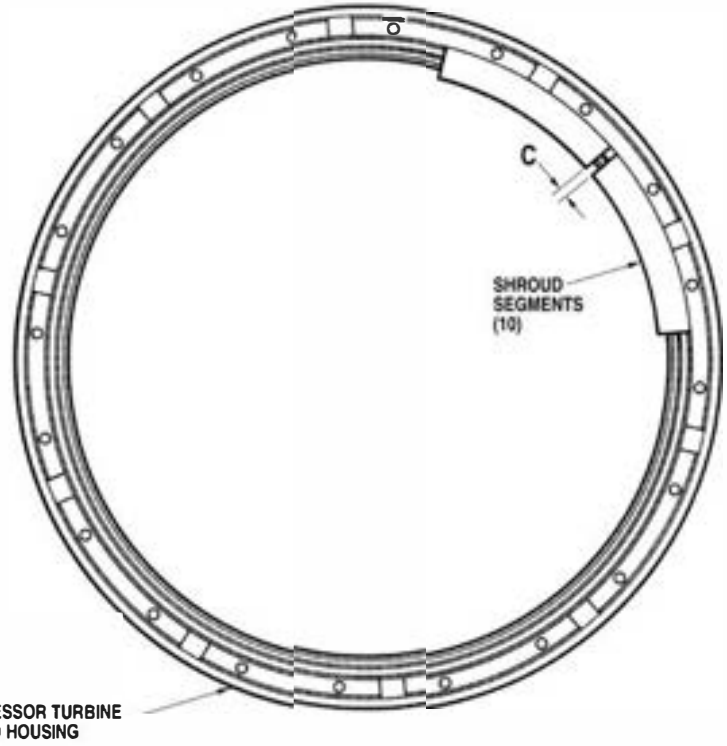
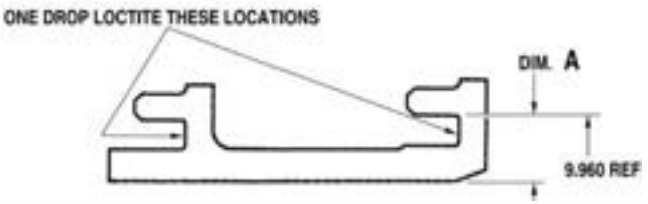


Figure 203 Shroud Housing Assembly



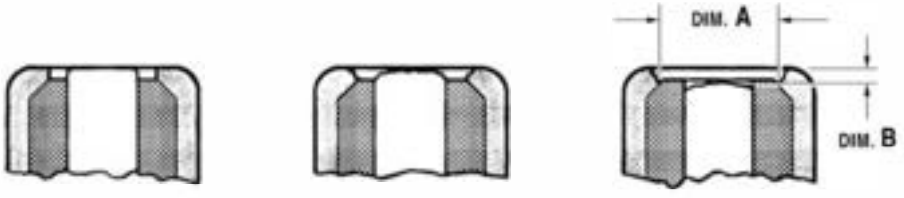


CROSS SECTION OF SEGMENT

Figure 203 Spark Igniter Inspection

CAUTION:

SHOULD AN IGNITER PLUG BE DROPPED, INTERNAL DAMAGE, POSSIBLY NOT DETECTABLE BY TEST, CAN OCCUR. RECOMMENDATION IS TO REPLACE THE IGNITER PLUG.



NOTE: FOR DIMENSIONS A AND B REFER TO TABLE 201.

Figure 203 Wiring Harness - Repair

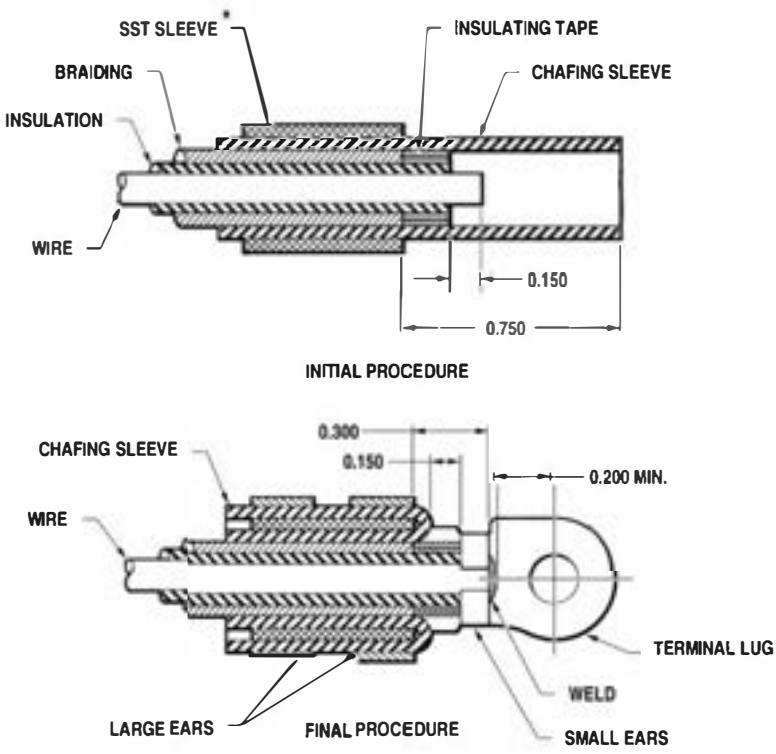
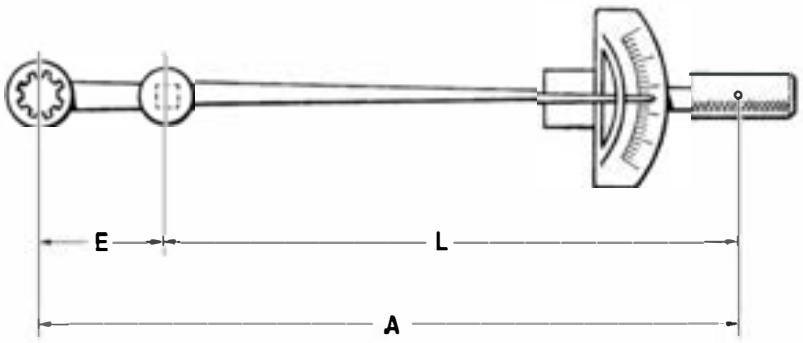


Figure 203 Torque Wrench and Extension



A = DISTANCE THROUGH WHICH FORCE IS APPLIED TO PART.

E = EFFECTIVE LENGTH OF SPECIAL EXTENSION OR ADAPTER.

L = EFFECTIVE LENGTH OF TORQUE WRENCH.

Figure 204 Internal Scavenge Pump Inlet Screen - Inspection and Cleaning

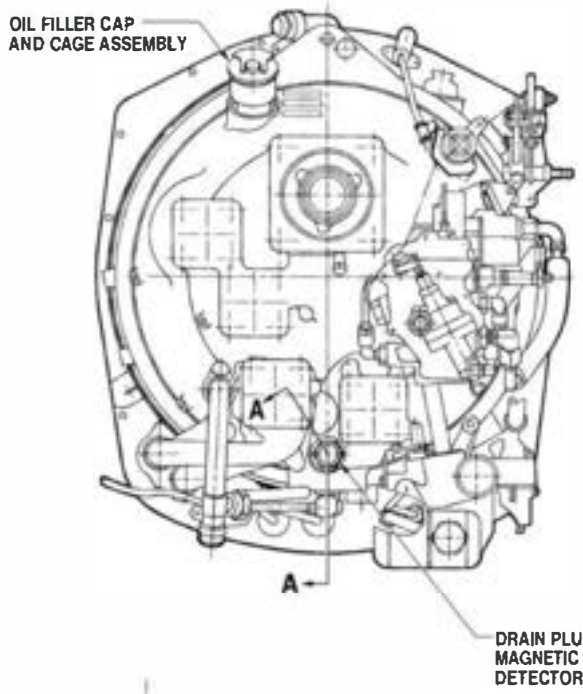
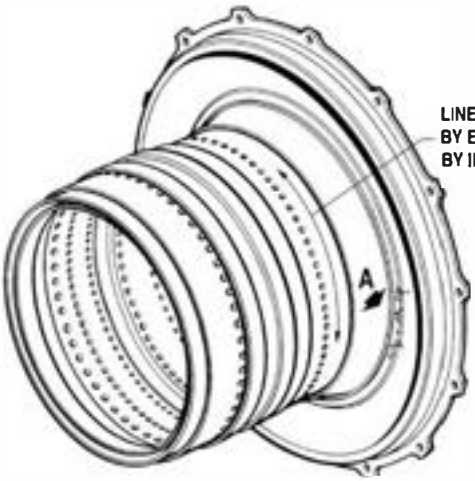


Figure 204 Combustion Chamber Inner Liner



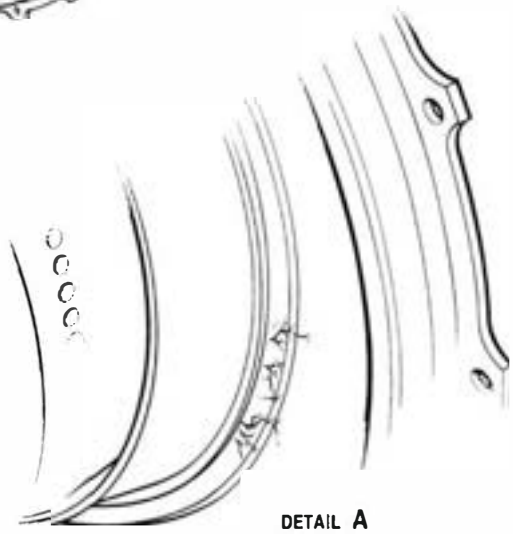
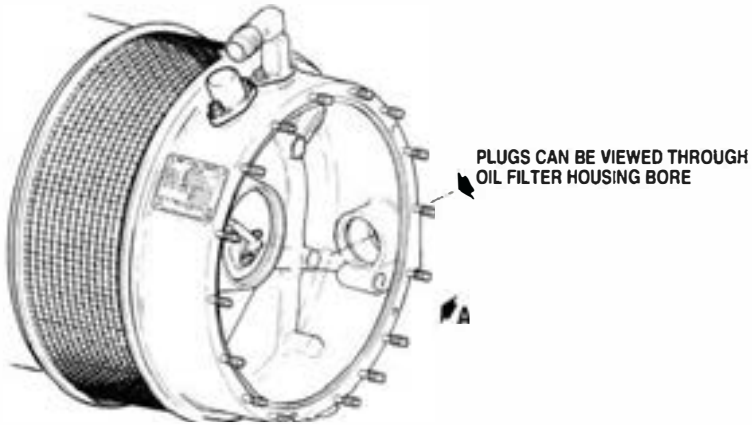
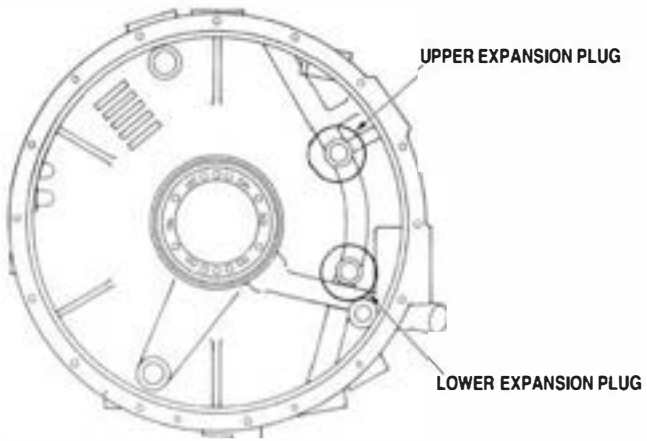


Figure 204 Compressor Inlet Case Expansion Plugs



VIEW OF COMPRESSOR INLET CASE WITH ACCESSORY GEARBOX OMITTED FOR CLARITY



VIEW ON ARROW A

Figure 204 Compressor Turbine Blade Shift

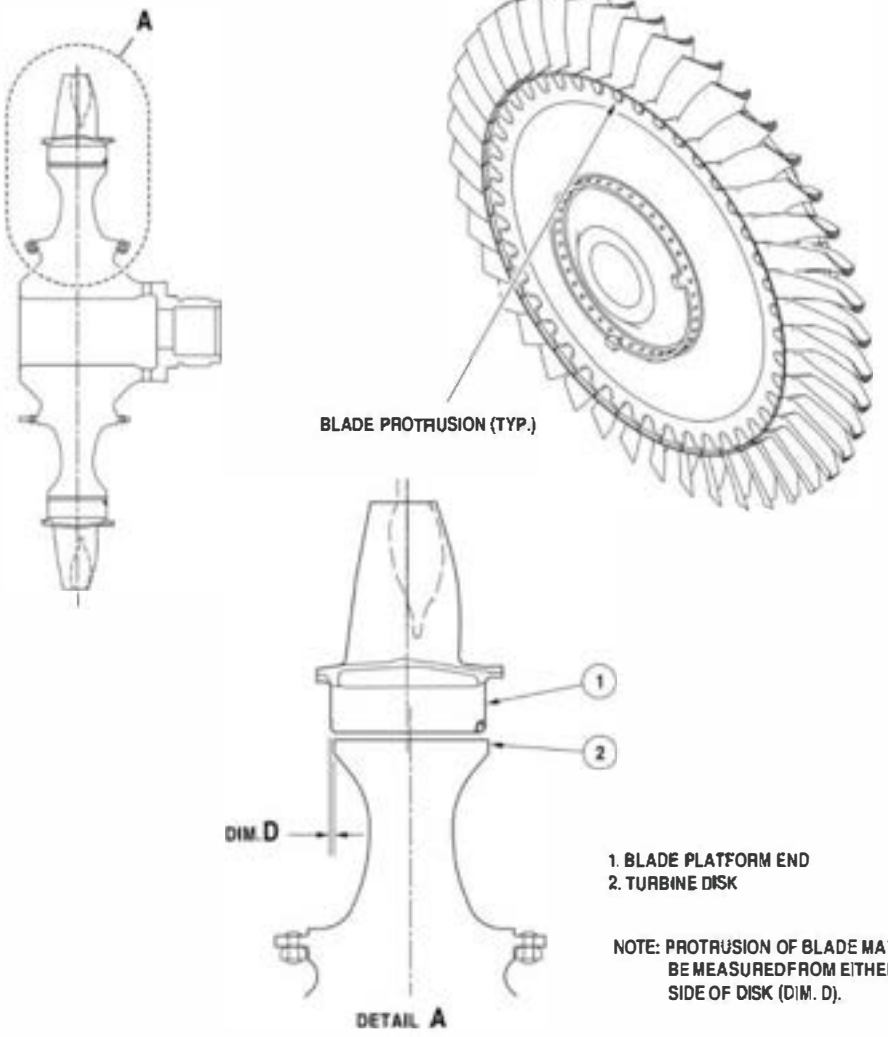


Figure 204 Compressor Turbine Shroud Segments - CT Blade Radial Tip Clearance Check

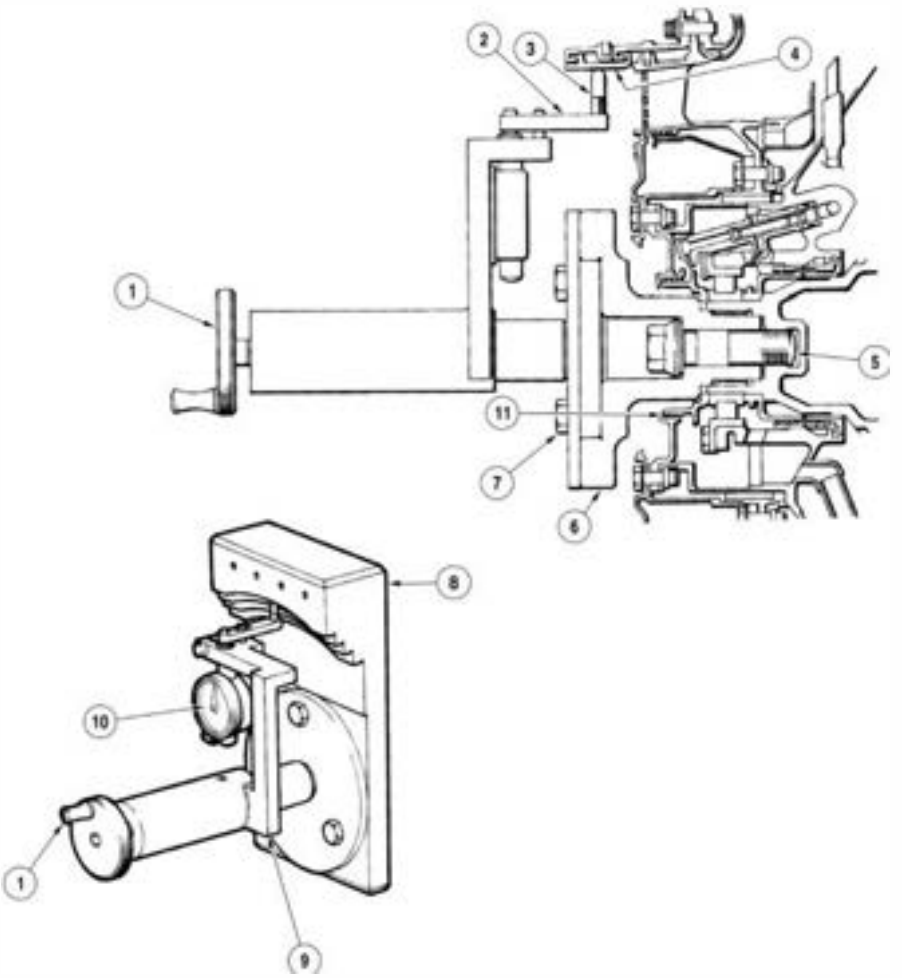


Figure 204 Electrosonic Cleaner - Oil Filter Element

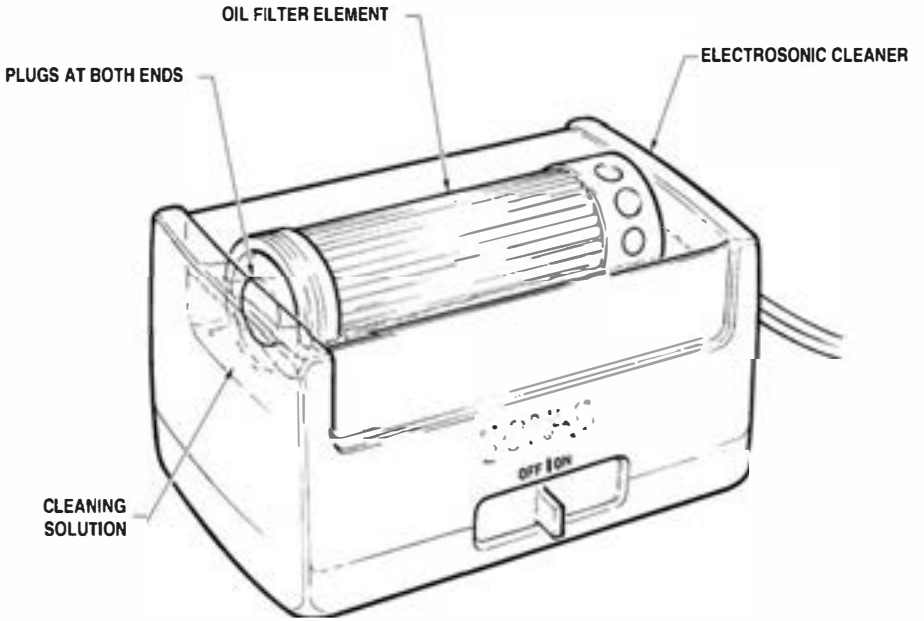


Figure 204 Fuel Control Pneumatic System Pressure Test - Typical

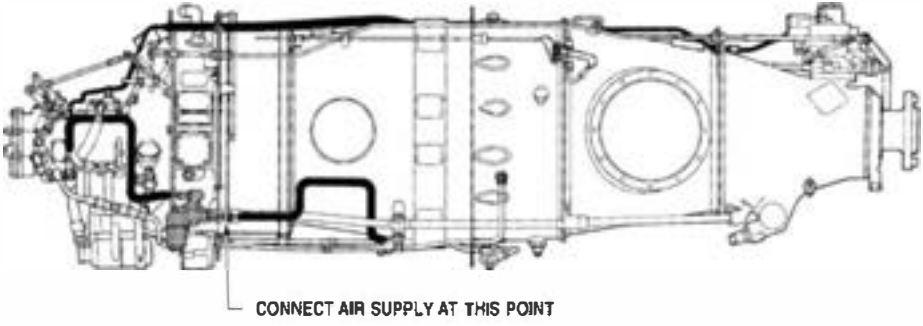


Figure 204 Fuel Nozzle Adapter and Sheath Installation Check

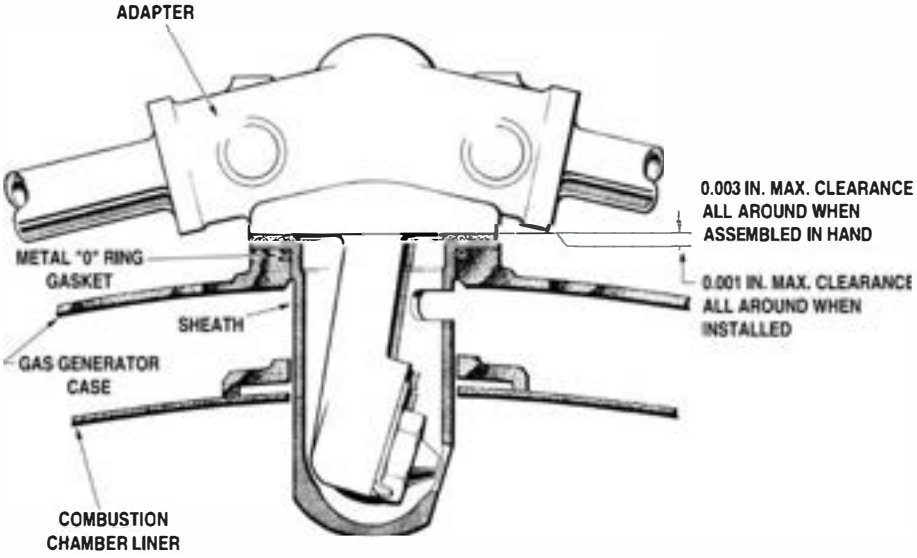


Figure 204 Installation and Replacement of Helical Inserts (sheet 2 of 2)

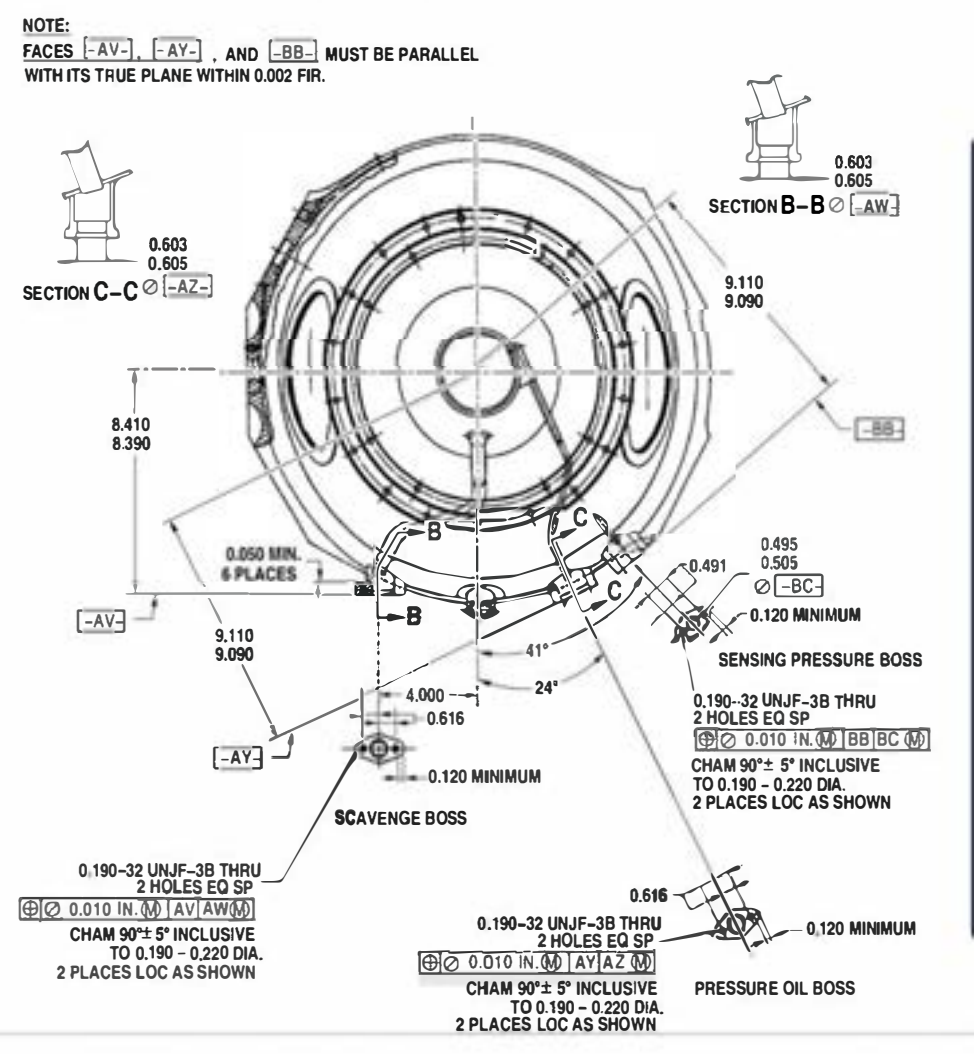


Figure 204 Installation and Replacement of Helical Inserts (sheet 1 of 2)

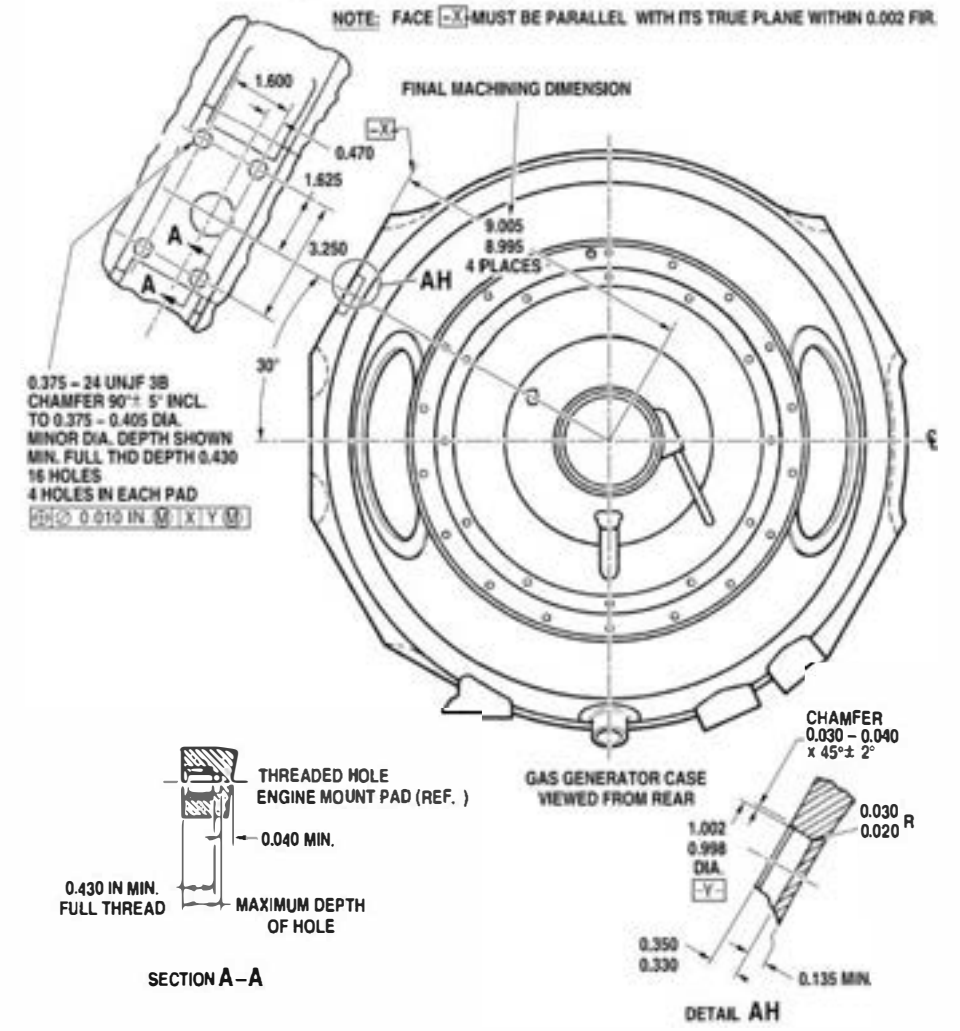


Figure 204 Lockwiring of Thrust Bearing Cover Bolts

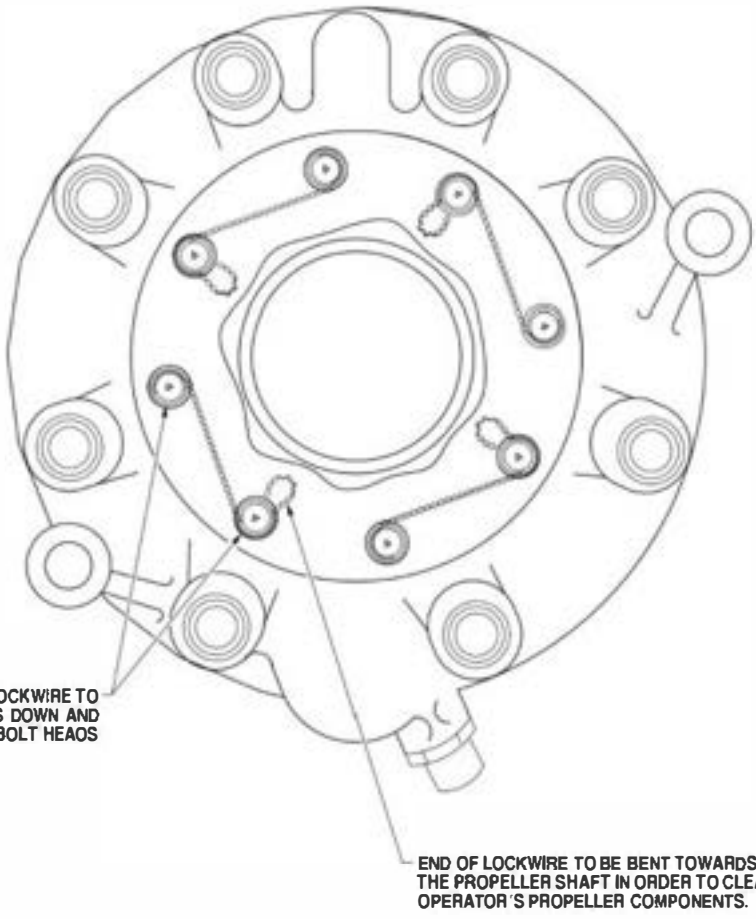


Figure 204 Power Turbine Stator Assembly Classification -Typical

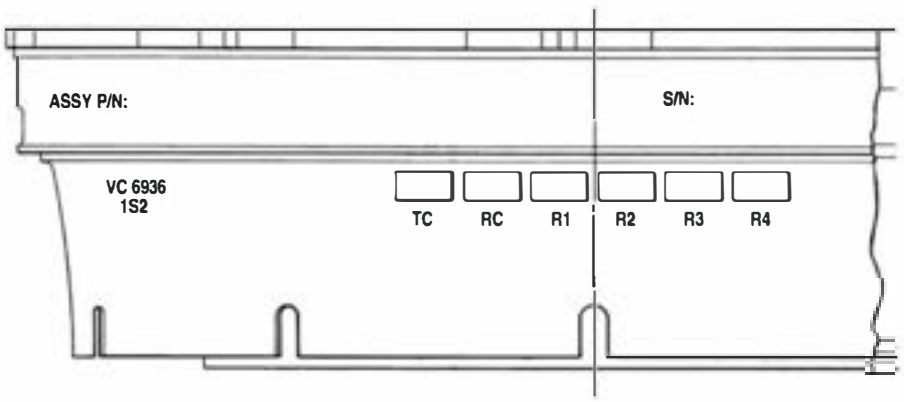


Figure 204 Power Turbine

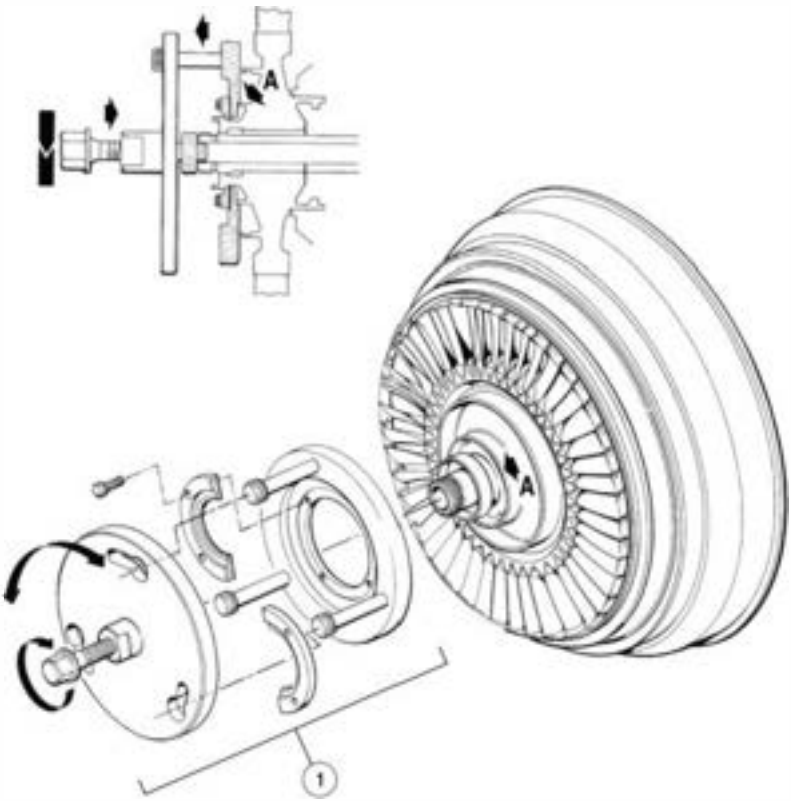


Figure 204 Removal/Installation of Front Scavenge Oil Tubes

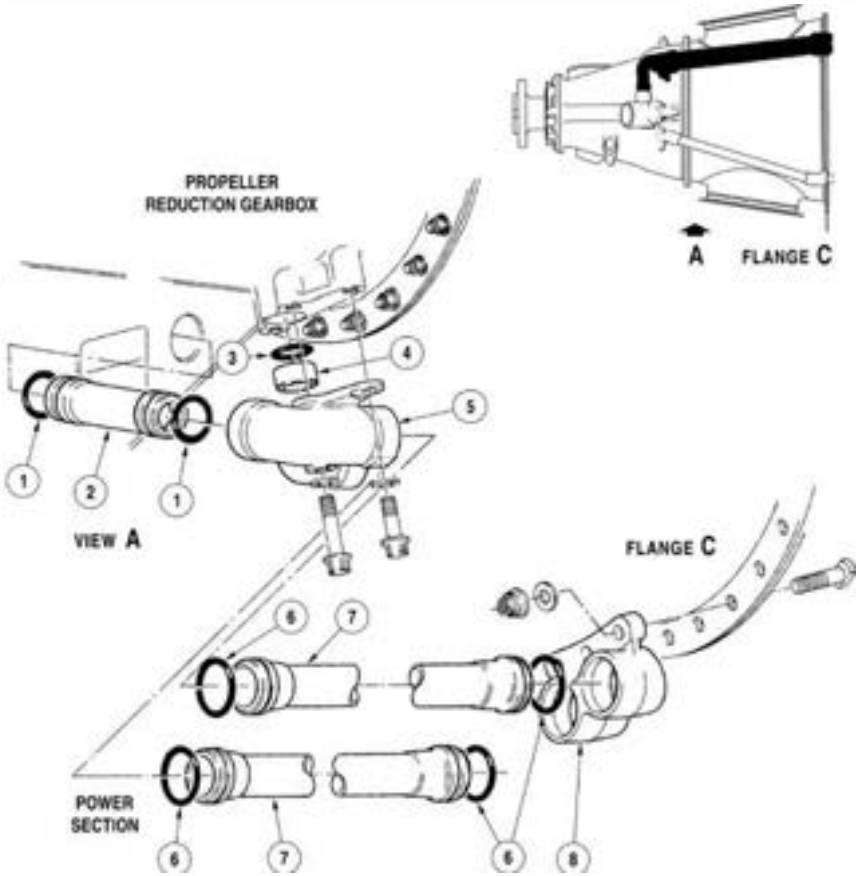
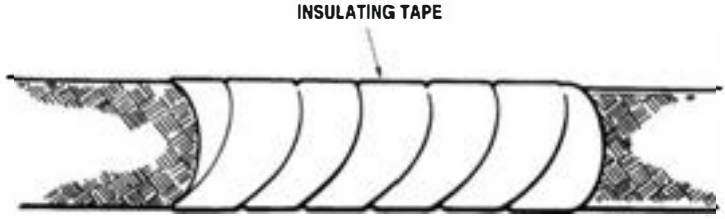


Figure 204 Repair of Ignition Cable - Major Damage



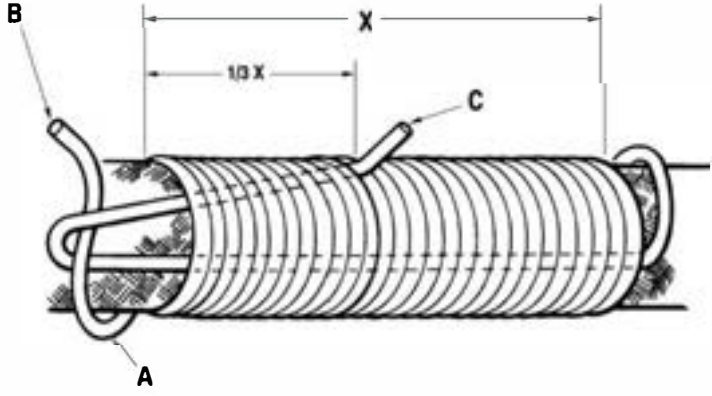
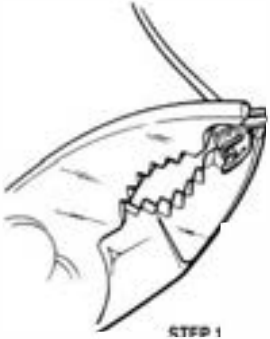


Figure 204 Wiring Harness - Repair



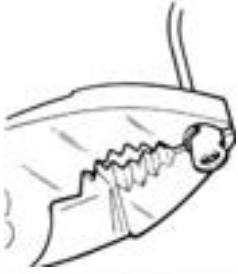


Figure 204 Examples of Lockwashers

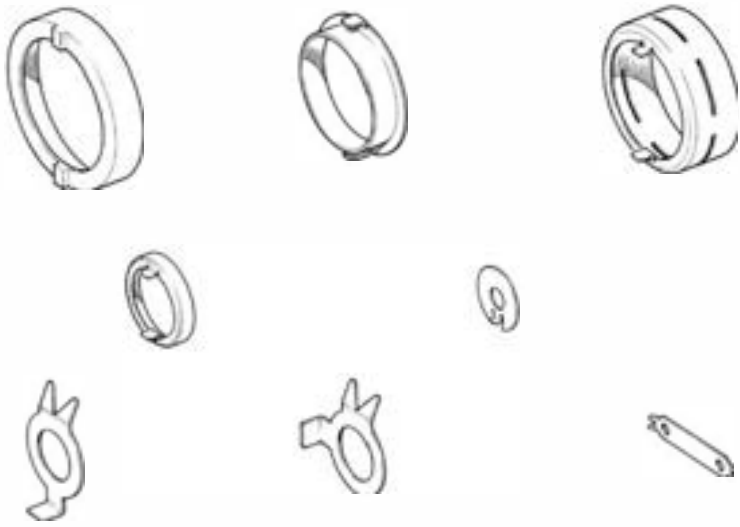
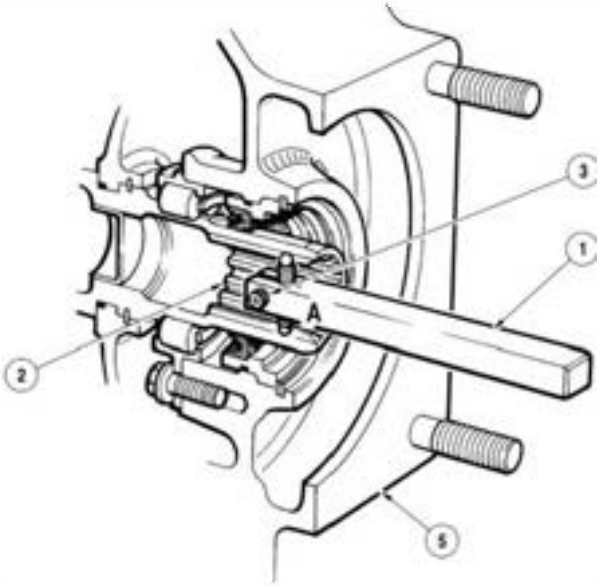
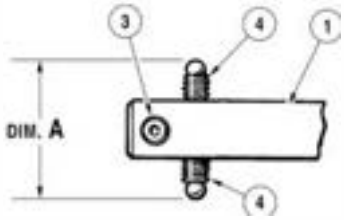


Figure 205 Accessory Gearshaft Inspection



ALLOW GAGE TO SUPPORT ITSELF



DETAIL A

Figure 205 Combustion Chamber Liners (sheet 2 of 2)

INNER WRAPPER EDGE (VANE CONTACT AREA)

VIEW E

Figure 205 Combustion Chamber Liners (sheet 1 of 2)

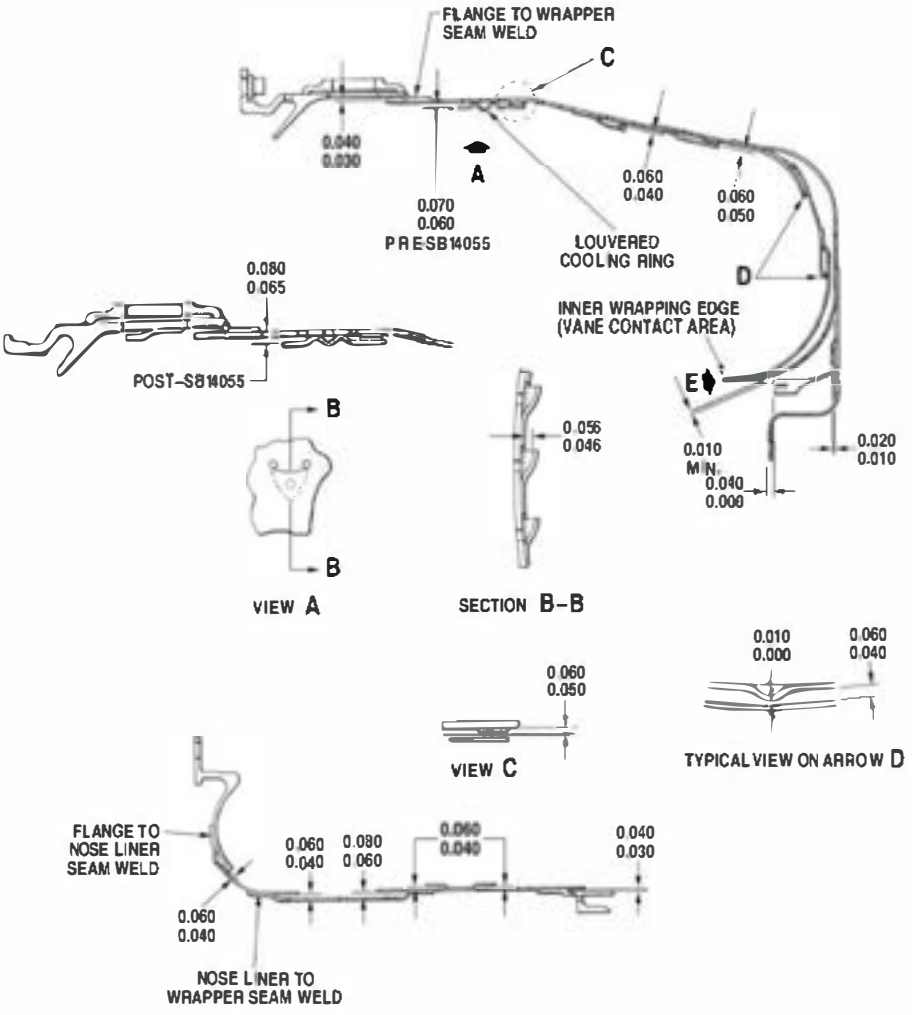


Figure 205 Compressor Turbine Shroud Segment Grinding

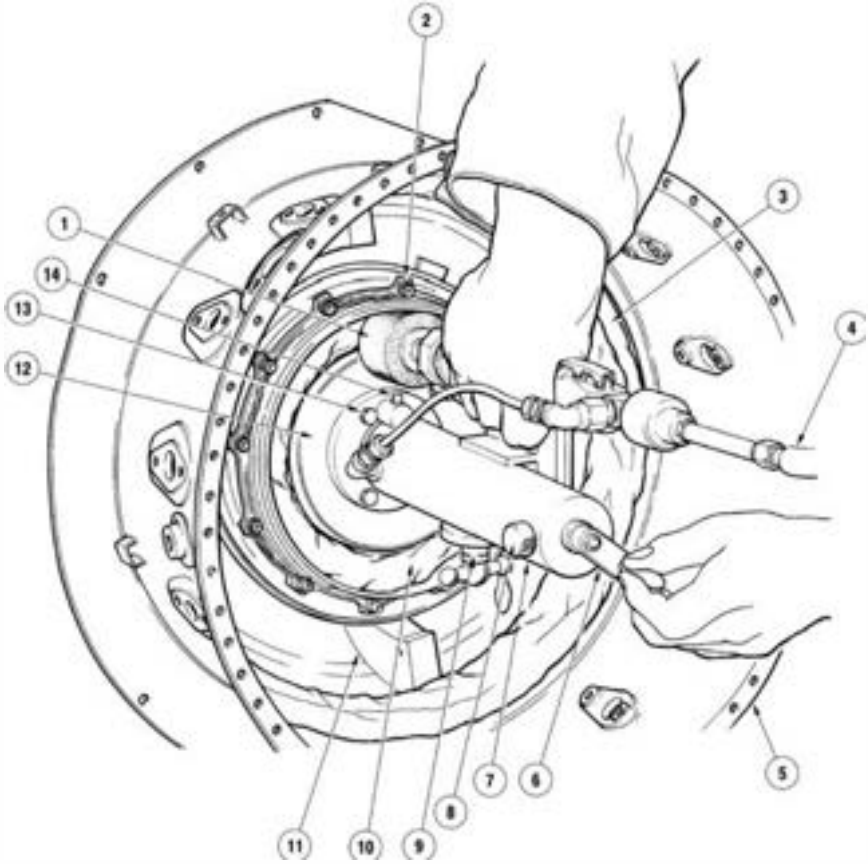
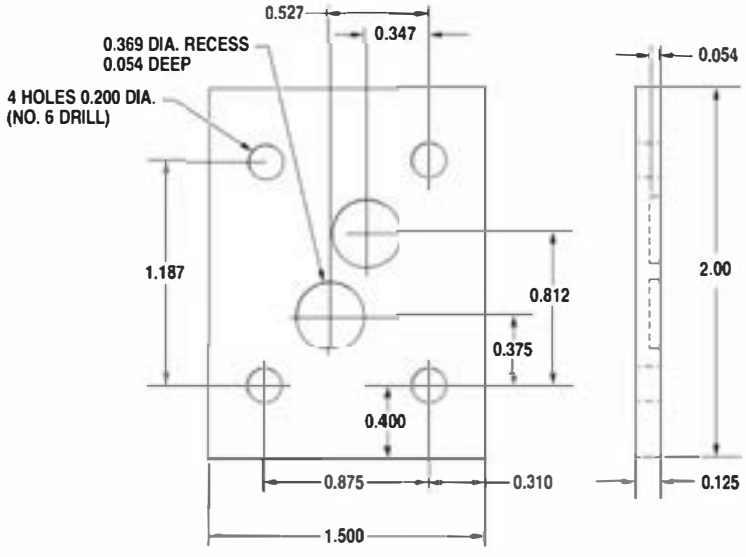


Figure 205 Inlet Adapter Blanking Plate



MATERIAL: MILD STEEL OR ALUMINUM SHEET 0.125 THICK (MIN.)

Figure 205 Inspection of Propeller Shaft

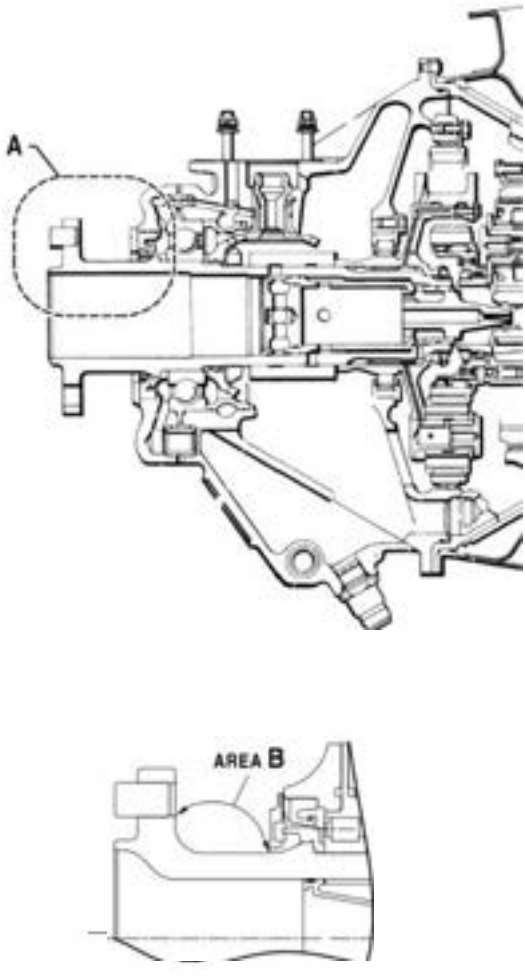


Figure 205 Installation of Power Turbine

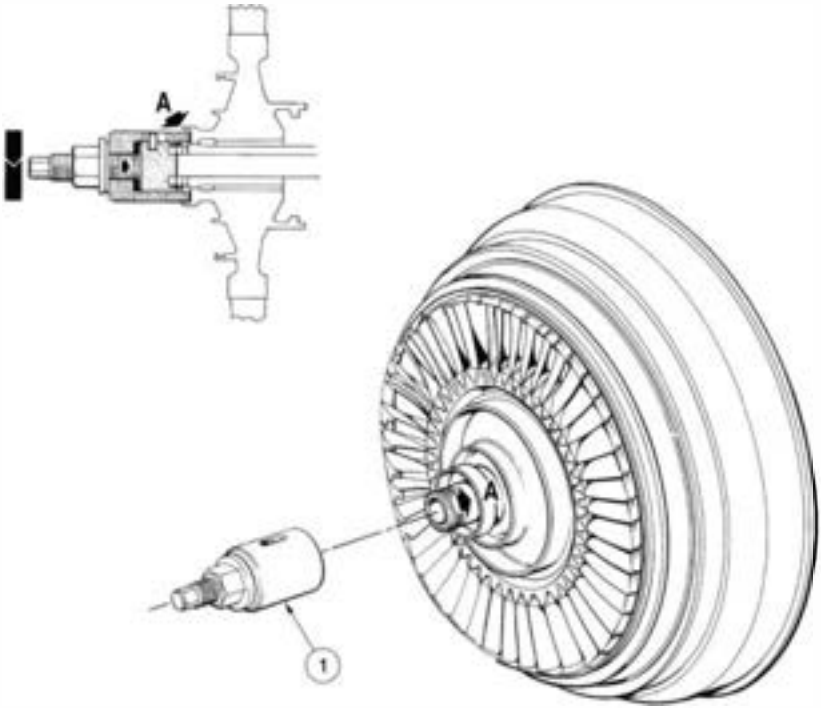


Figure 205 Power Turbine Section Sealing Surfaces (Typical)

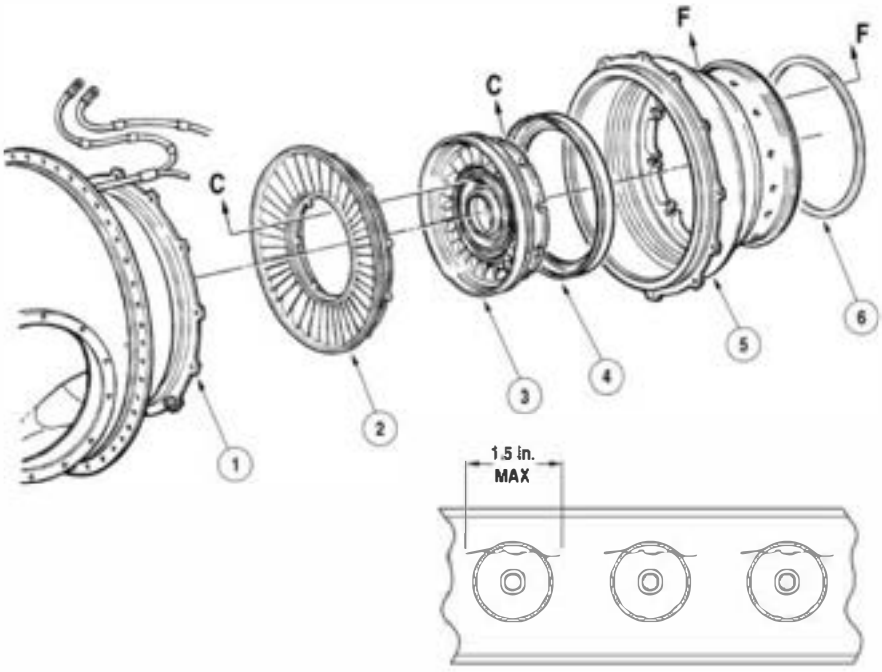


Figure 205 Removal/Installation of Rear Scavenge Oil Tubes

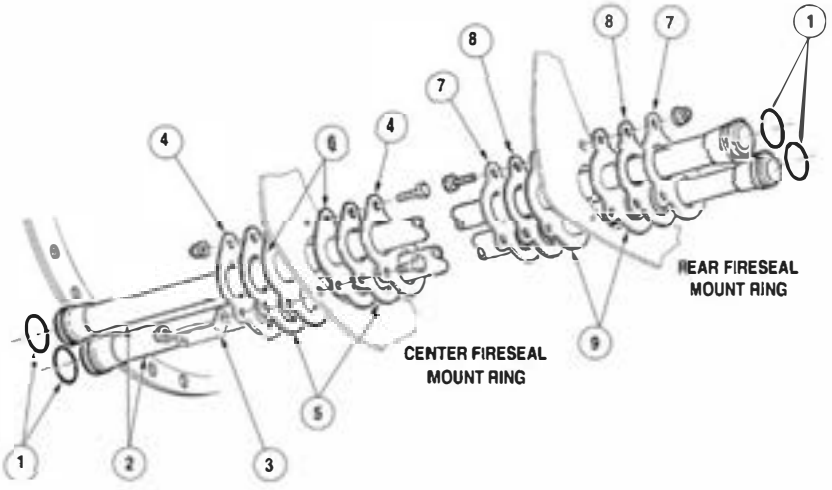
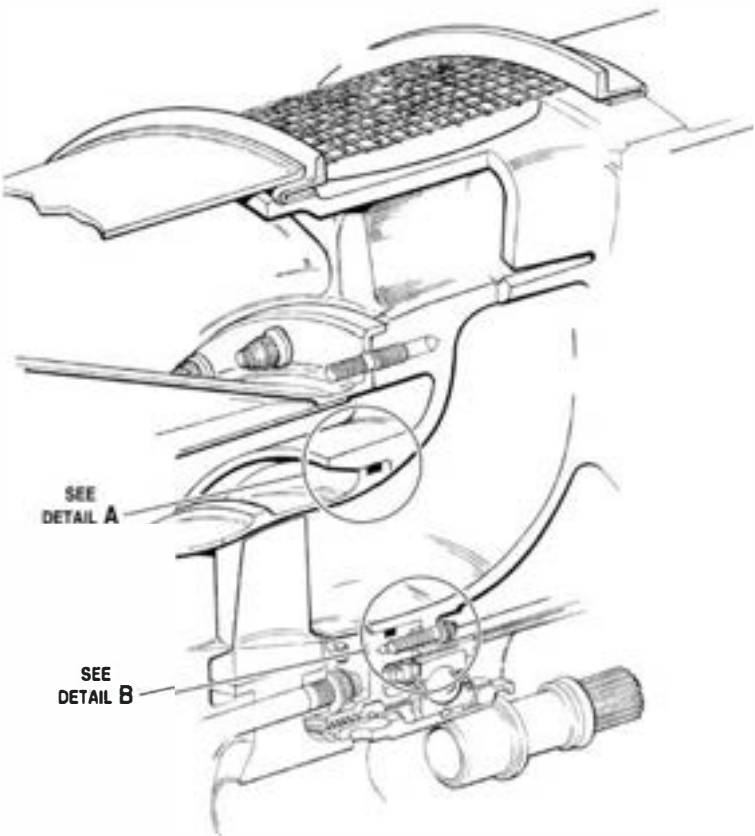
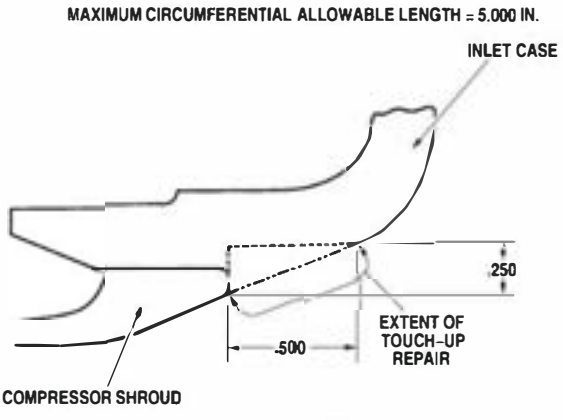


Figure 205 Repair of Corrosion - Compressor Inlet Case (sheet 2 of 3)

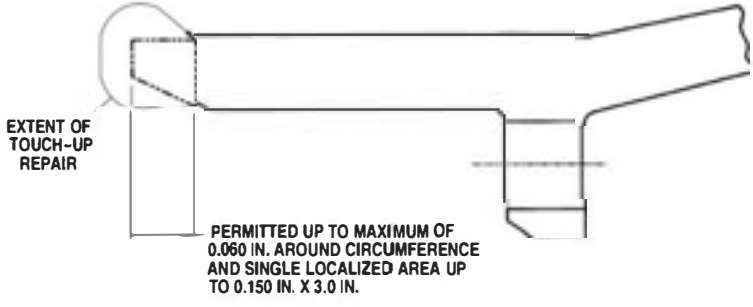


Repair of Corrosion - Compressor Inlet Case (Specific Areas) c79512

Figure 205 Repair of Corrosion - Compressor Inlet Case (sheet 3 of 3)



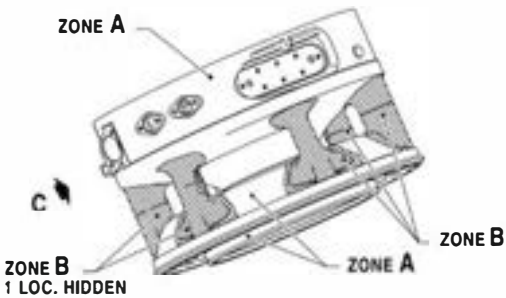
DETAIL A

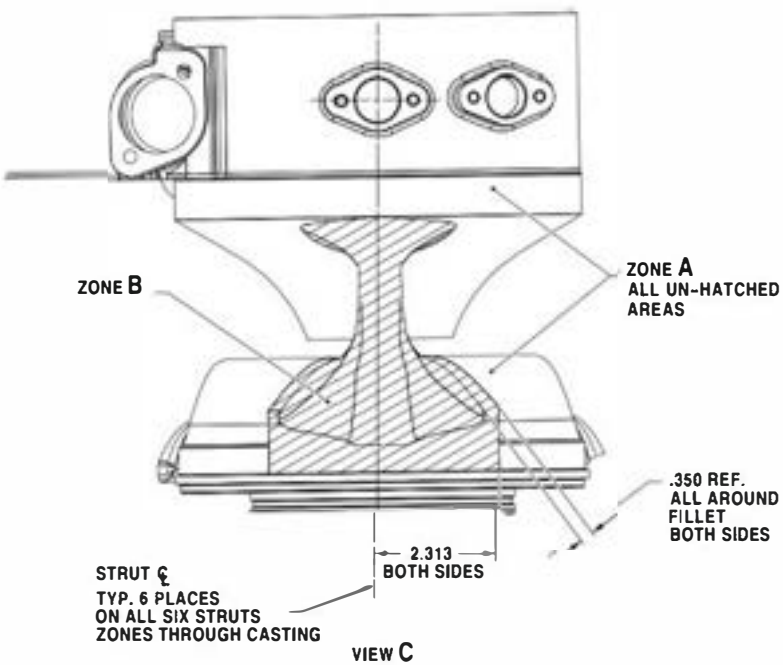


DETAIL B

Repair of Corrosion - Compressor Inlet Case (Specific Areas) icn-00198-g000004490-001-01

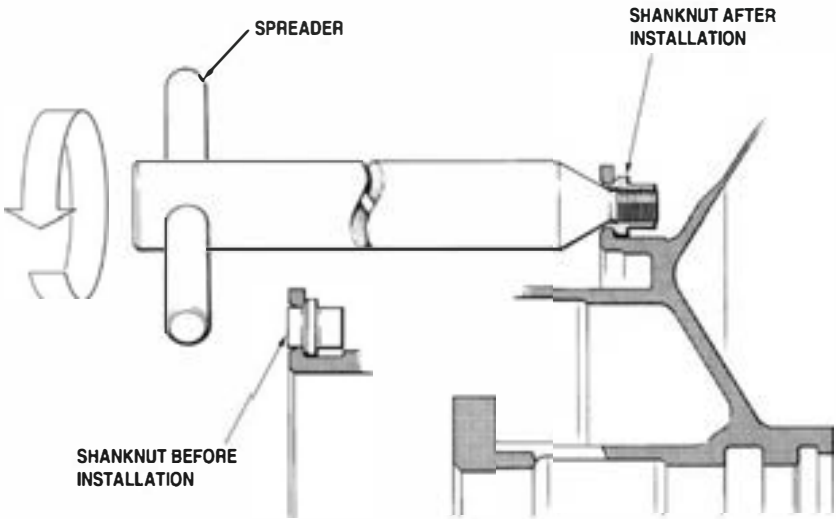
Figure 205 Repair of Corrosion - Compressor Inlet Case (sheet 1 of 3)





Repair of Corrosion - Compressor Inlet Case (Zone A and Zone B) c223628

Figure 205 Shanknut Replacement



TYPICAL CROSS-SECTION AREA AND APPLICATION

Figure 205 Stages of corrosion

STAGE 1

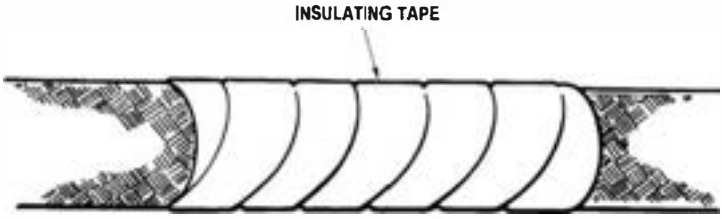
STAGE 2

STAGE 3

STAGE 4

c60623

Figure 205 Wiring Harness Braid Repair



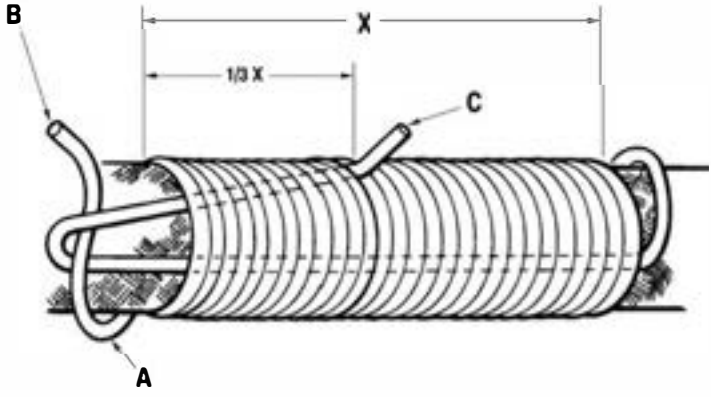
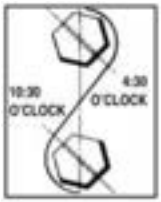
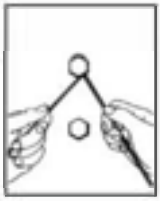


Figure 205 Lockwiring Procedure

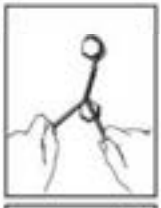


POSITION THE HOLES.

INSERT PROPER GAGE WIRE.



GRASP UPPER END OF THE WIRE AND BEND IT AROUND THE HEAD OF THE BOLT, THEN UNDER THE OTHER END OF THE WIRE. BE SURE WIRE IS TIGHT AROUND HEAD.



TWIST WIRE UNTIL WIRE IS JUST SHORT OF HOLE IN THE SECOND BOLT.

KEEPING WIRE UNDER TENSION, TWIST IN A CLOCKWISE DIRECTION UNTIL THE WIRE IS TIGHT. WHEN TIGHTENED THE WIRE SHALL HAVE APPROXIMATELY 7 TO 10 TWISTS PER INCH.

INSERT THE UPPERMOST WIRE, WHICH POINTS TOWARDS THE SECOND BOLT, THROUGH THE HOLE WHICH LIES BETWEEN THE NINE AND TWELVE O'CLOCK POSITIONS. GRASP THE END OF THE WIRE WITH A PAIR OF PLIERS AND PULL THE WIRE TIGHT.

BRING THE FREE END OF THE WIRE AROUND THE BOLT HEAD IN A COUNTERCLOCKWISE DIRECTION AND UNDER THE END PROTRUDING FROM THE BOLT HOLE. TWIST THE WIRE IN A COUNTERCLOCKWISE DIRECTION.

GRASP THE WIRE BEYOND THE TWISTED PORTION AND TWIST THE WIRE ENDS COUNTERCLOCKWISE UNTIL TIGHT.

DURING THE FINAL TWISTING MOTION OF THE PLIERS, BEND THE WIRE DOWN AND UNDER THE HEAD OF THE BOLT.

CUT OFF EXCESS WIRE WITH DIAGONAL CUTTERS.

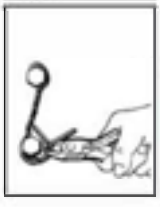


Figure 206 Lockwiring Examples (sheet 2 of 3)

EXAMPLE 12

EXAMPLE 13

EXAMPLES 12 AND 13 SHOW METHODS FOR ATTACHING LEAD SEAL TO PROTECT CRITICAL ADJUSTMENTS.

EXAMPLE 14

EXAMPLE 14 SHOWS BOLT WIRED TO A RIGHT ANGLE BRACKET WITH THE WIRE WRAPPED AROUND THE BRACKET.

EXAMPLE 15

EXAMPLE 15 SHOWS CORRECT METHOD FOR WIRING ADJUSTABLE CONNECTING ROD.

EXAMPLE 16

EXAMPLE 16 SHOWS CORRECT METHOD FOR WIRING THE COUPLING NUT ON FLEXIBLE LINE TO THE STRAIGHT CONNECTOR BRAZED ON RIGID TUBE.

EXAMPLE 17

EXAMPLE 18

EXAMPLE 19

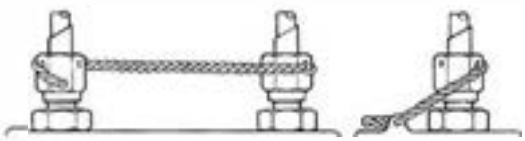
EXAMPLE 20

FITTINGS INCORPORATING WIRE LUGS SHALL BE WIRED AS SHOWN IN EXAMPLES 17 AND 18. WHERE NO LOCKWIRE LUG IS PROVIDED, WIRE SHOULD BE APPLIED AS SHOWN IN EXAMPLES 19 AND 20 WITH CAUTION BEING EXERTED TO ENSURE THAT WIRE IS WRAPPED TIGHTLY AROUND THE FITTING.

EXAMPLE 21

SMALL SIZE COUPLING NUTS SHALL BE WIRED BY WRAPPING THE WIRE AROUND THE NUT AND INSERTING IT THROUGH THE HOLES AS SHOWN.

Figure 206 Lockwiring Examples (sheet 3 of 3)



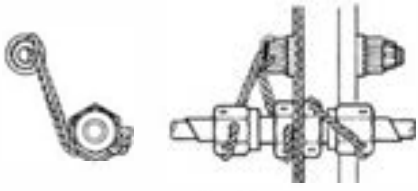
EXAMPLE 22

EXAMPLE 23

COUPLING NUTS ATTACHED TO STRAIGHT CONNECTORS SHALL BE WIRED AS SHOWN WHEN HEX IS AN INTEGRAL PART OF THE CONNECTOR.

EXAMPLE 24

COUPLING NUTS ON A TEE SHALL BE WIRED AS SHOWN ABOVE SO THAT TENSION IS ALWAYS IN THE TIGHTENING DIRECTION.



EXAMPLE 25

STRAIGHT CONNECTOR (BULKHEAD TYPE)

EXAMPLE 26

EXAMPLE 27

EXAMPLE 28

EXAMPLES 26, 27 AND 28 SHOW THE VARIOUS STANDARD FITTINGS WITH CHECK NUT WIRED SO THAT IT NEED NOT BE DISTURBED WHEN REMOVING THE COUPLING NUT.

Figure 206 Compressor Turbine Vane Ring Lockplate - Repair

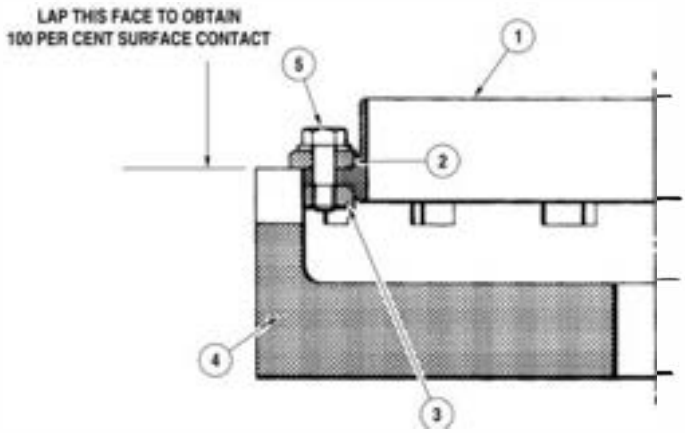
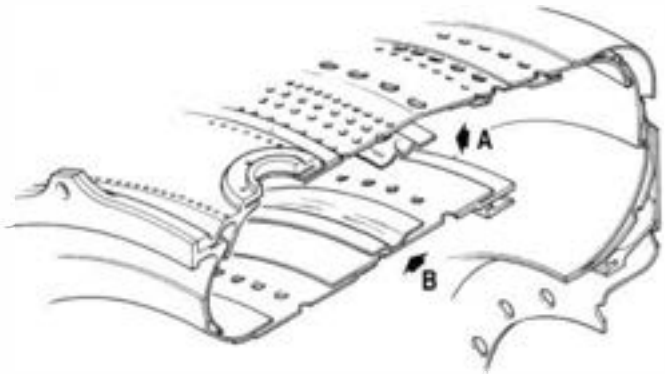
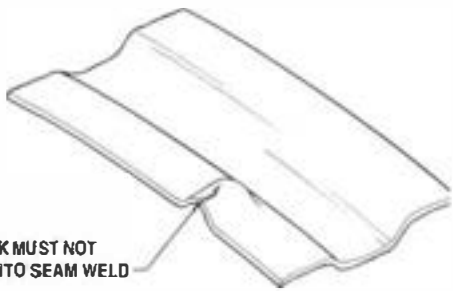


Figure 206 Cooling Rings - Inspection

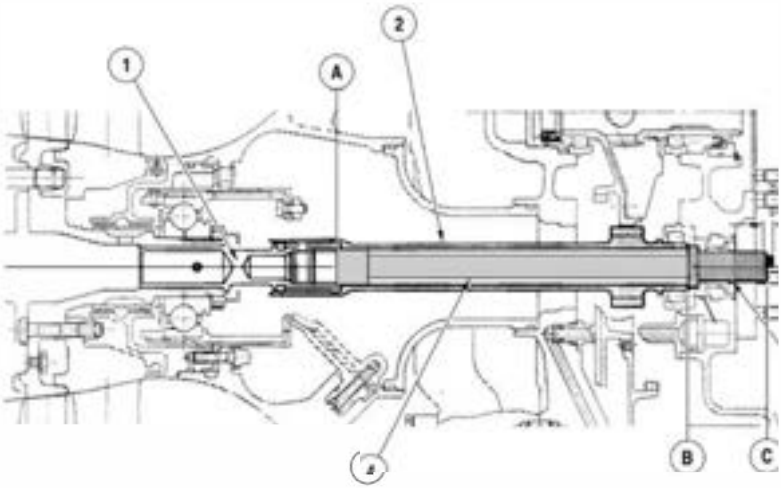


LOUVERED TYPE
DETAIL A



NON-LOUVERED TYPE
DETAIL B

Figure 206 Coupling Shaft Engagement Check



SECTION THROUGH GEARBOX SHOWING AGB COUPLING GAGE

Figure 206 CT Disk Assembly Trim Weights (sheet 2 of 2)

TRIM WEIGHT TABLE

TRIM WEIGHT CLASS FROM DATA PLATE		A CLASS 1	B CLASS 2	C CLASS 3	D CLASS 4	E CLASS 5	G SINGLE RIVET
NUMBER OF HOLES EACH SIDE OF ORIGINAL TRIM WEIGHT LOCATION	1				CL1		
	2				CL1		
	3			CL1			
	4			CL1	CL2		
	5		CL1	CL1	CL2		
	6	CL1	CL1	CL2	CL3		
	7	CL1	CL3	CL4		CL5	SINGLE RIVET
	8	CL3	CL4				

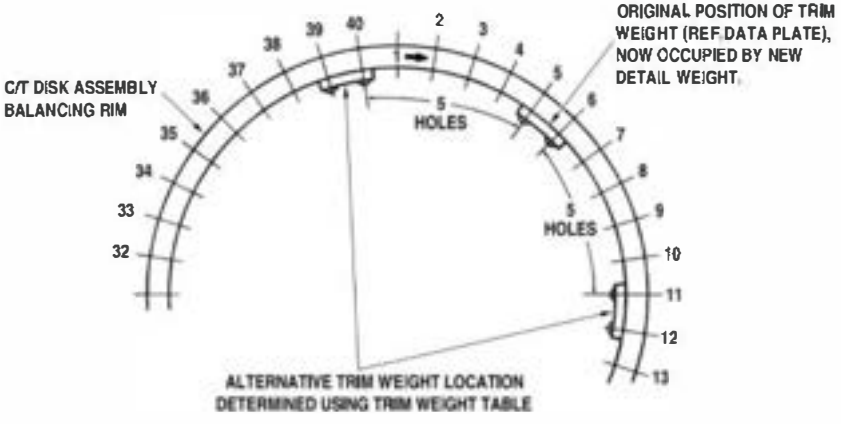
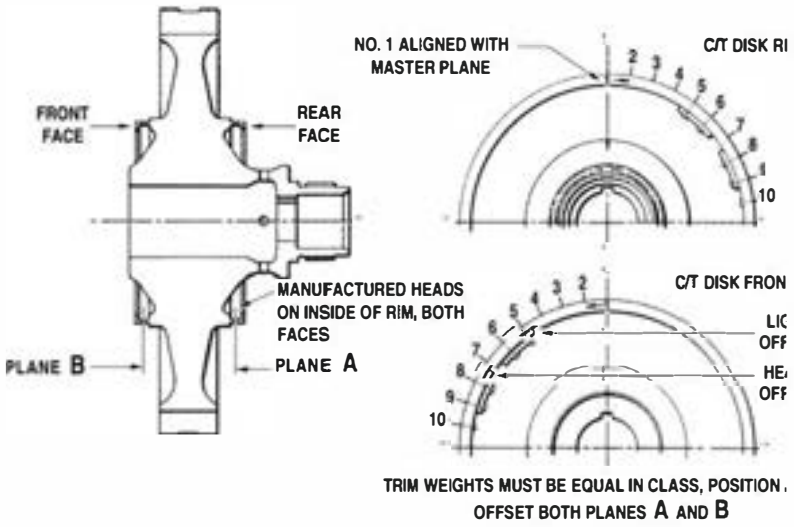


Figure 206 CT Disk Assembly Trim Weights (sheet 1 of 2)



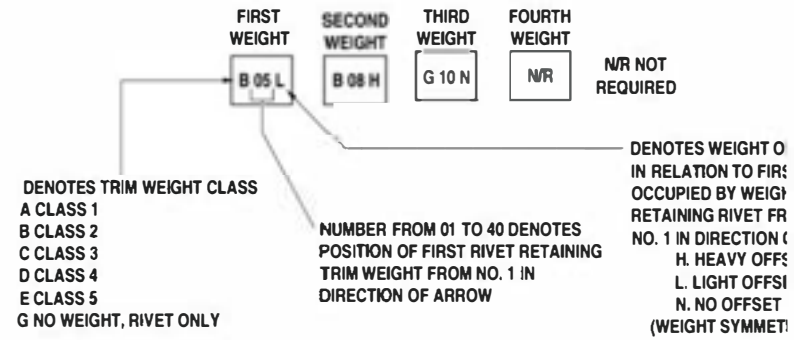


Figure 206 Nozzle Sheath Wear Limits

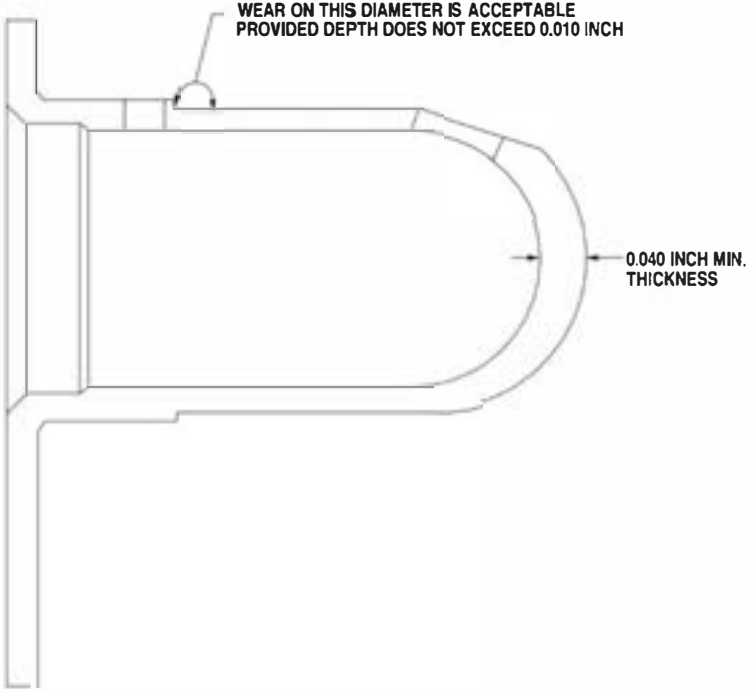


Figure 206 Power Turbine First-Stage Blade Shift

POWER TURBINE

1. BLADE PLATFORM END
2. TURBINE DISK

NOTE: PROTRUSION OF BLADE MAY BE MEASURED FROM EITHER SIDE OF DISK

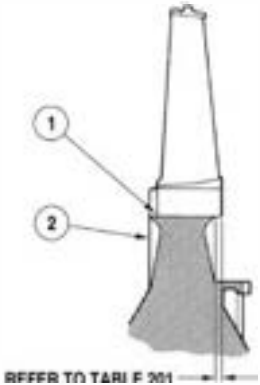
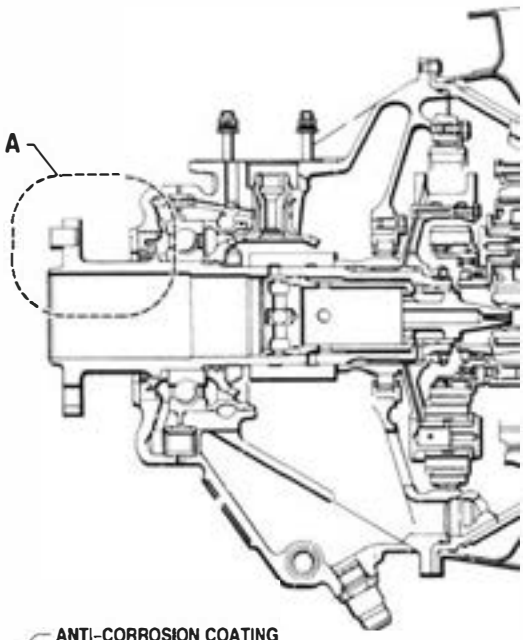
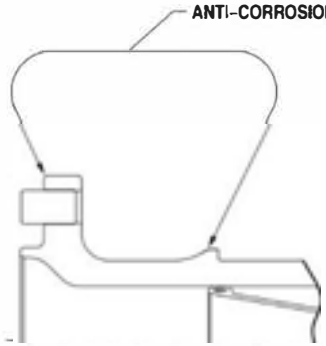


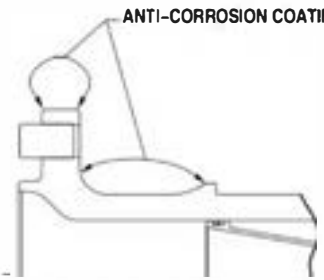
Figure 206 Propeller Shaft Anti-corrosion Coating - Local Restoration





DETAIL A

PRE-SB14500



DETAIL A

POST-SB14500

Figure 206 Repair of Diffuser Exit Duct

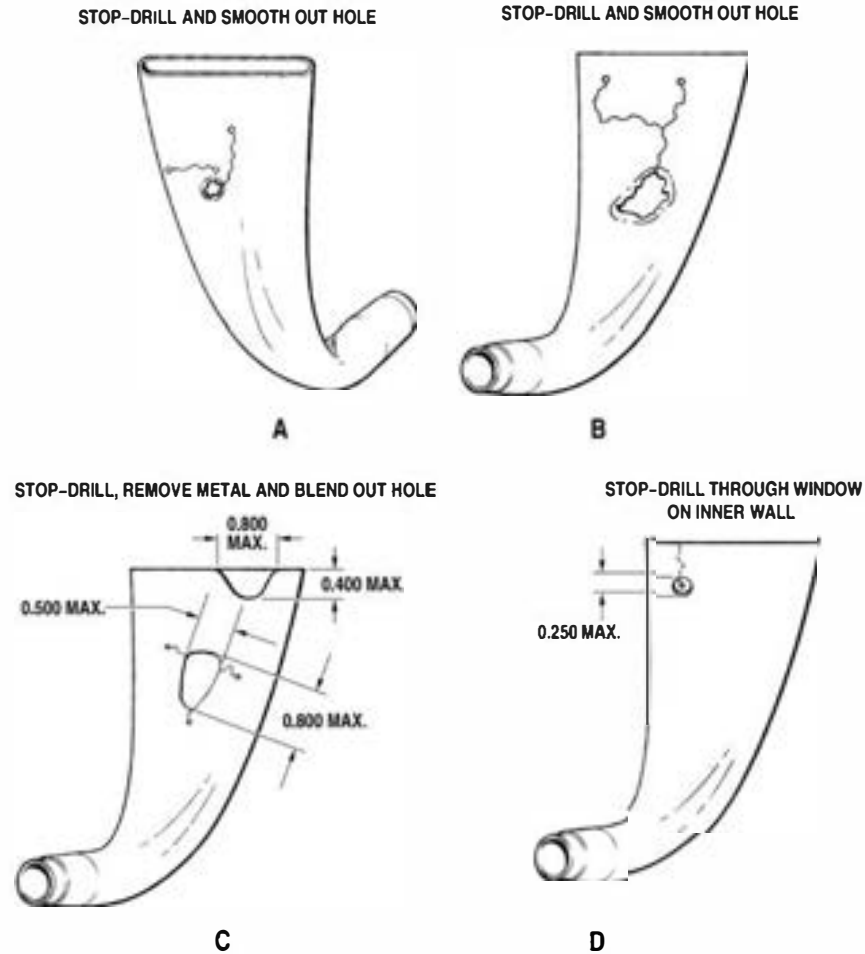
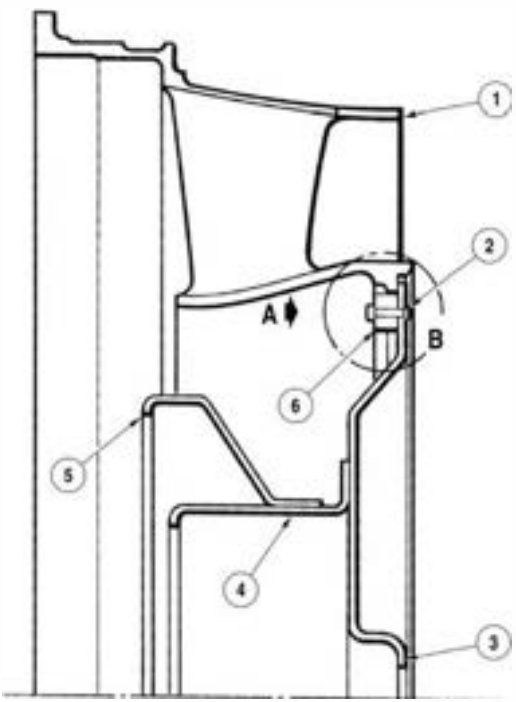
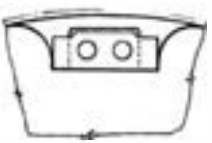
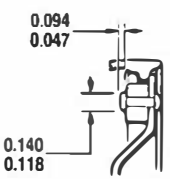


Figure 206 Replacement of Interstage Baffle Rivets



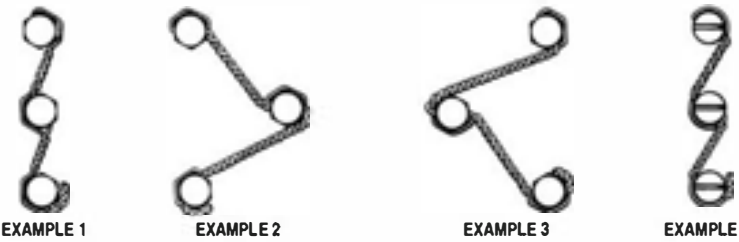


VIEW ON A



DETAIL B

Figure 206 Lockwiring Examples (sheet 1 of 3)



EXAMPLE 1 EXAMPLE 2 EXAMPLE 3 EXAMPLE 4

EXAMPLES 1,2,3 AND 4 APPLY TO ALL TYPES OF BOLTS. FILLISTER HEAD SCREWS, SQUARE HEAD PLUGS, AND OTHER SIMILAR PARTS WHICH ARE WIRED SO THAT THE LOOSENING TENDENCY OF EITHER PART IS COUNTERACTED BY TIGHTENING OF THE OTHER PART. THE DIRECTION OF TWIST, FROM THE SECOND TO THE THIRD UNIT, IS COUNTER-CLOCKWISE TO KEEP THE LOOP IN POSITION AGAINST THE HEAD OF THE BOLT. THE WIRE ENTERING THE HOLE IN THE THIRD UNIT WILL BE THE LOWER WIRE AND BY MAKING A COUNTER-CLOCKWISE TWIST AFTER IT LEAVES THE HOLE. THE LOOP WILL BE SECURED IN PLACE AROUND THE HEAD OF THAT BOLT.

EXAMPLE 5 EXAMPLE 6 EXAMPLE 7 EXAMPLE 8

EXAMPLES 5,6,7 AND 8 SHOW METHODS FOR WIRING VARIOUS STANDARD ITEMS. WIRE MAY BE WRAPPED OVER THE UNIT RATHER THAN AROUND IT WHEN WIRING CASTELLATED NUTS OR ON OTHER ITEMS WHEN THERE IS A CLEARANCE PROBLEM.

EXAMPLE 9

EXAMPLE 9 SHOWS THE METHOD FOR WIRING BOLTS IN DIFFERENT PLANES. NOTE THAT WIRE SHOULD ALWAYS BE APPLIED SO THAT TENSION IS IN THE TIGHTENING

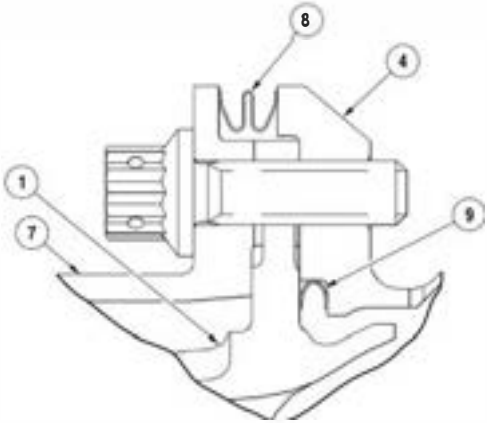
EXAMPLE 10

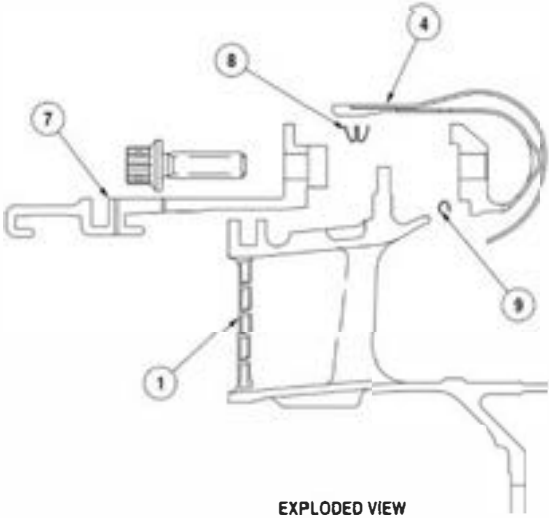
EXAMPLE 10 SHOWS HOLLOW HEAD PLUGS WIRED WITH THE TAB BENT INSIDE THE HOLE TO AVOID SNAGS AND POSSIBLE INJURY TO PERSONNEL WORKING

EXAMPLE 11

EXAMPLE 11 SHOWS CORRECT APPLICATION OF SINGLE WIRE TO CLOSELY SPACED MULTIPLE GROUP.

Figure 207 Compressor Turbine Stator, Housing and Small Exit Duct - Repair (sheet 2 of 2)





EXPLODED VIEW

Figure 207 Compressor Turbine Stator, Housing and Small Exit Duct - Repair (sheet 1 of 2)

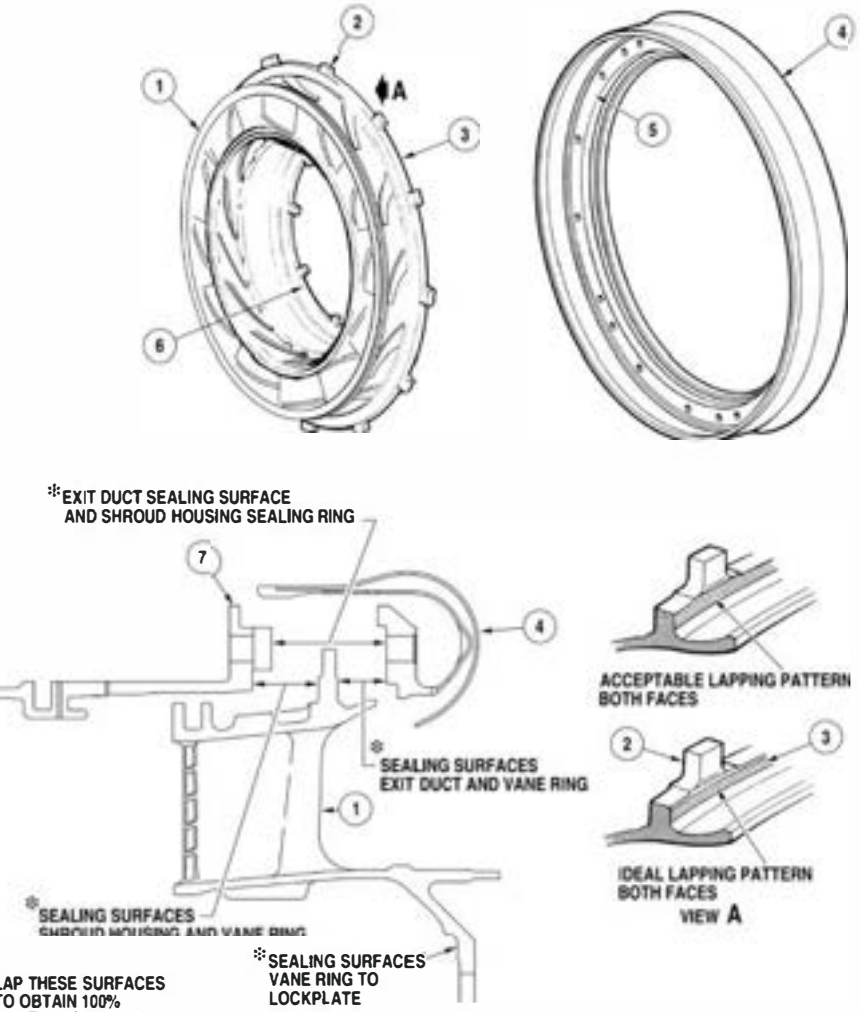
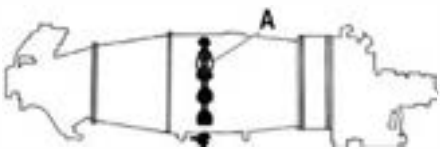
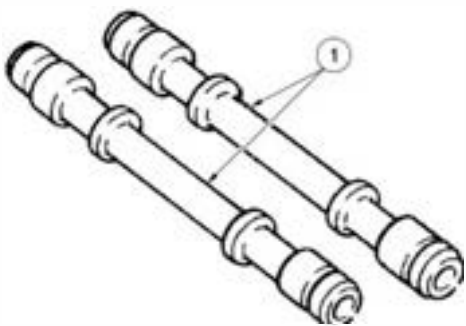


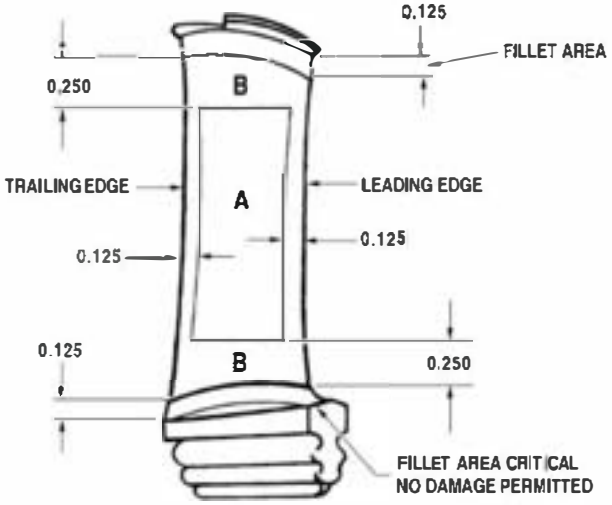
Figure 207 Fuel Manifold Transfer Tube





DETAIL A
(TYPICAL)

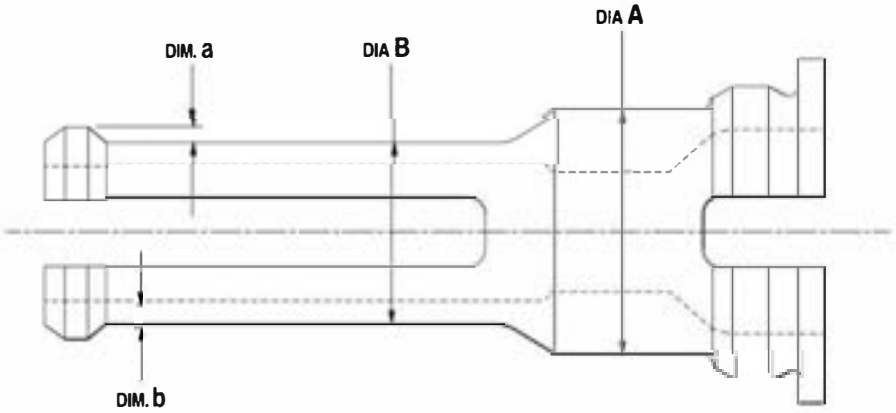
Figure 207 Power Turbine Second-Stage Blade Inspection



NOTE:

1. RIPPLING OF TRAILING EDGE IS NOT ACCEPTABLE

Figure 207 Spring Lock Insert



NOTE: INTERNAL CURVATURE MAY BE IGNORED
WHEN MEASURING DIM. b

Figure 207 Standard Safety Cable Components

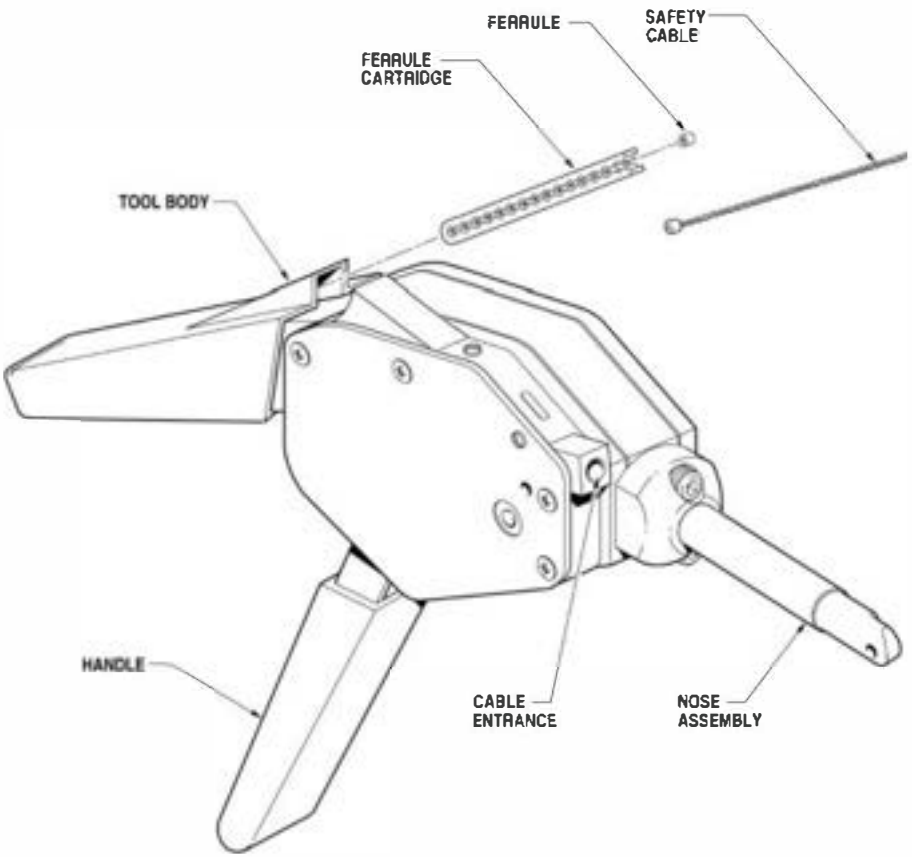


Figure 208 Manifold Adapter Sealing Surfaces

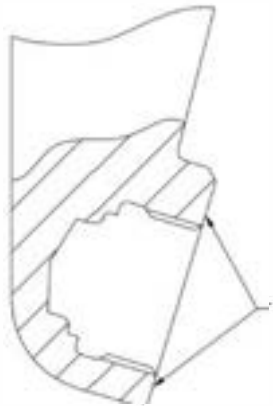


Figure 208 Power Turbine Interstage Stator Assembly Inspection

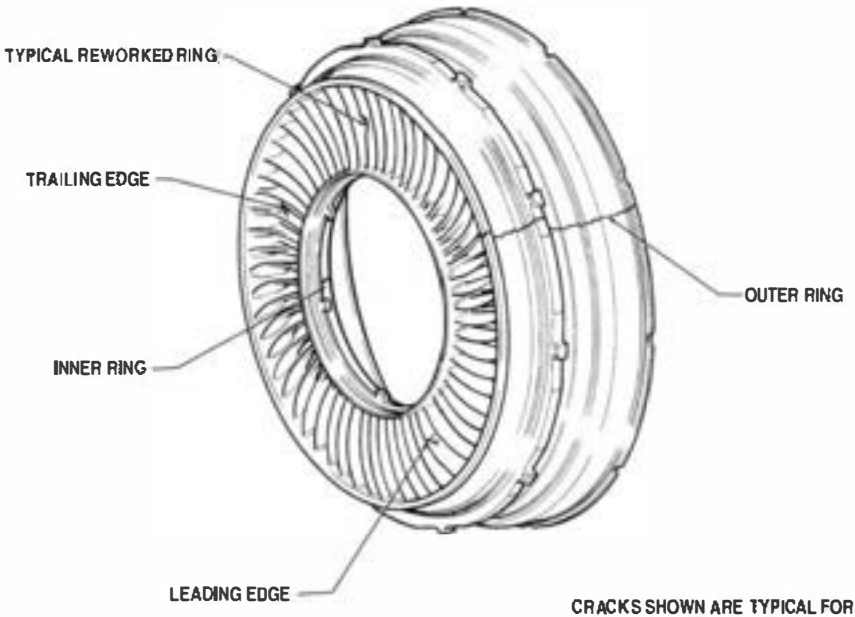


Figure 208 Replacement of Accessory Drive Oil Seals (Typical)

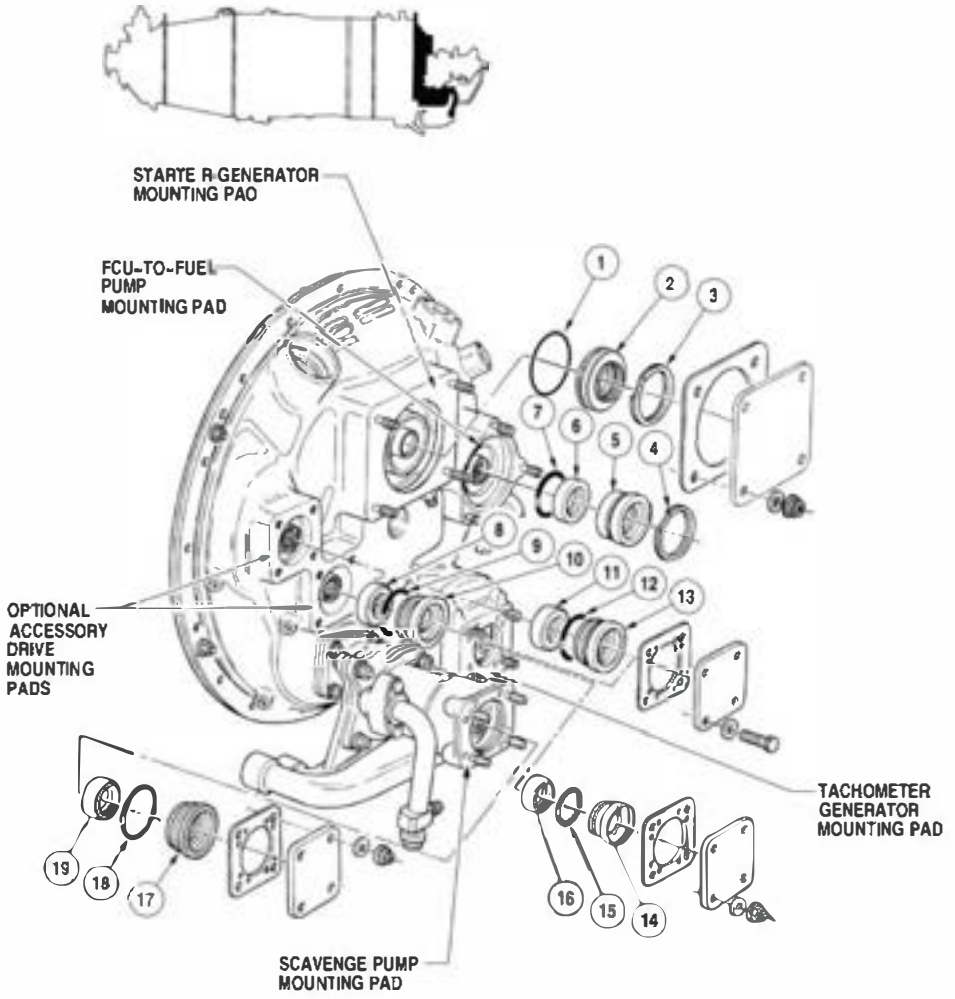


Figure 208 Shroud Housing Assembly Slots and Stator Lugs - Clearance Check

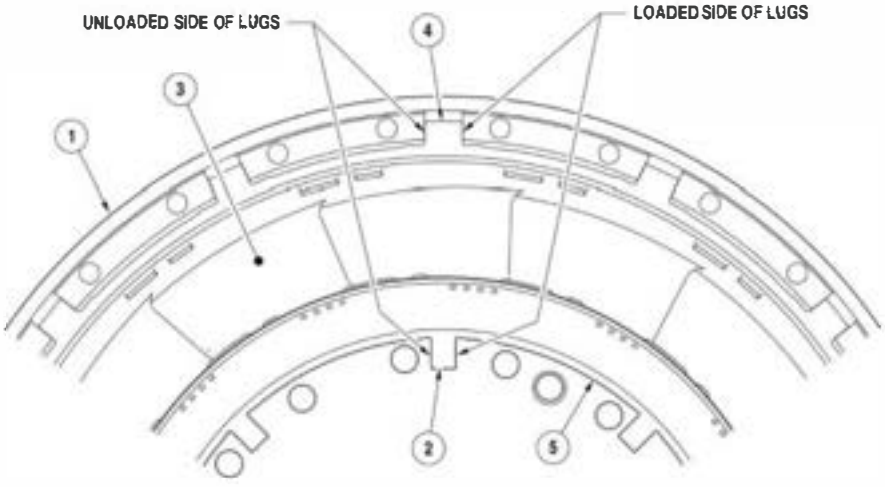


Figure 208 Safety Cable Patterns

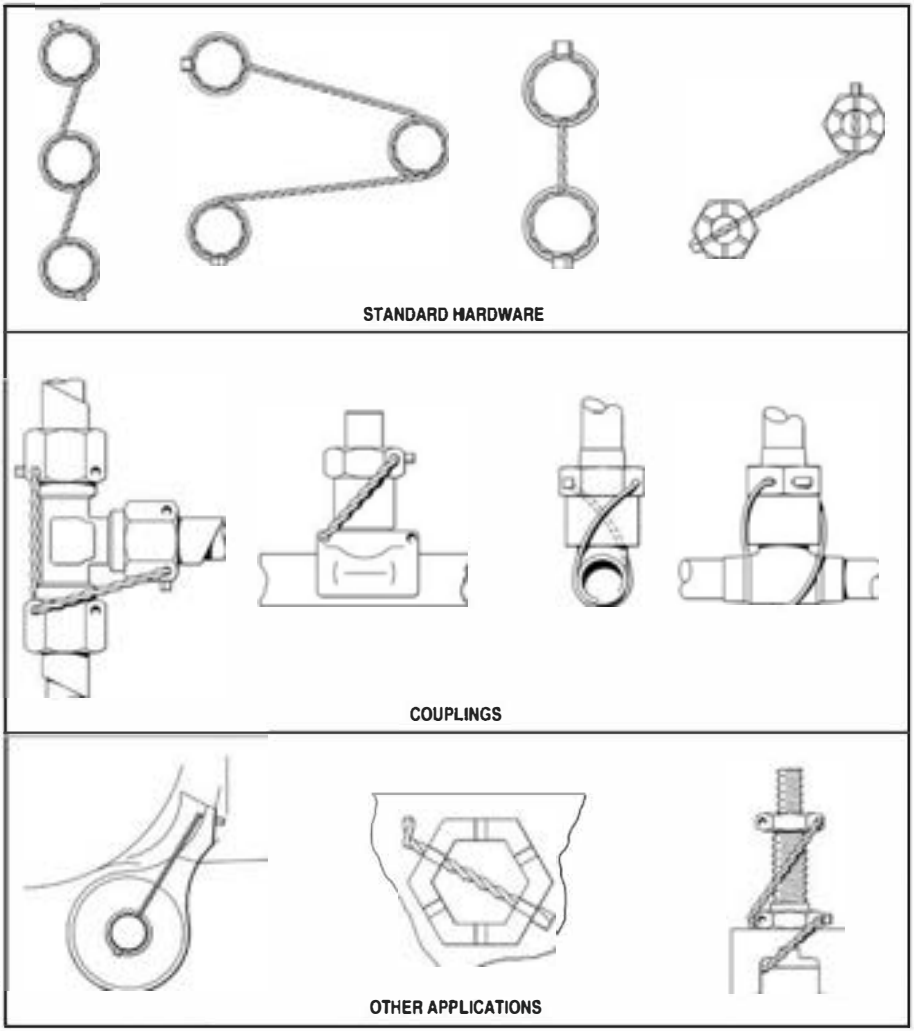


Figure 209 Fits and Clearances

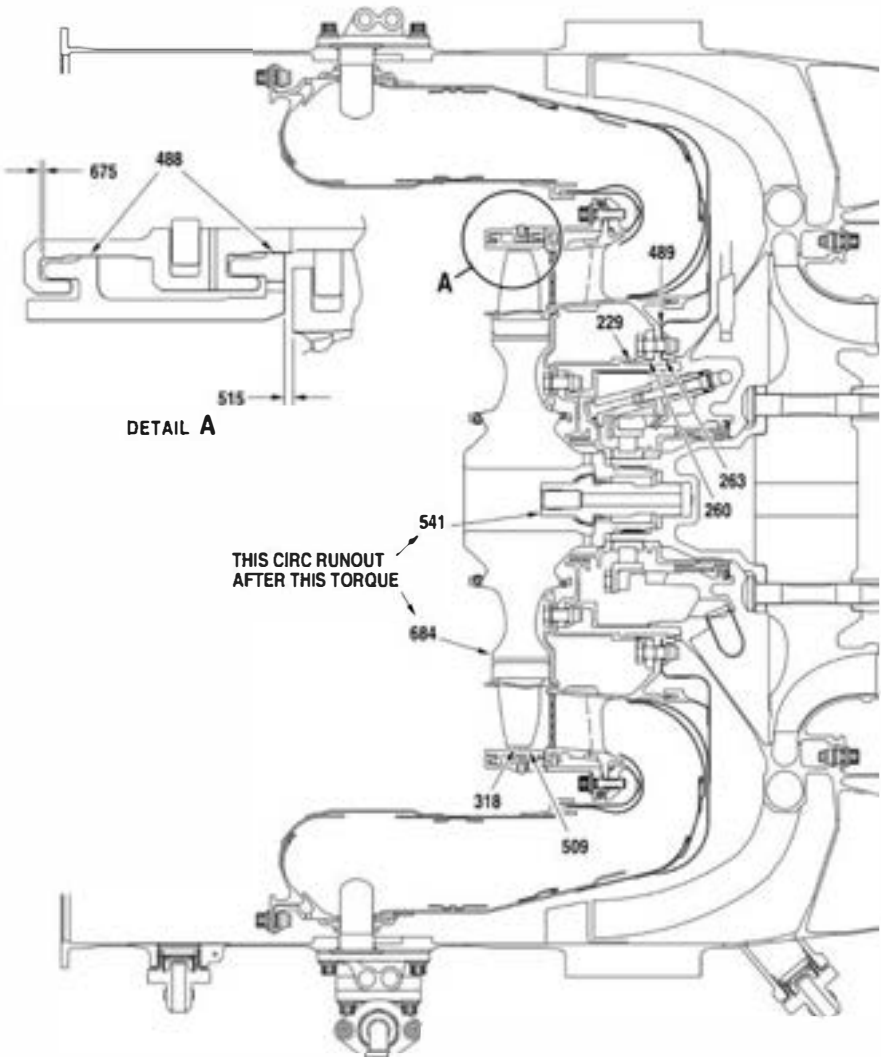


Figure 209 Fuel Nozzle Spray Conditions

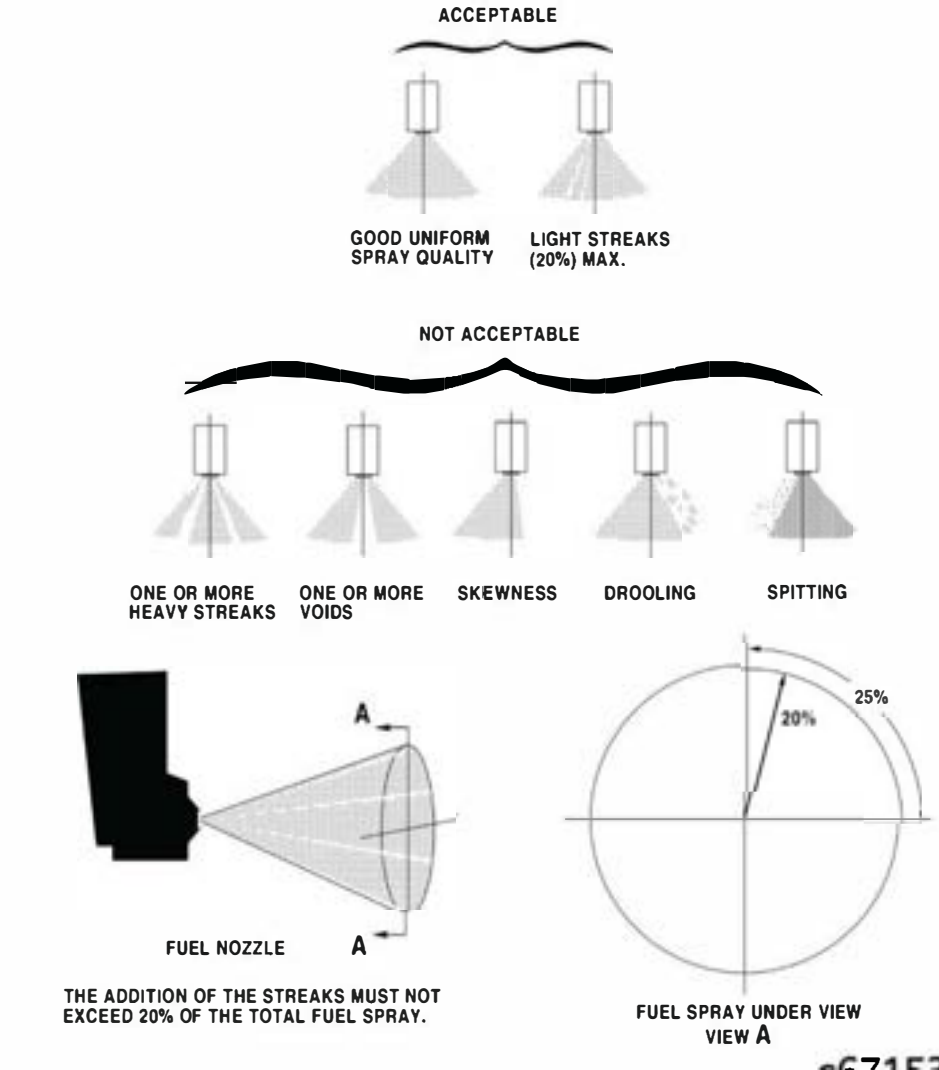
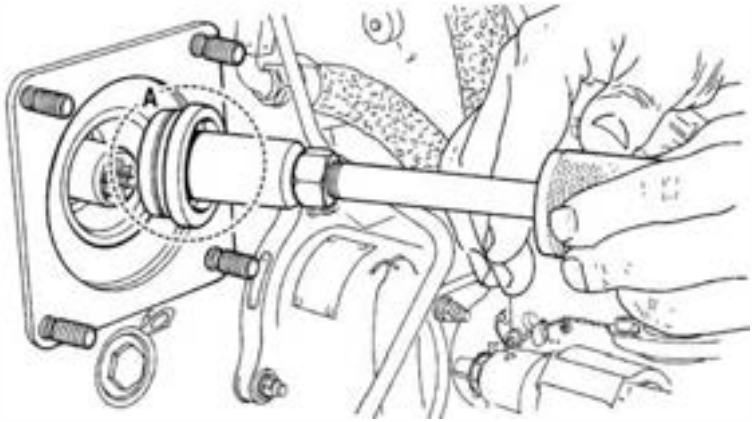


Figure 209 Oil Seal Carrier and Oil Seal (Typical)



DETAIL A
SEAL CONFIGURATION
FOR STARTER-GENERATOR

DETAIL A
SEAL CONFIGURATION
FOR FCU DRIVE

DETAIL A
SEAL CONFIGURATION
FOR ACCESSORY DRIVE

Figure 209 Safety Cable Installation

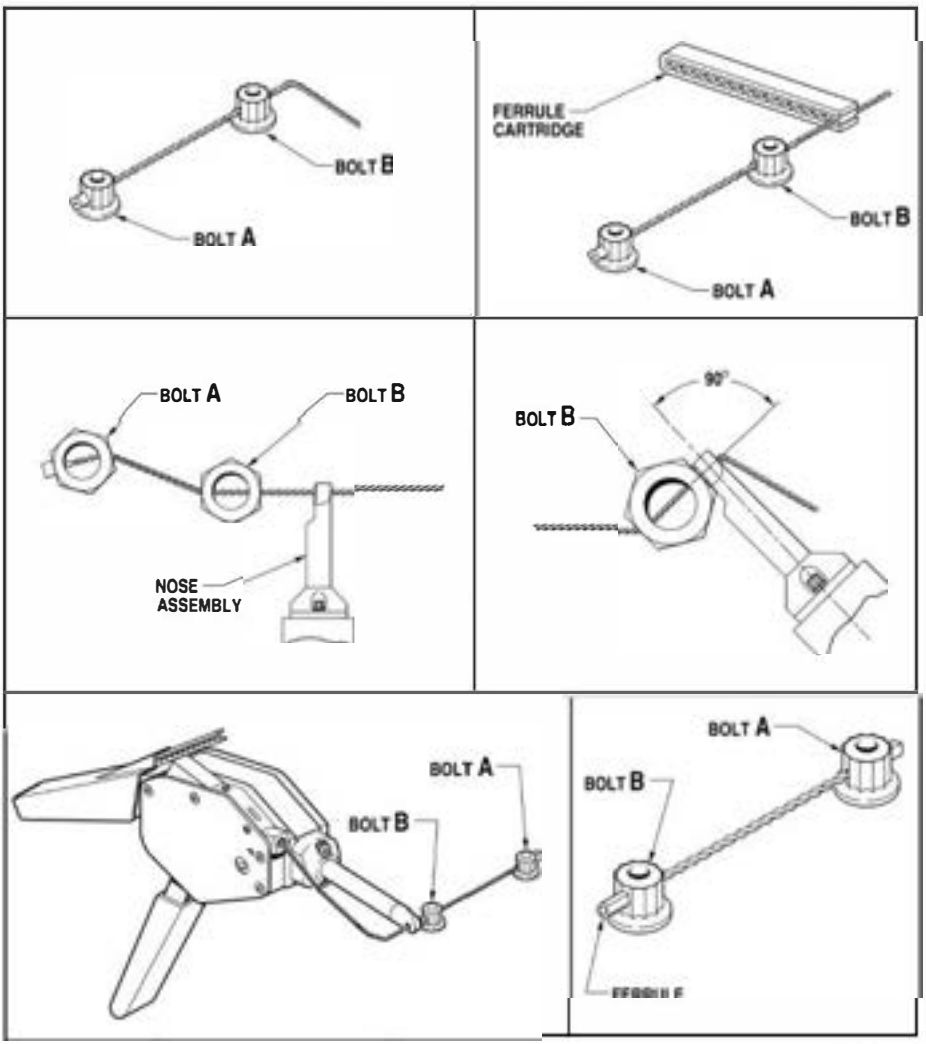
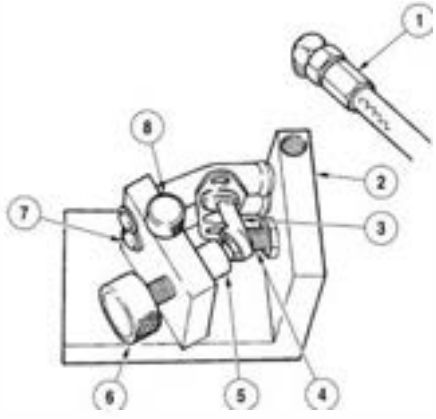
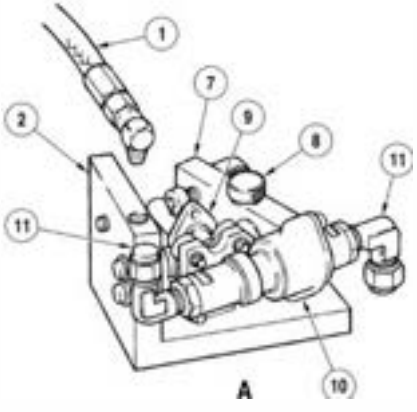
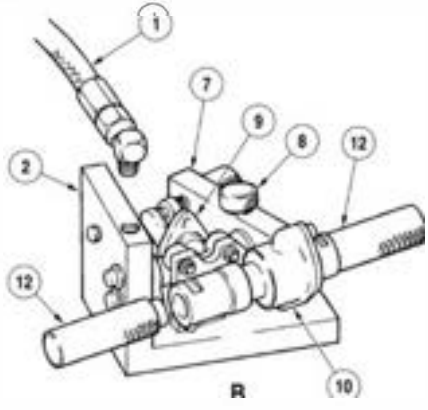


Figure 210 Fuel Nozzle Leakage Test - External Leaks



MANIFOLD ADAPTERS





INLET MANIFOLD ADAPTER
WITH FLOW DIVIDER

Figure 210 Installation of Oil Seal Carrier (Typical)

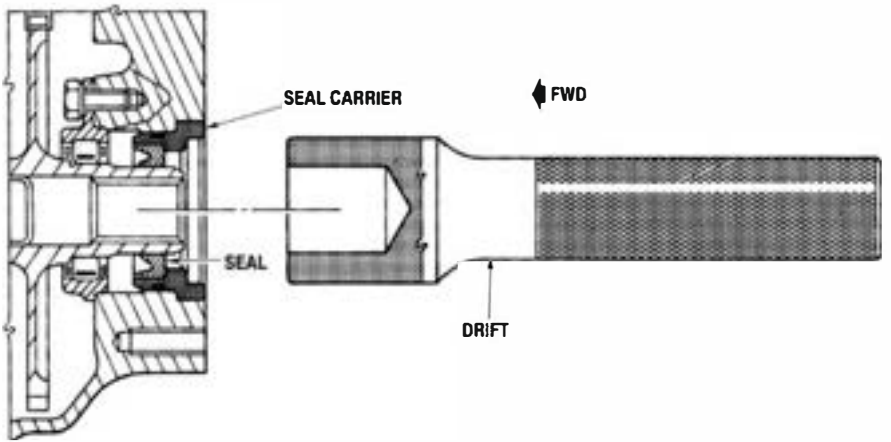
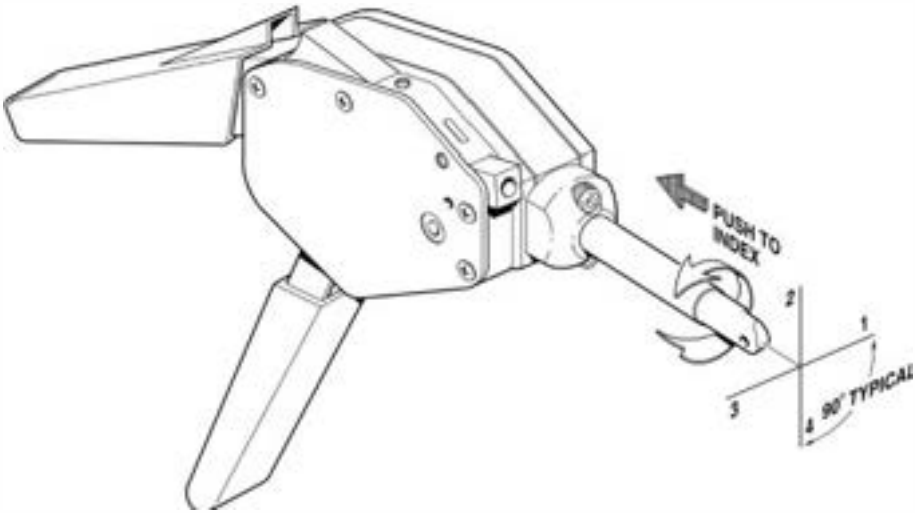


Figure 210 Nose Assembly Rotation



NOTE: THE NOSE ASSEMBLY CAN BE ADJUSTED TO 4 POSITIONS IN 90° INCREMENTS. TO SELECT THE POSITION, PUSH THE NOSE ASSEMBLY IN AND ROTATE TO THE DESIRED POSITION.

Figure 211 Installation of Seal/Mandrel and Carrier Assembly (Typical) (sheet 2 of 2)

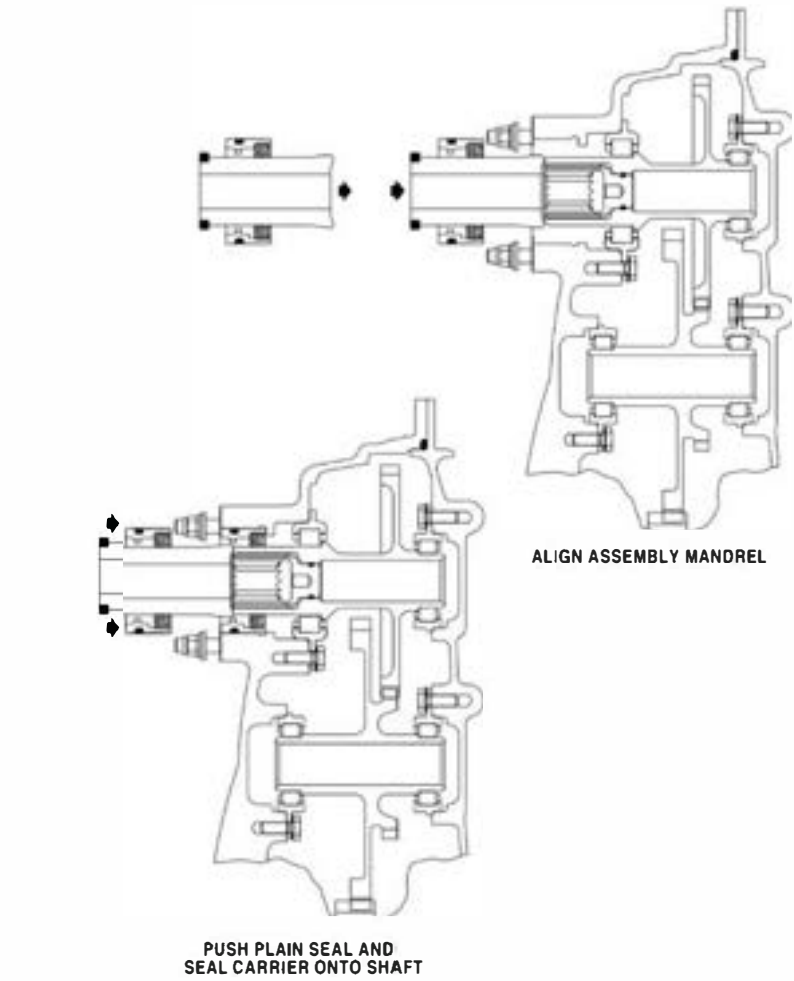


Figure 211 Installation of Seal/Mandrel and Carrier Assembly (Typical) (sheet 1 of 2)

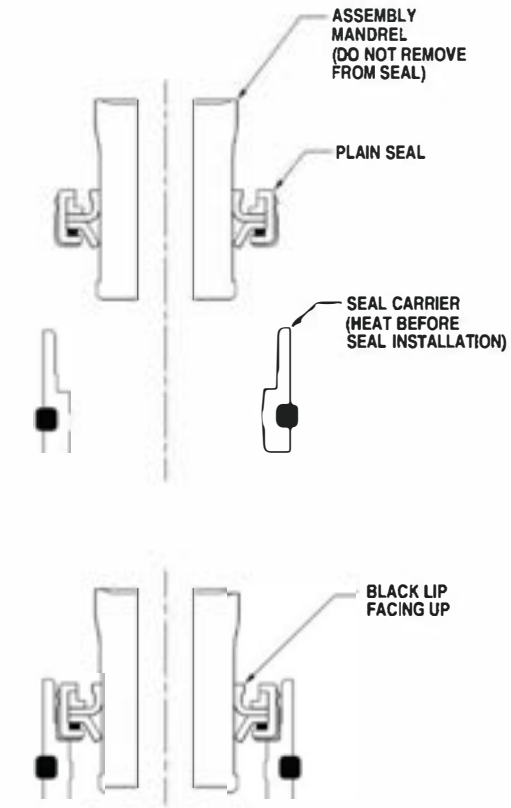
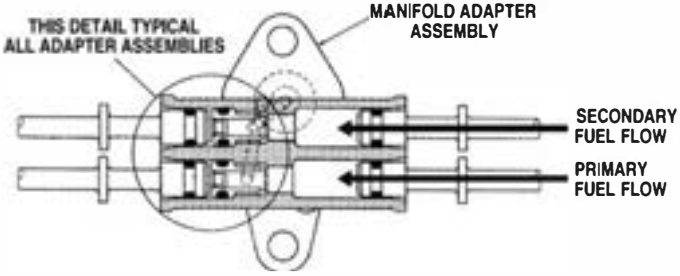


Figure 211 Internal Leak Test - Manifold Adapter Assembly



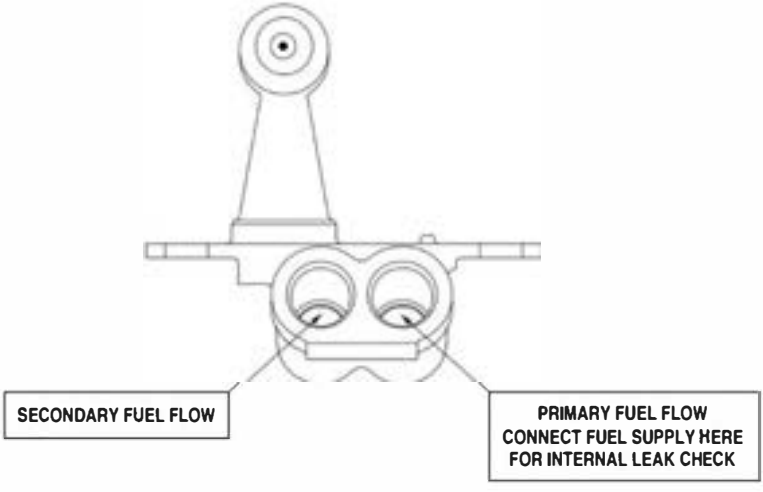
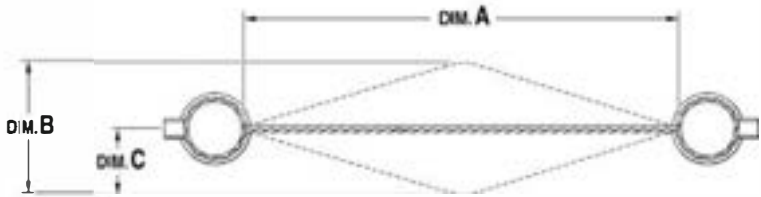
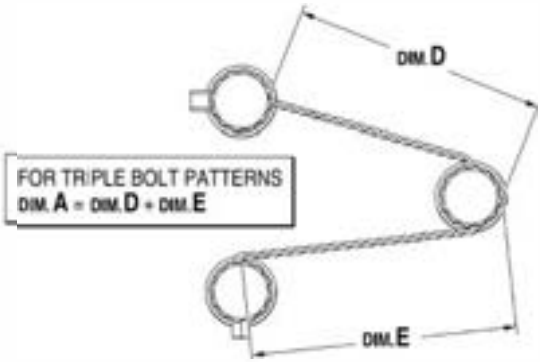


Figure 211 Safety Cable Flex Limits





DIM. A	DIM. B	DIM. C
0.5 IN. (12.7 mm)	0.125 IN. (3.18 mm)	0.062 IN. (1.59 mm)
1.0 IN. (25.4 mm)	0.250 IN. (6.35 mm)	0.125 IN. (3.18 mm)
2.0 IN. (50.8 mm)	0.375 IN. (9.52 mm)	0.188 IN. (4.76 mm)
3.0 IN. (76.2 mm)	0.375 IN. (9.52 mm)	0.188 IN. (4.76 mm)
4.0 IN. (101.6 mm)	0.500 IN. (12.70 mm)	0.250 IN. (6.35 mm)
5.0 IN. (127.0 mm)	0.500 IN. (12.70 mm)	0.250 IN. (6.35 mm)
6.0 IN. (152.4 mm)	0.625 IN. (15.88 mm)	0.312 IN. (7.94 mm)

Figure 212 Fuel Manifold Adapter and Nozzle Assembly Function Test

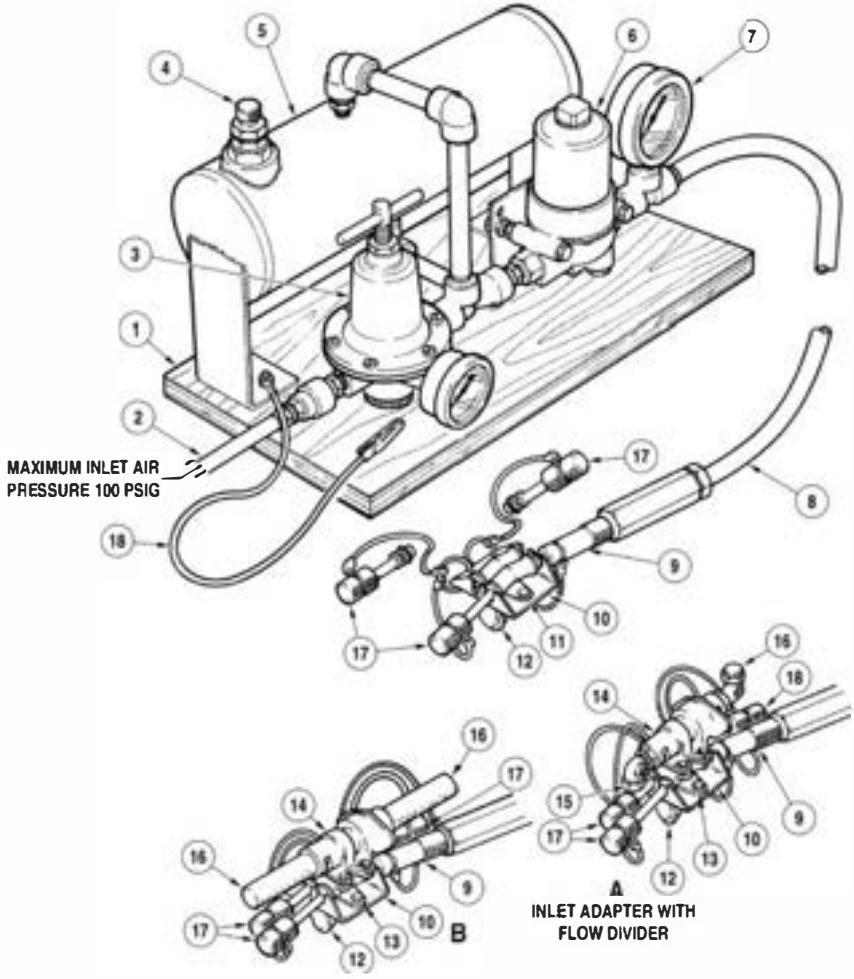


Figure 212 Oil Pump Drive Seal

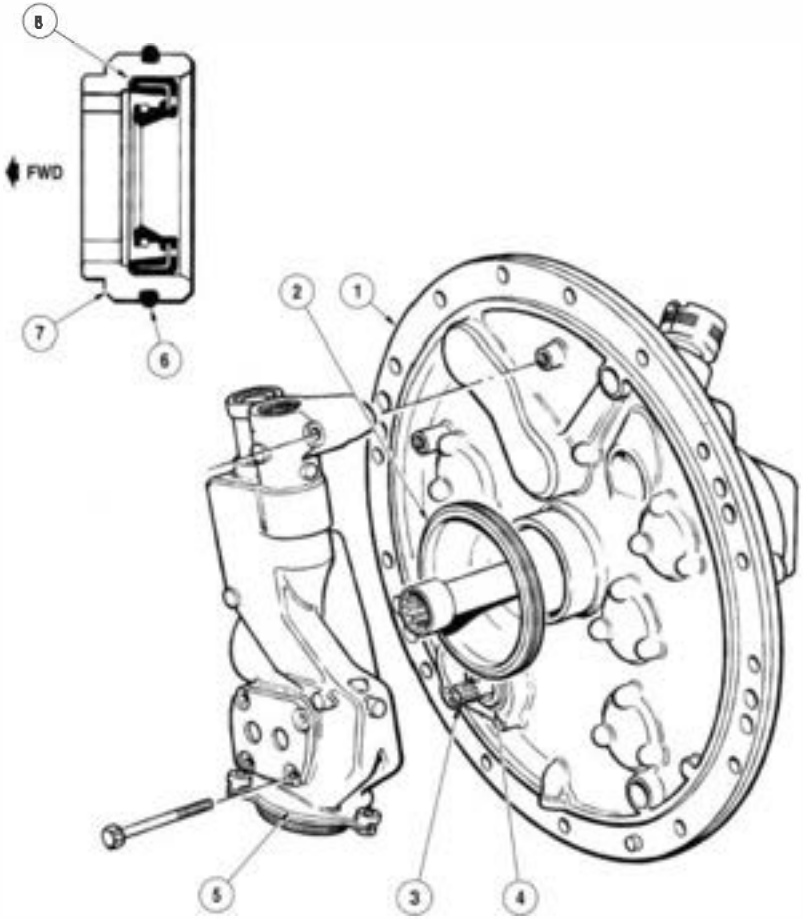
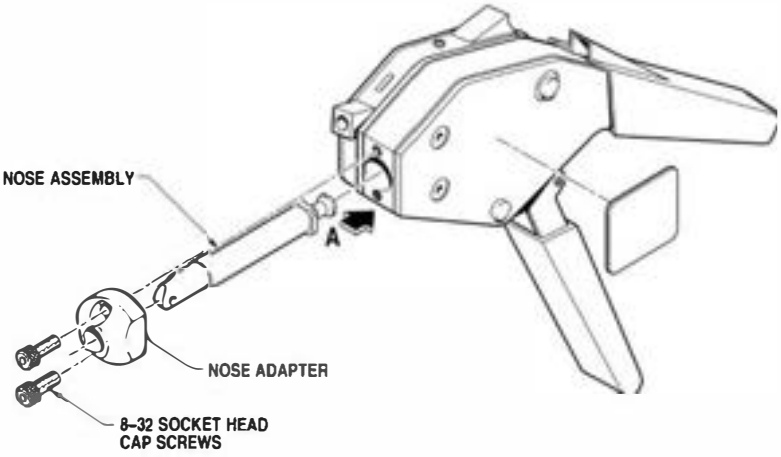


Figure 212 Indenter Adjustment



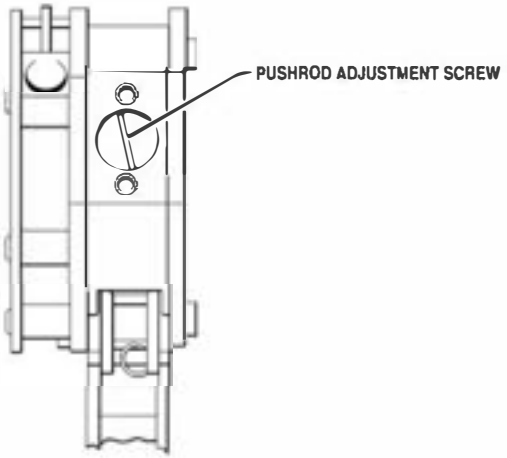


Figure 213 Replacement of Starter-generator Gearshaft

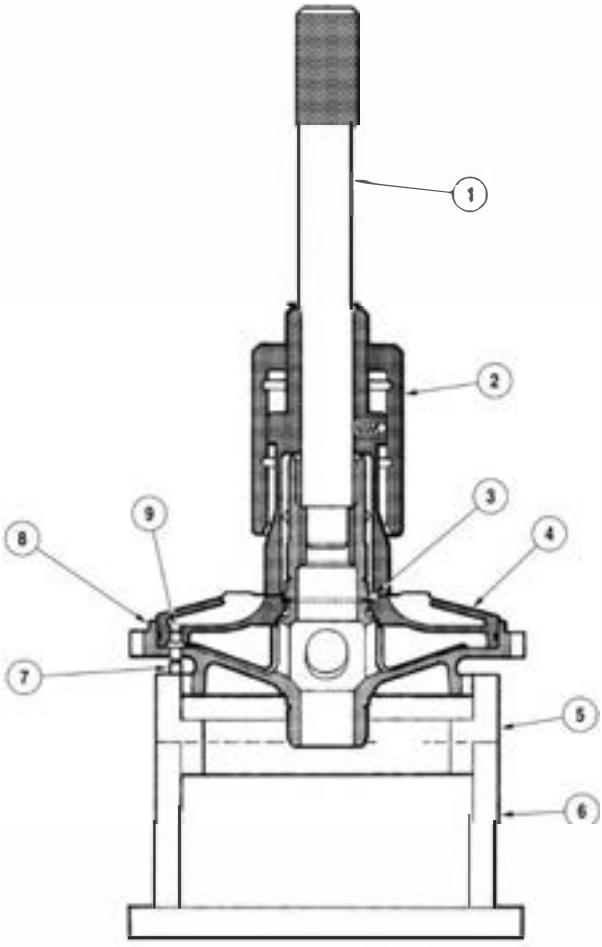


Figure 213 Spray Chamber (PWC90086)

c200883

Figure 213 Test Block - Crimper Calibration

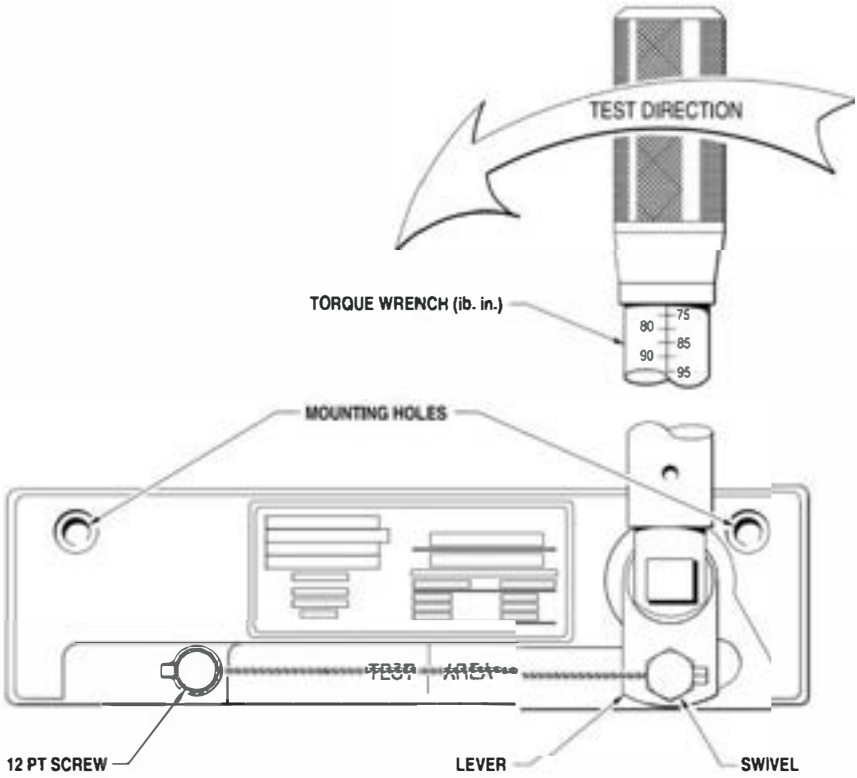


Figure 214 Replacement of Starter-generator Gearshaft Carbon Seal (sheet 2 of 2)

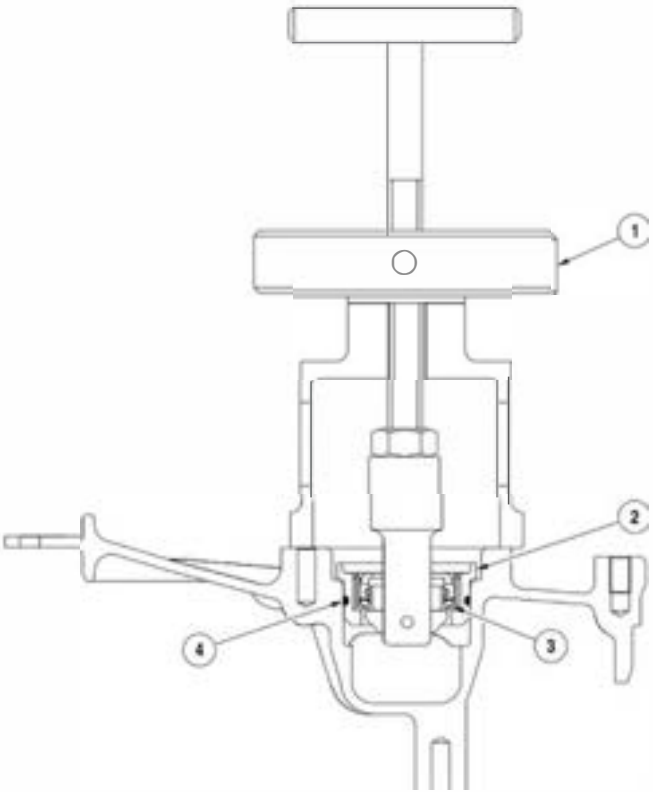


Figure 214 Replacement of Starter-generator Gearshaft Carbon Seal (sheet 1 of 2)

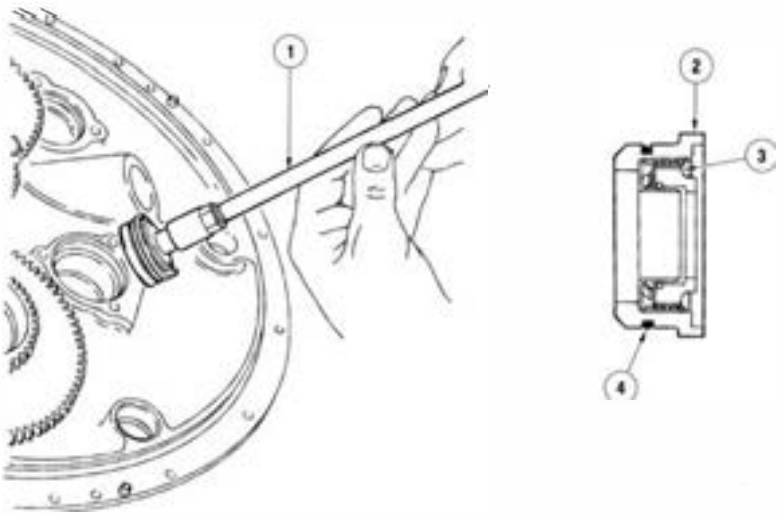
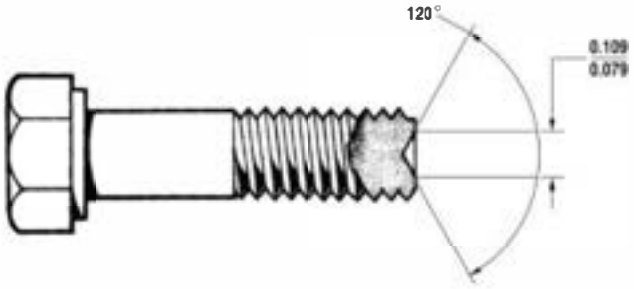
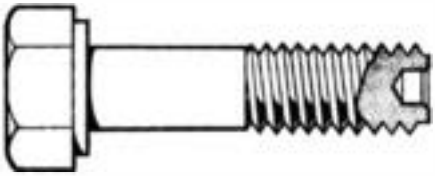


Figure 214 Reduced Pitch Diameter Bolt Identification



REDUCED PITCH DIAMETER BOLT



STANDARD BOLT

Figure 215 Oil Filler Tube, Filler Cap and Gage Assembly

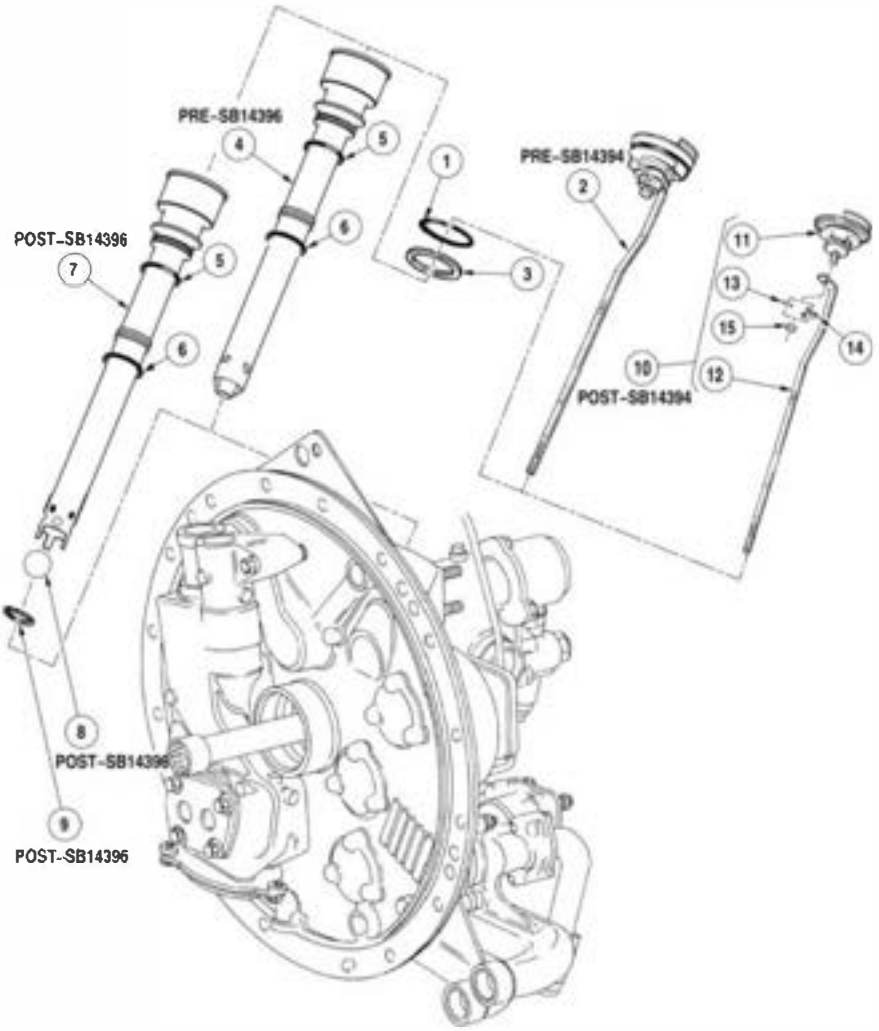


Figure 215 Hardware Code Identification

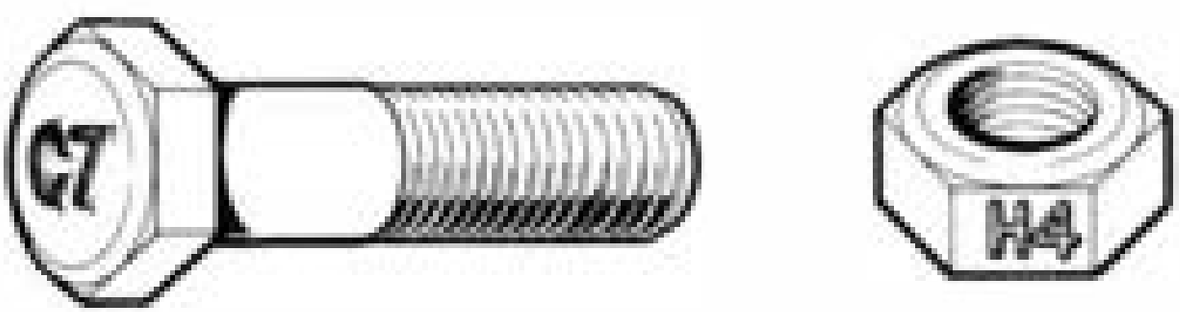


Figure 216 Oil Pressure Regulating Valve and Cold Oil Pressure Relief Valve

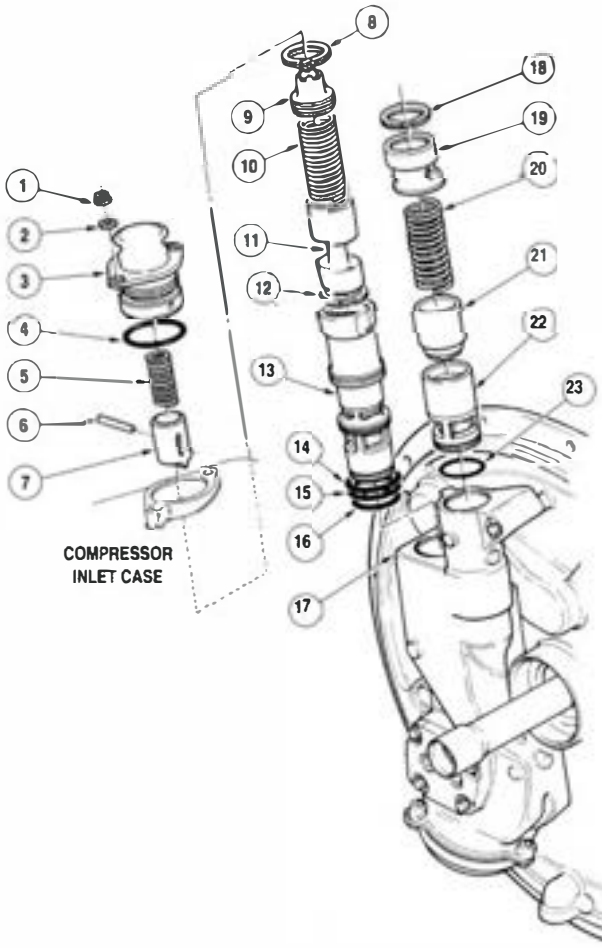


Figure 301 Oil Drain Plug Locations (Typical)

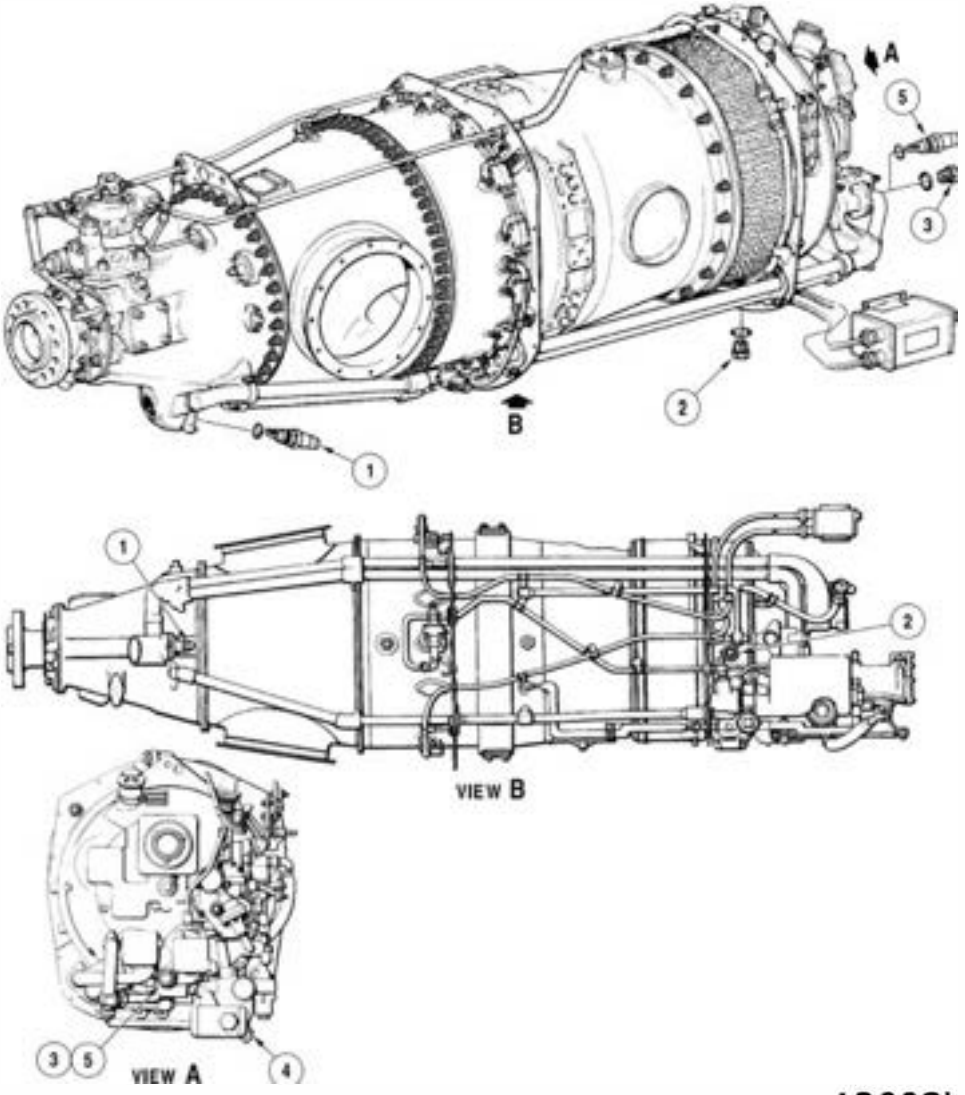


Figure 302 Shipping/Storage Container

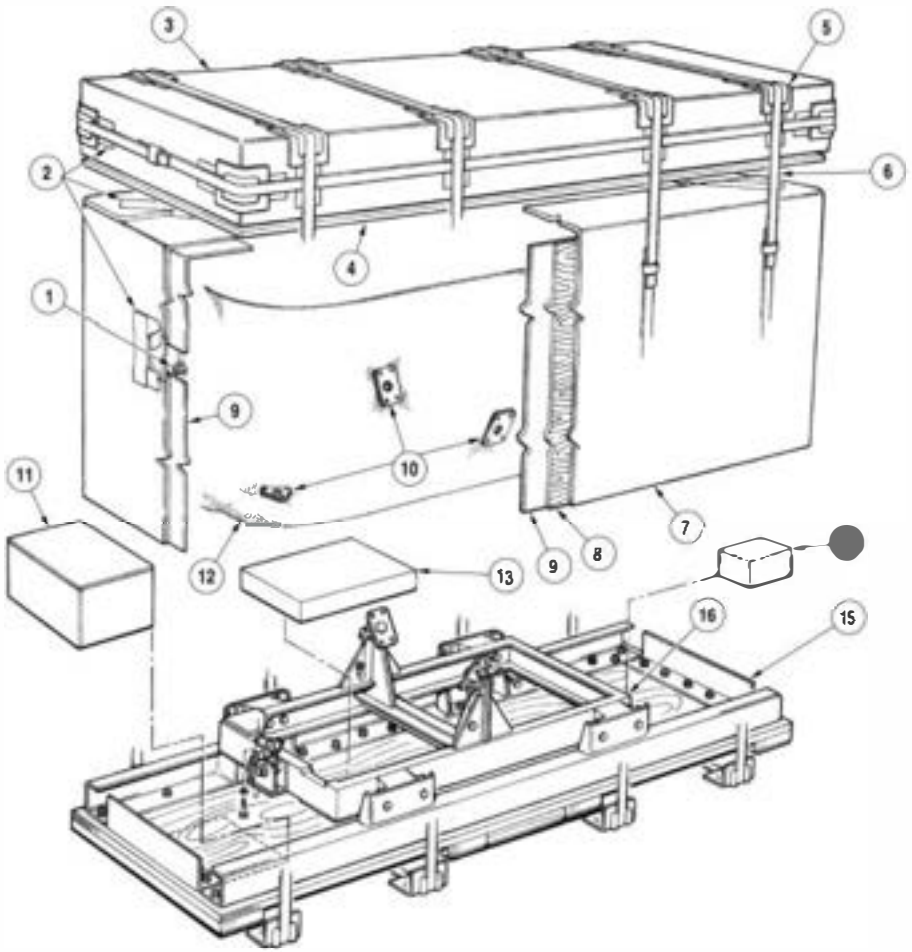


Figure 303 Removal/Installation of Engine from/in Fiberboard Shipping/Storage Container

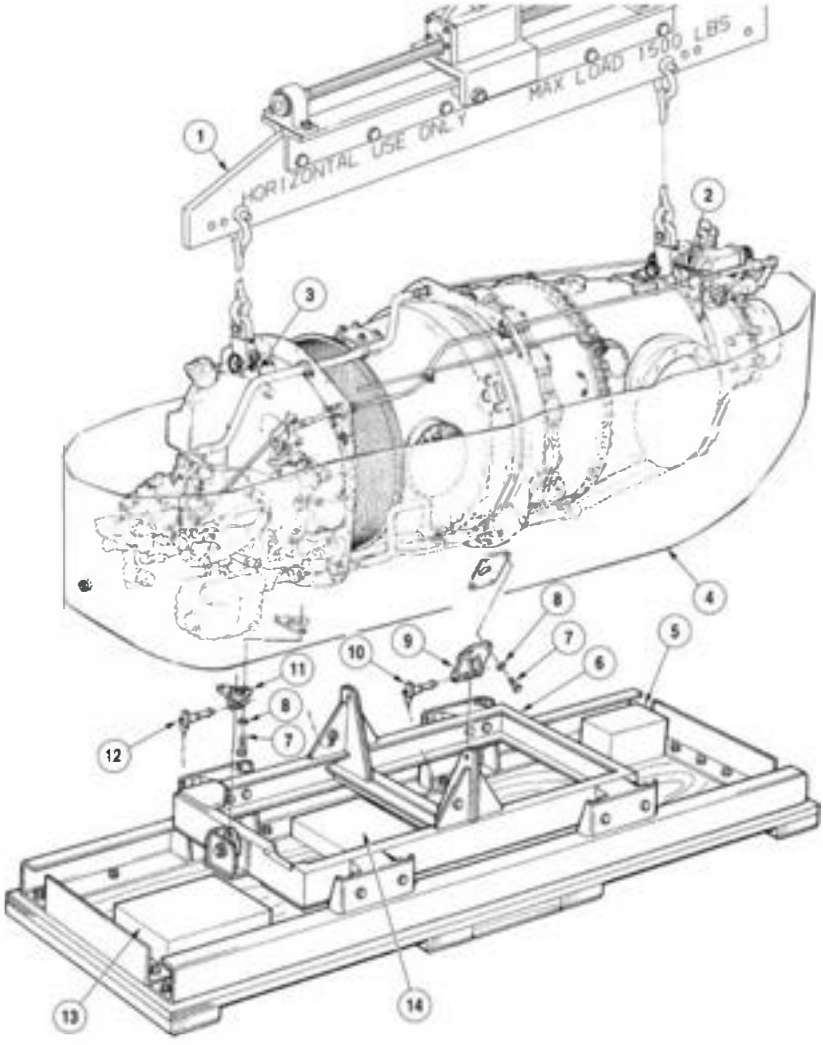


Figure 304 Shipping Caps, Covers and Plugs, Engine (Typical)

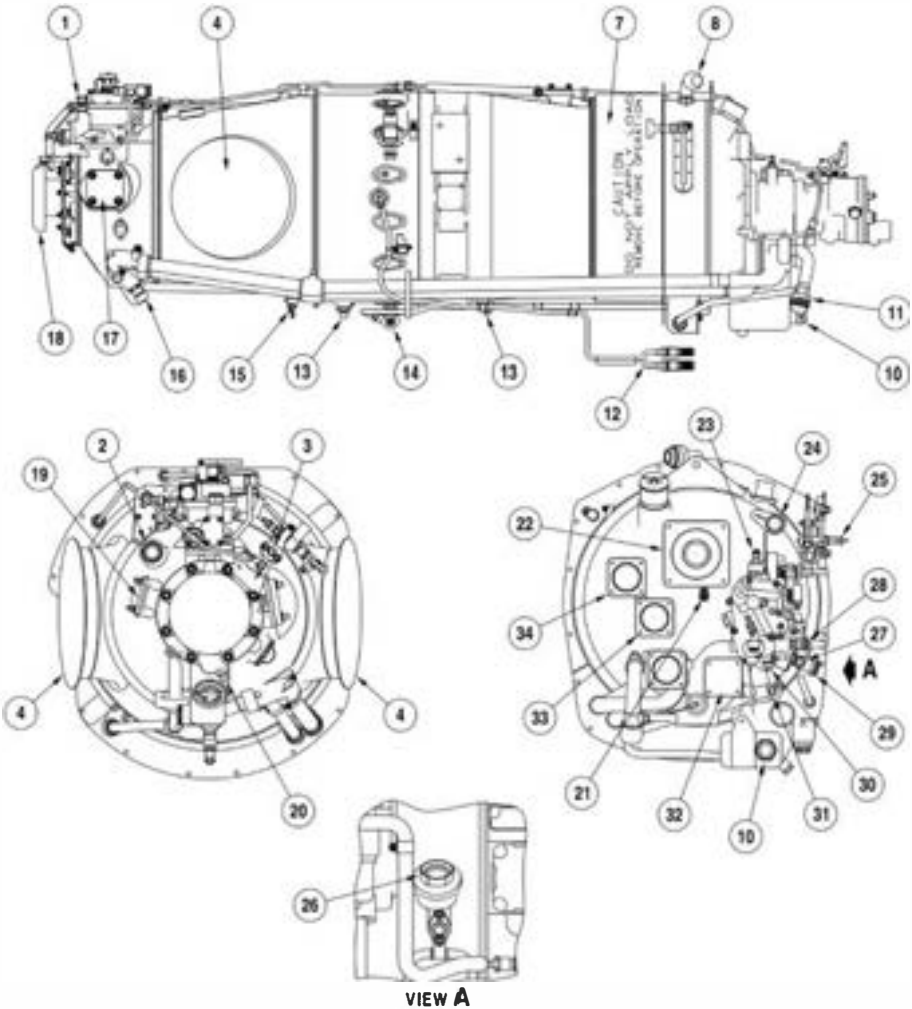


Figure 305 Removal/Installation of Engine from/in Stand - (PWC51140 or PWC70907)

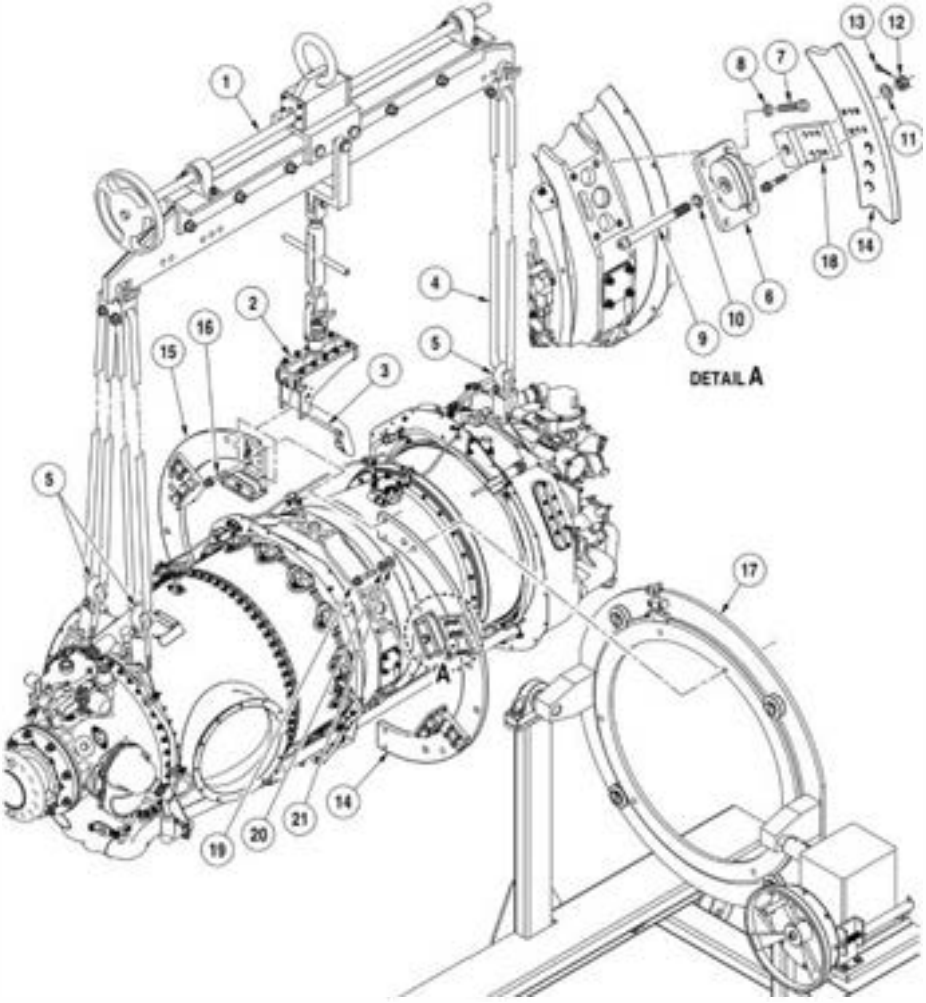


Figure 306 Power Section/Power Section Module (PS/PSM) Shipping/Storage Container

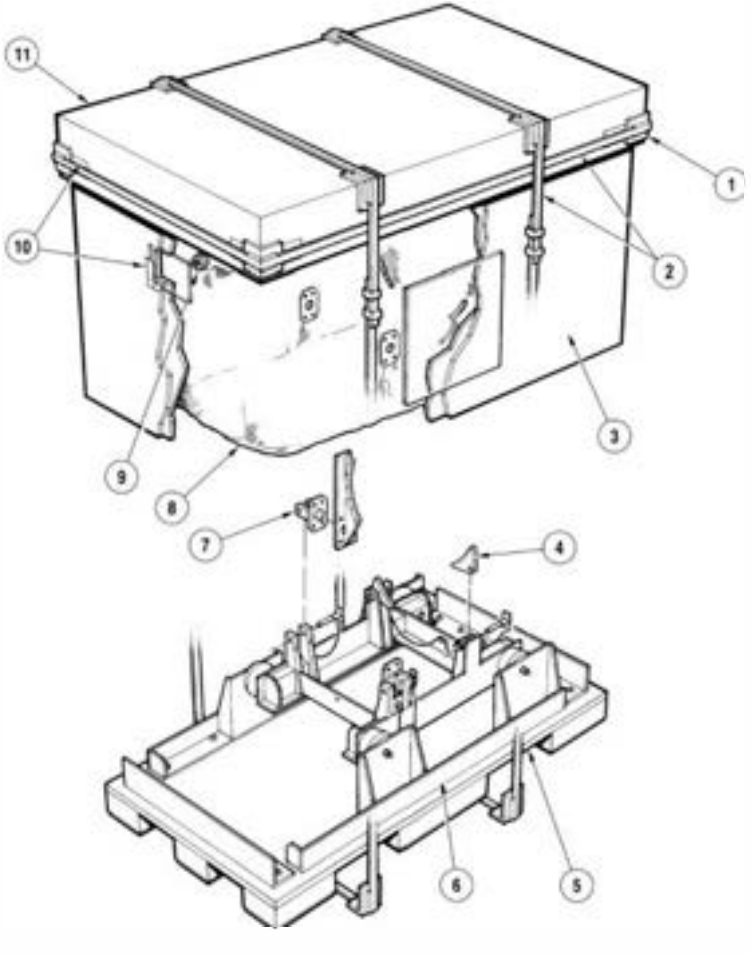


Figure 307 Removal/Installation of Power Section/Power Section Module (PS/PSM) from/in Container

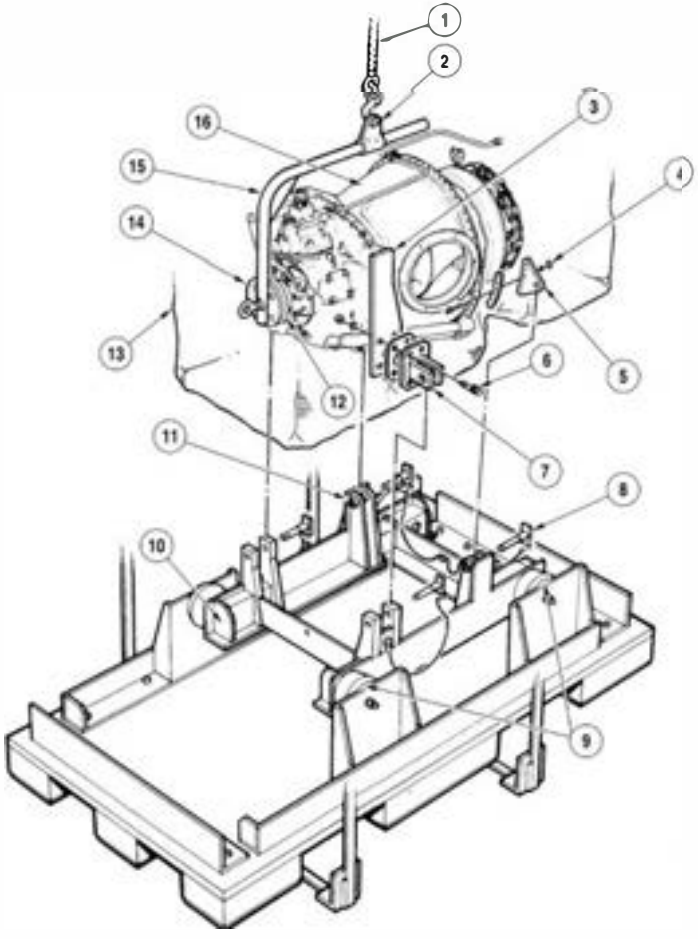
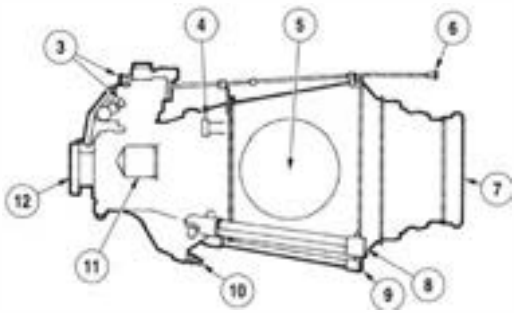


Figure 308 Shipping Caps, Covers and Plugs, Power Section/Power Section Module



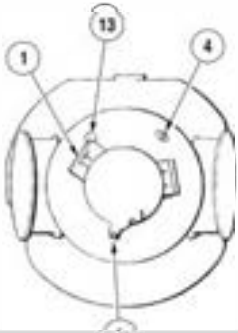


Figure 309 Removal/Installation of Power Section from/in Stand (Typical)

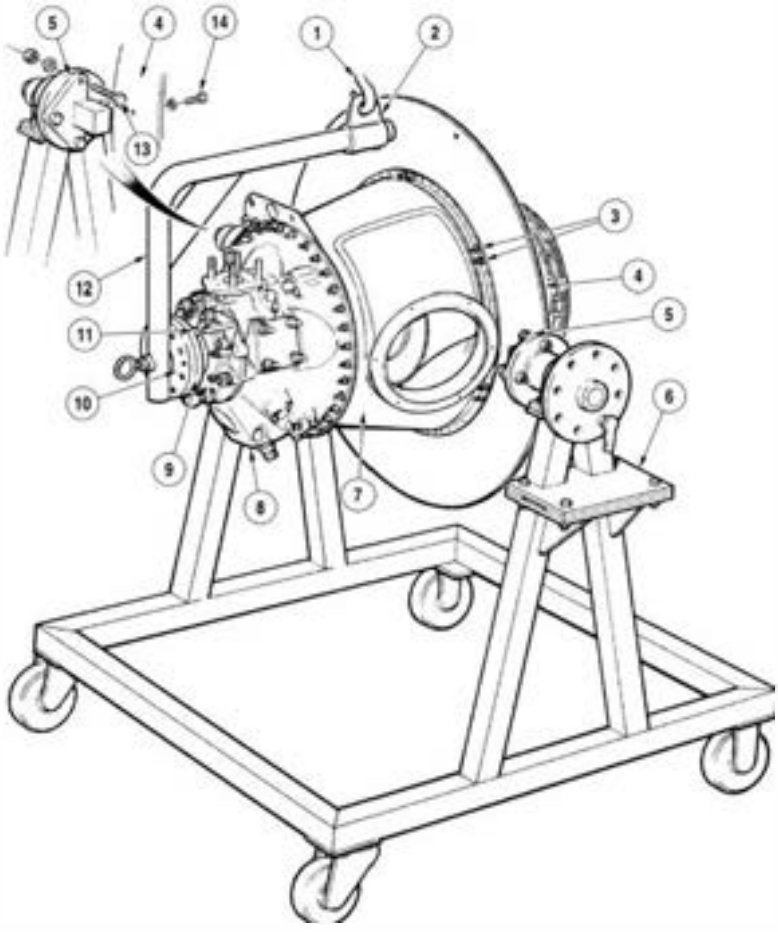


Figure 310 Removal/Installation of GGM from/in Container - Typical

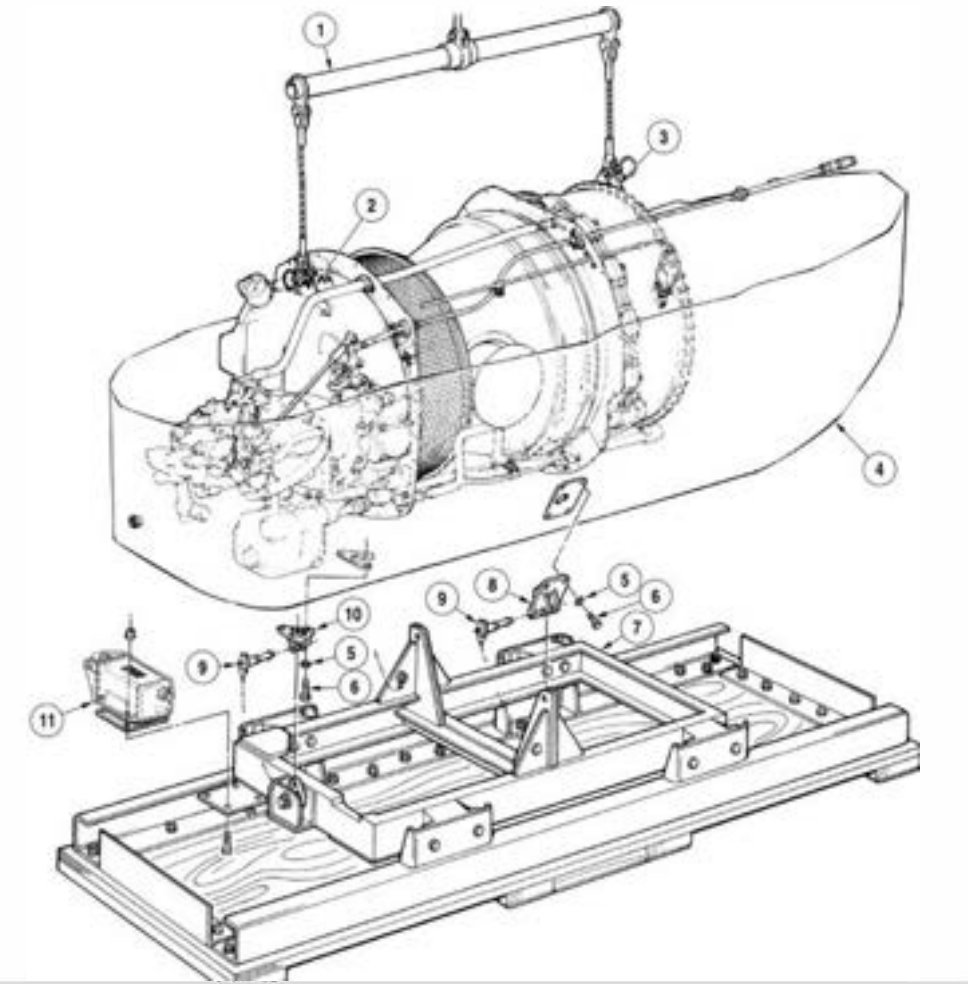


Figure 311 Shipping Caps, Covers and Plugs, Gas Generator Module - Typical

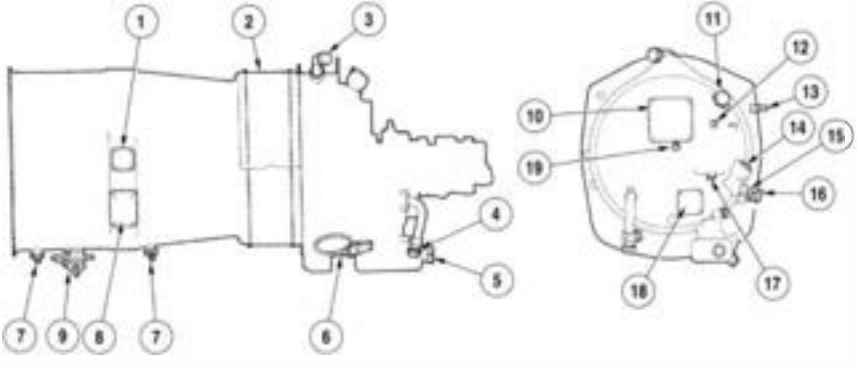


Figure 312 Removal/Installation of GGM from/in Stand - (PWC51140 or PWC70907)

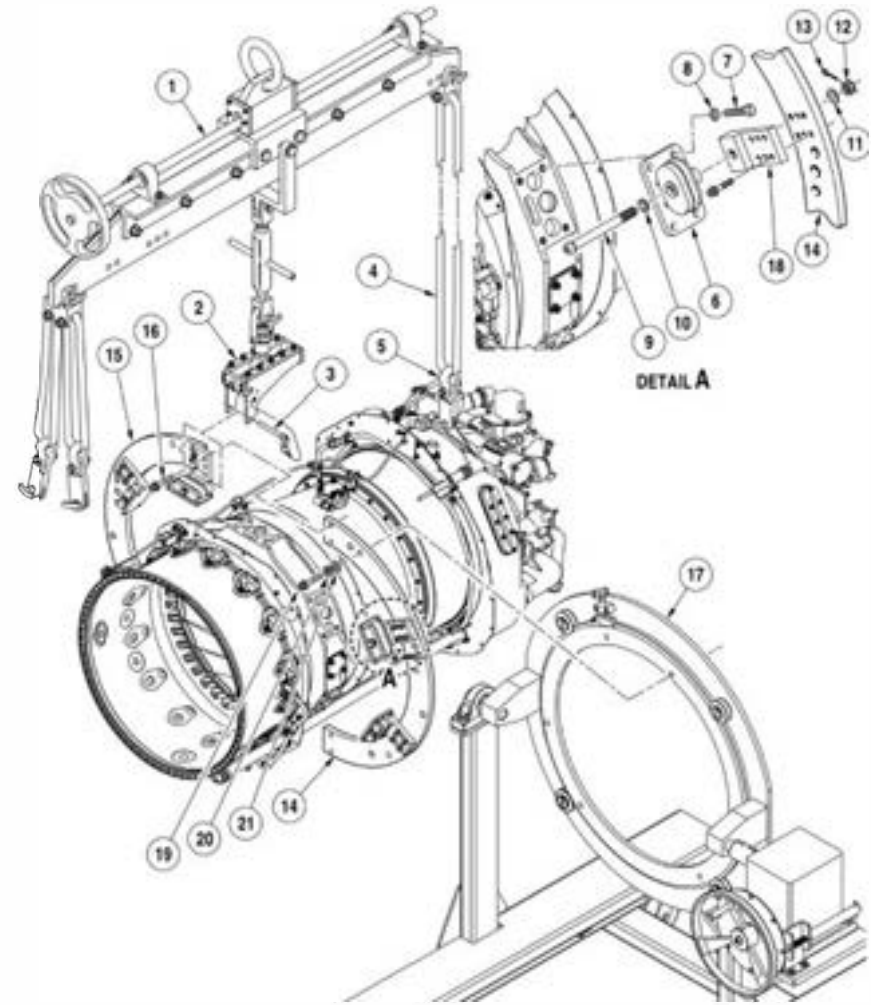


Figure 401 Removal/Installation of Power Section/Power Section Module (PS/PSM)

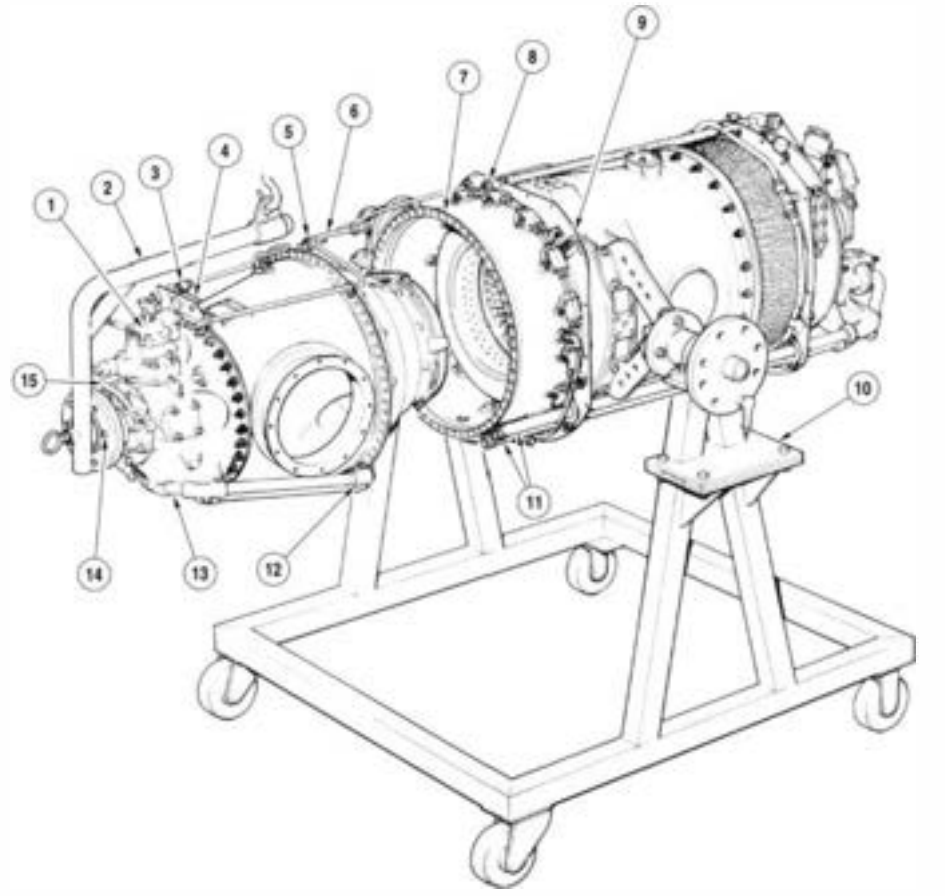


Figure 402 Component Location on Engine Flanges

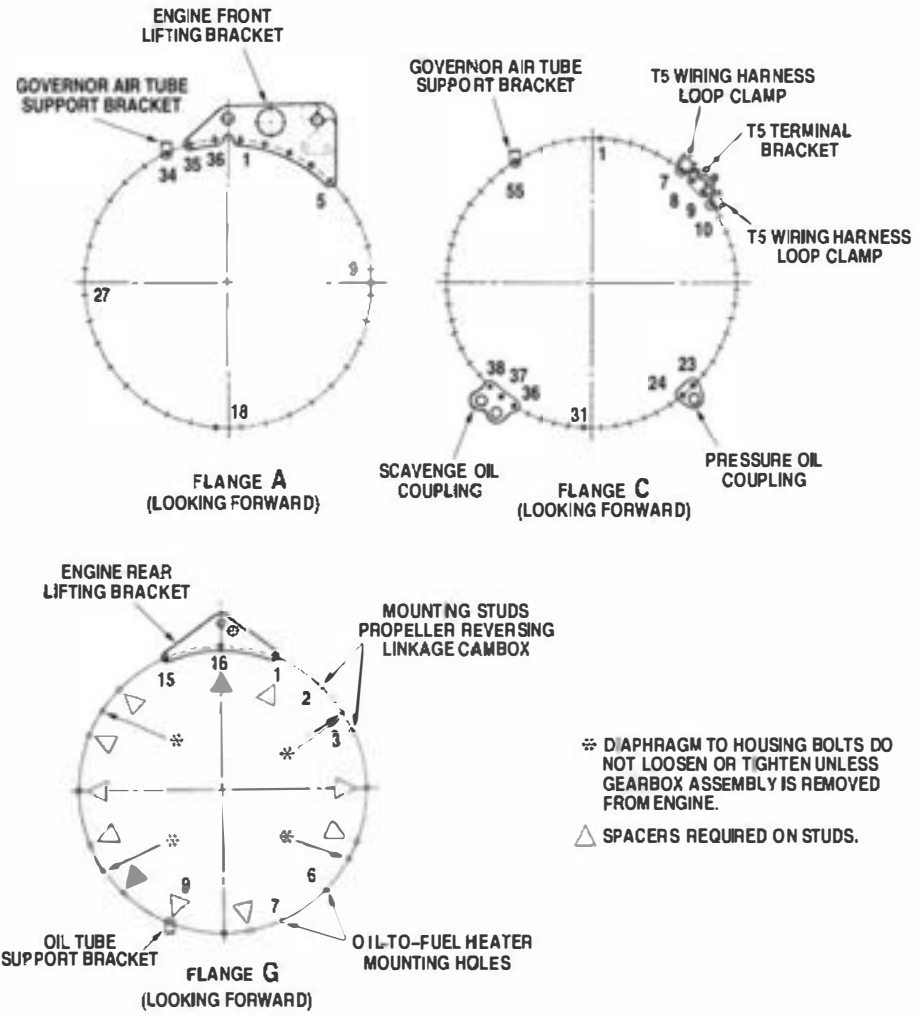


Figure 501 Temperature Limits

AREA A
1. FIND AND CORRECT CAUSE OF OVERTEMPERATURE.
2. FOR START OVERTEMPERATURE VISUAL INSPECT THROUGH EXHAUST DUCT.
3. RECORD IN ENGINE LOG BOOK.

AREA B
DO HOT SECTION INSPECTION.

AREA C
SHIP ENGINE TO AN APPROVED P&WC OVERHAUL FACILITY FOR LIGHT OVERHAUL INSPECTION DUE TO OVERTEMPERATURE IN AREA C.

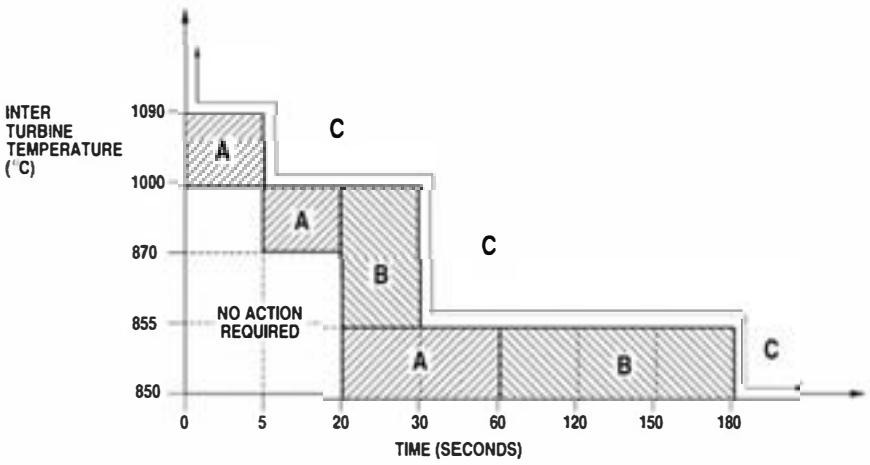
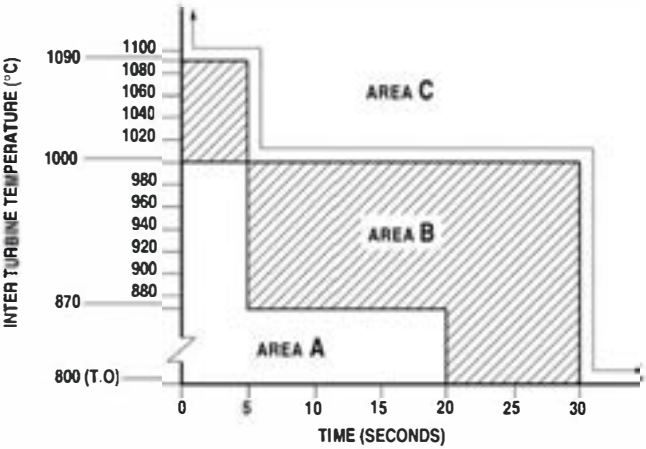


Figure 502 Inadvertent Cut-off and Relight During Taxi

AREA **A** RECORD OCCURRENCE IN ENGINE LOG BOOK.

AREA **B**
1. DO HOT SECTION INSPECTION.
2. RETURN COMPRESSOR TURBINE BLAOE AND DISK ASSEMBLY TO AN OVERHAUL FACILITY FOR STRETCH CHECK, FLUORESCENT PENETRANT INSPECTION AND A METALLURGICAL ANALYSIS (CUT-UP) OF TWO BLADES.

AREA **C** SEND ENGINE TO AN OVERHAUL FACILITY.



T.O. = TAKEOFF ITT (MAX. OBSERVED)

Figure 503 Torque Limits

AREA **A** : NO ACTION REQUIRED.

AREA **B** : DETERMINE AND CORRECT THE CAUSE OF OVERTORQUE (REF. 72-00-00, ENGINE, TURBOPROP - INSPECTION). RECORD IN ENGINE LOG BOOK.

AREA **C** : RETURN THE ENGINE TO AN APPROVED OVERHAUL FACILITY.

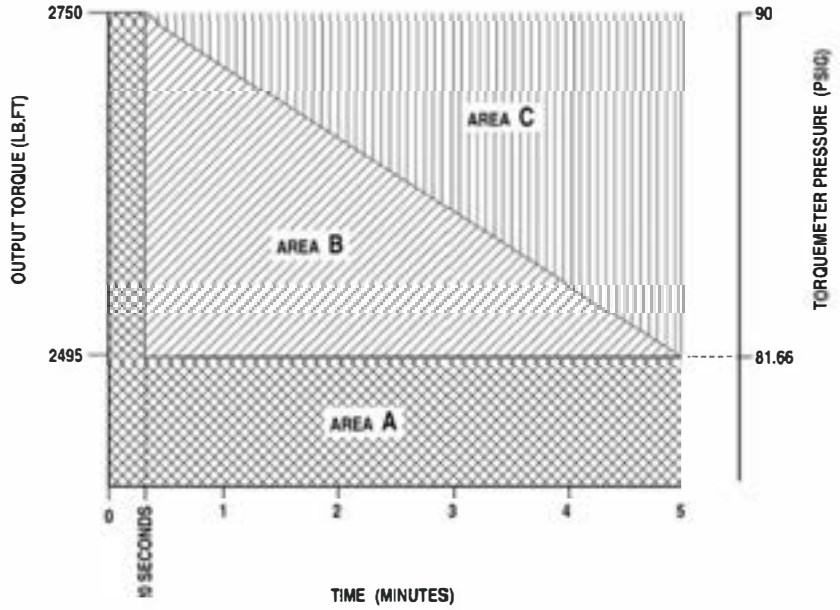


Figure 504 Torque Limits (BS1354)

AREA **A** : NO ACTION REQUIRED.

AREA **B** : DETERMINE AND CORRECT THE CAUSE OF OVERTORQUE (REF. 72–00–00, ENGINE, TURBOPROP – INSPECTION). RECORD IN ENGINE LOG BOOK.

AREA **C** : RETURN THE ENGINE TO AN APPROVED OVERHAUL FACILITY.

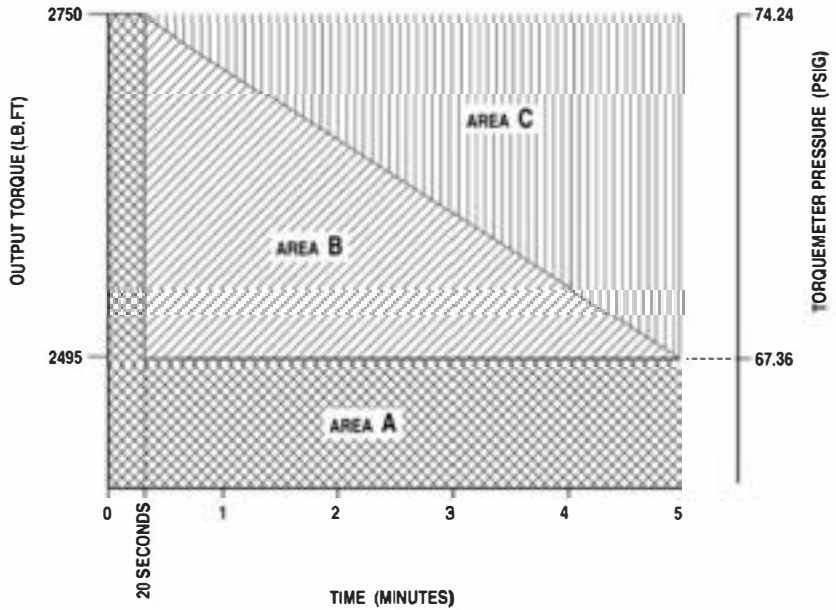


Figure 505 Gas Generator (Ng) Overspeed Chart

AREA A – FIND AND CORRECT THE CAUSE OF GAS GENERATOR (Ng) OVERSPEED.
– RECORD THE OCCURRENCE IN THE ENGINE LOG BOOK.
– ADD THE NUMBER OF EXCEEDANCES IN AREA A. A MAXIMUM OF 25 EXCEEDANCES ARE PERMITTED PER TBO PERIOD. IF YOU FIND MORE THAN 25 EXCEEDANCES, REPORT TO P&WC AND OBEY AREA B.

AREA B – SEND THE ENGINE TO AN APPROVED OVERHAUL FACILITY FOR LIGHT OVERHAUL BECAUSE OF GAS GENERATOR (Ng) OVERSPEED AND SUPPLY Ng MONITORED.

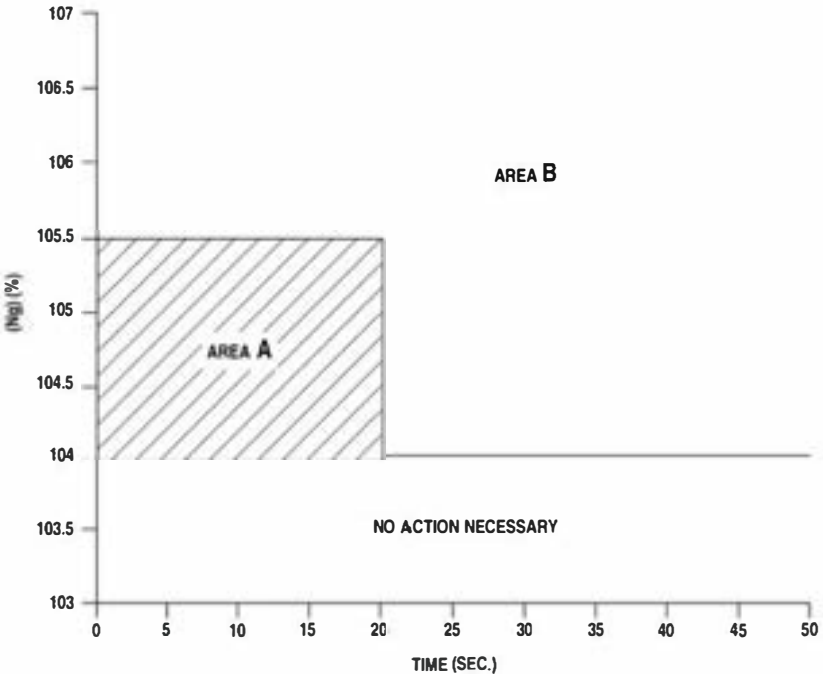


Figure 506 Propeller Governor Adjustment Points

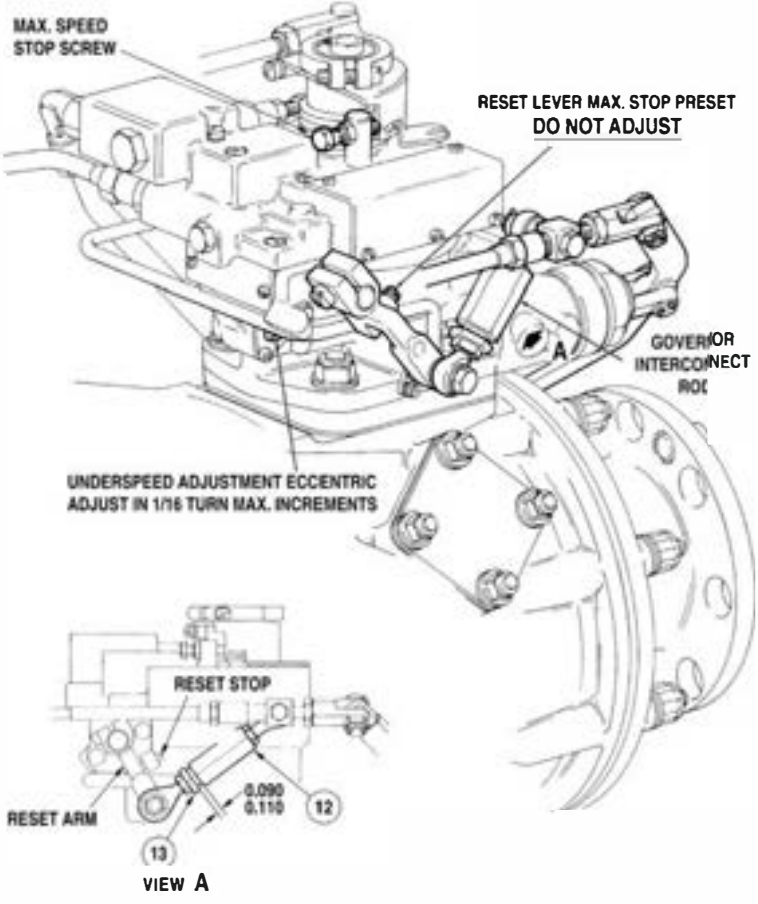


Figure 507 FCU Adjustment Points

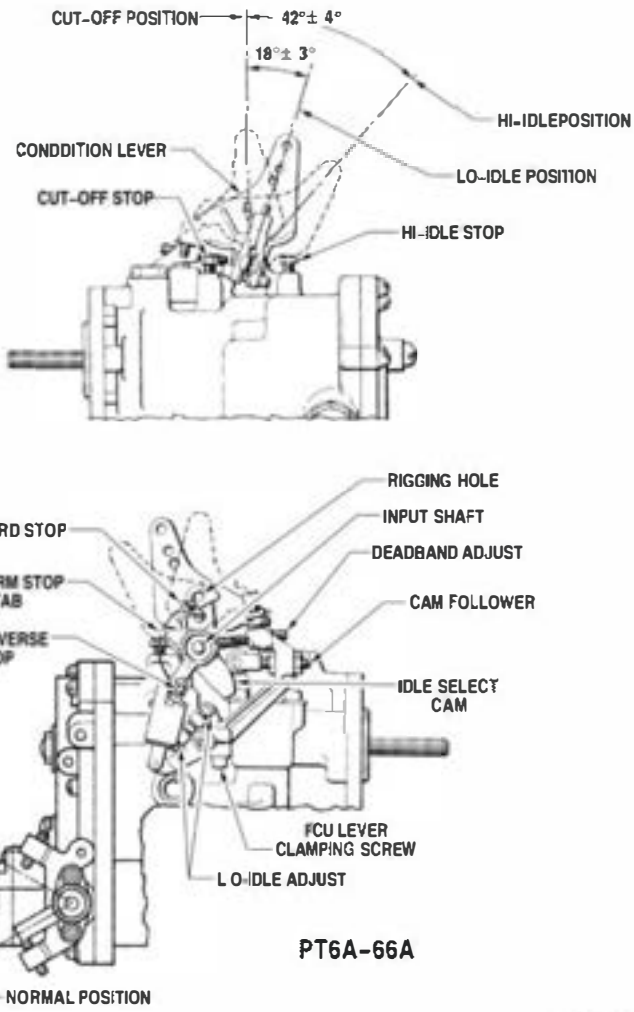


Figure 508 MOP Adjustment (BS1323)

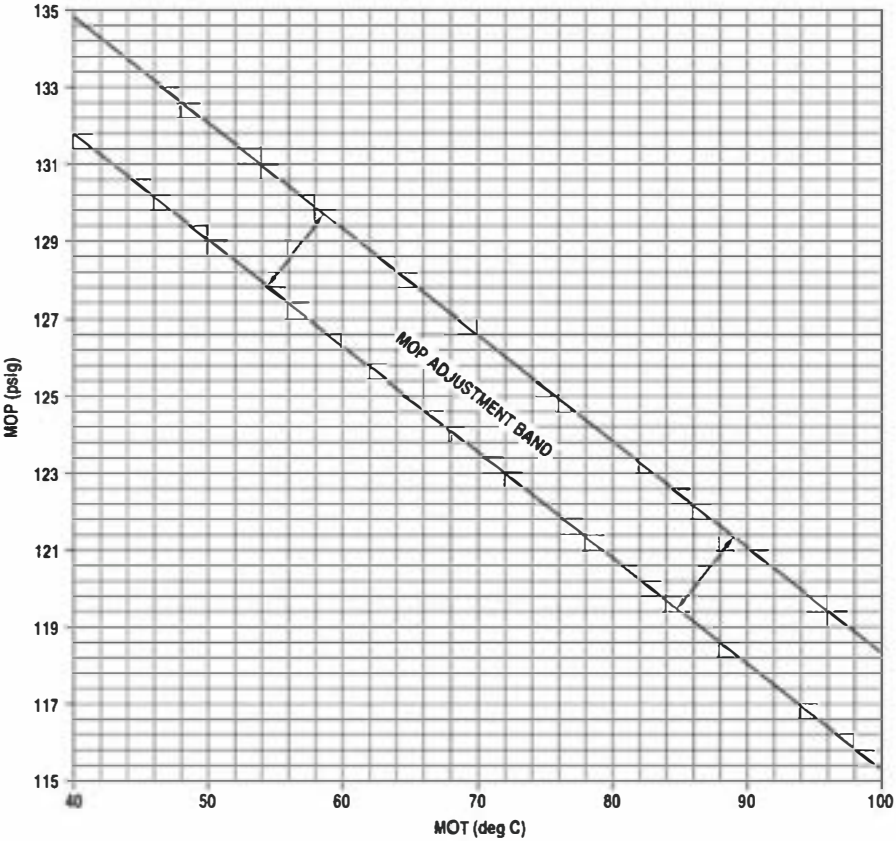


Figure 509 Oil Pressure Adjustment

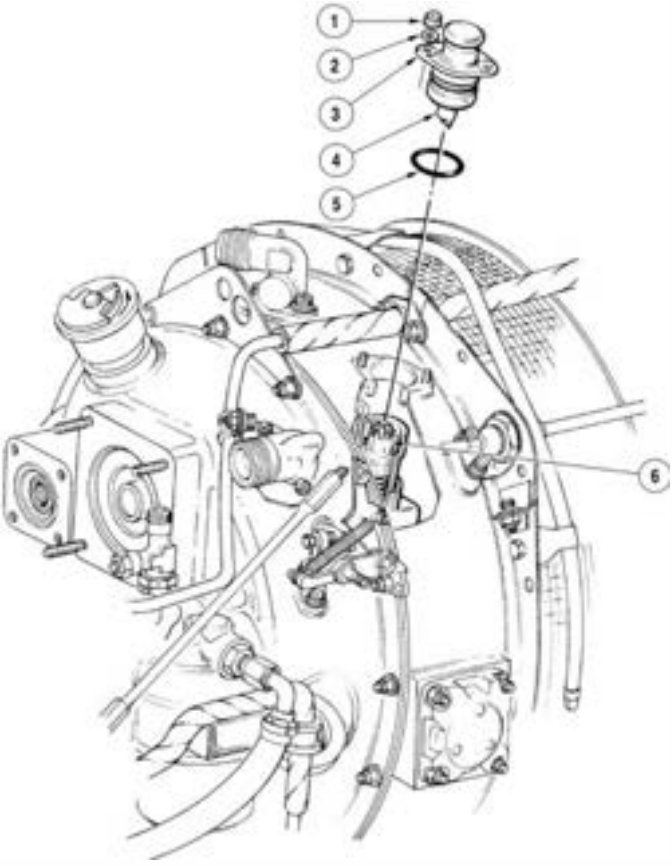


Figure 510 Torque Limiter Adjustment Point

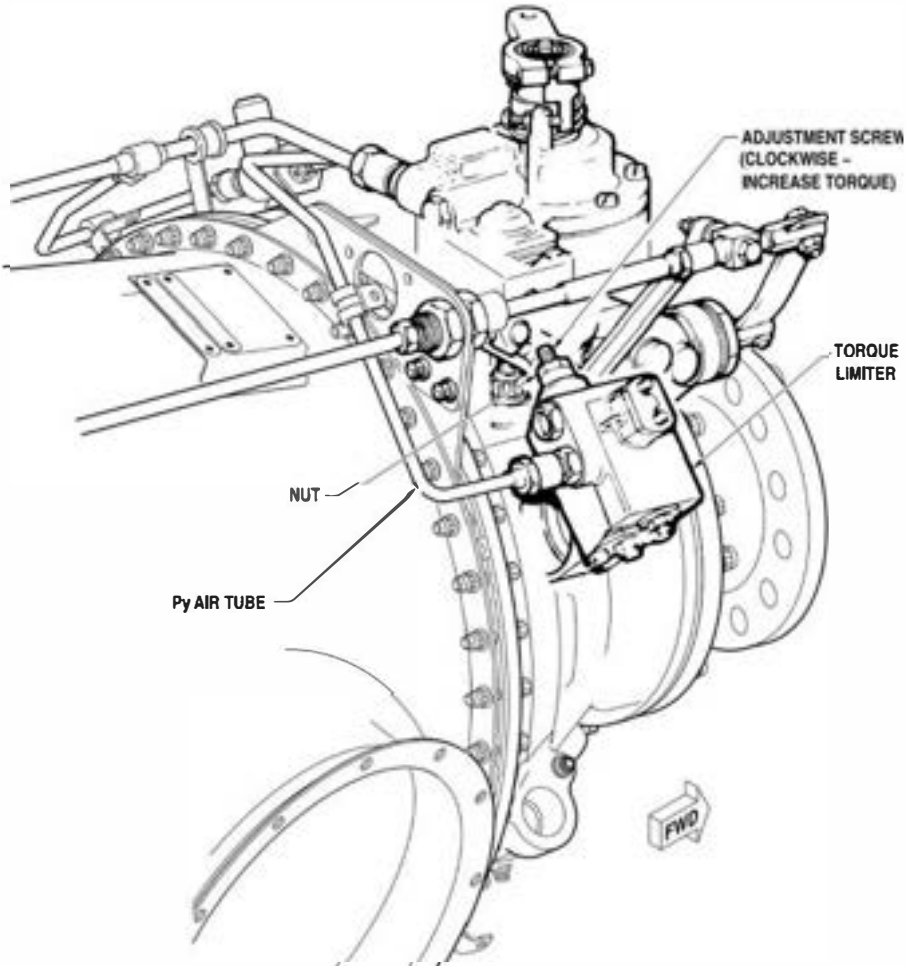


Figure 601 Air Inlet Case Corrosion Prevention (sheet 2 of 2)

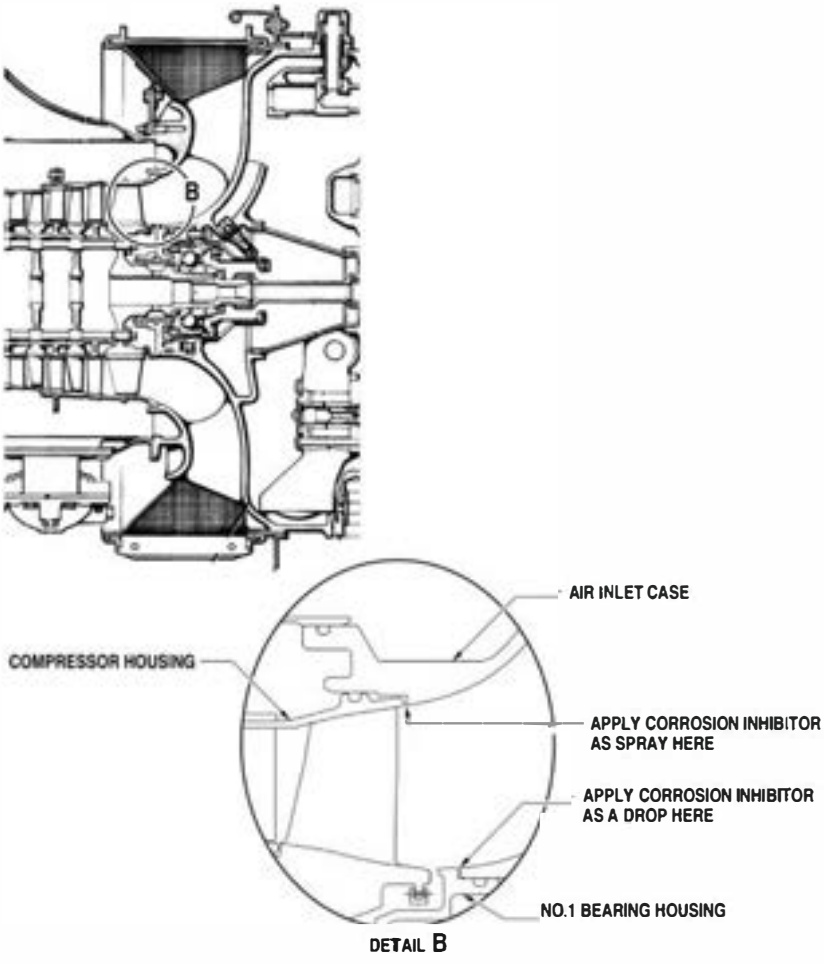


Figure 601 Air Inlet Case Corrosion Prevention (sheet 1 of 2)

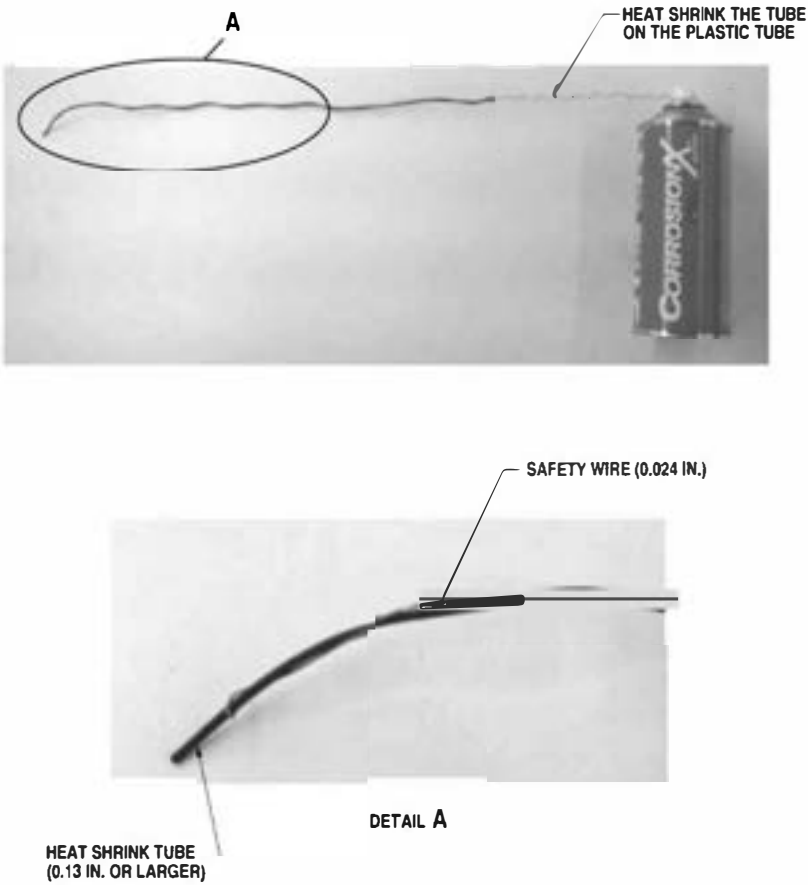
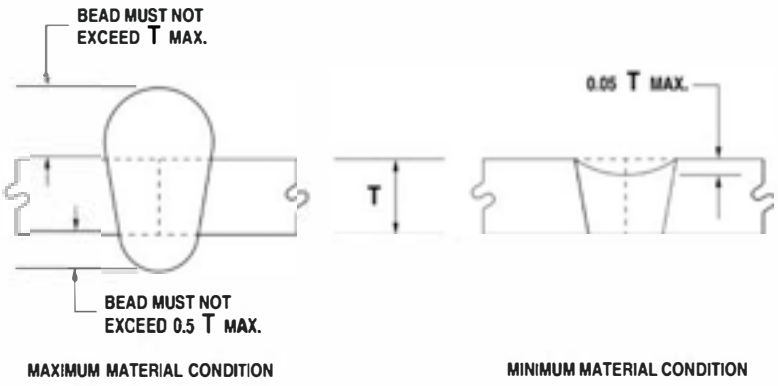
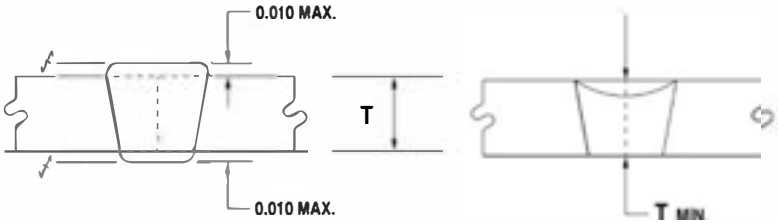


Figure 601 Weld Repair - Inspection



A – NOMINAL WELD – NO FINISHING REQUIRED



B – FINISHED WELD – DIMENSIONS AFTER DRESSING

Figure 602 Large Bent Airfoil on First-Stage Compressor Rotor

Figure 603 Borescope and Accessories Installed

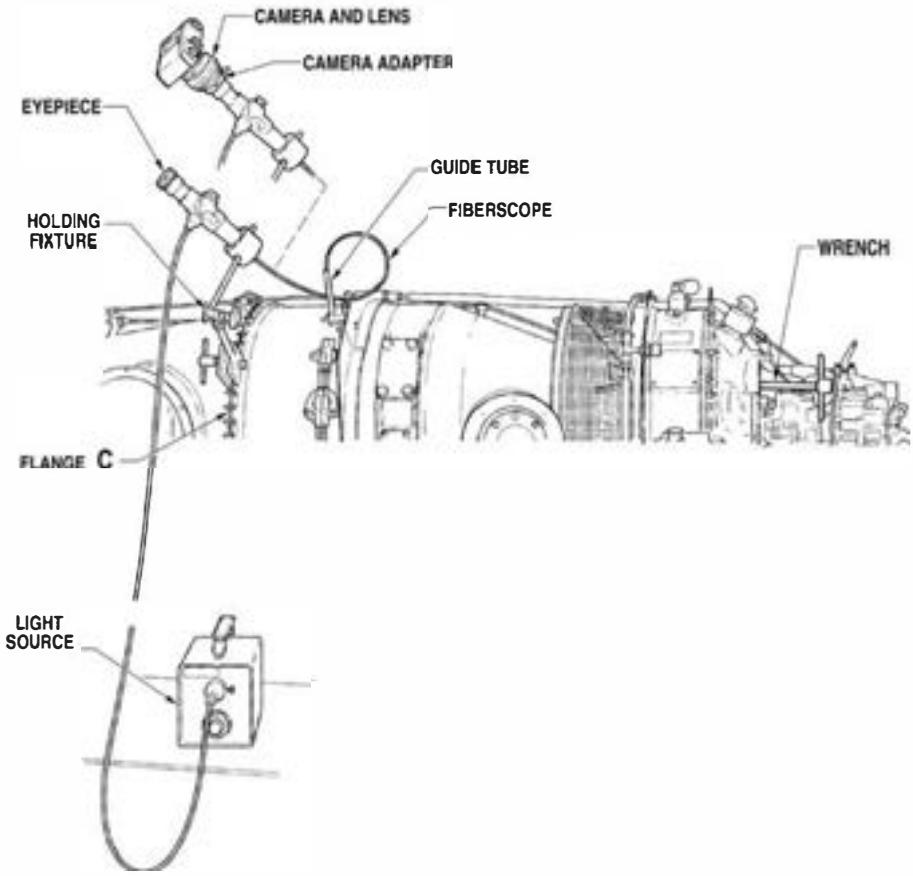
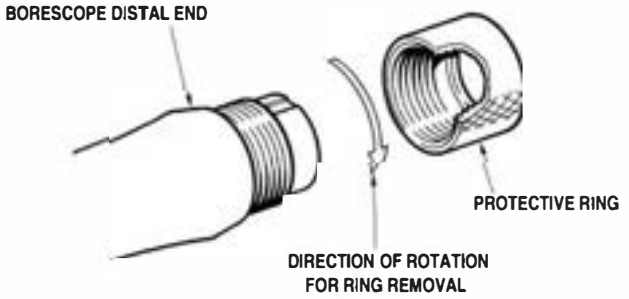
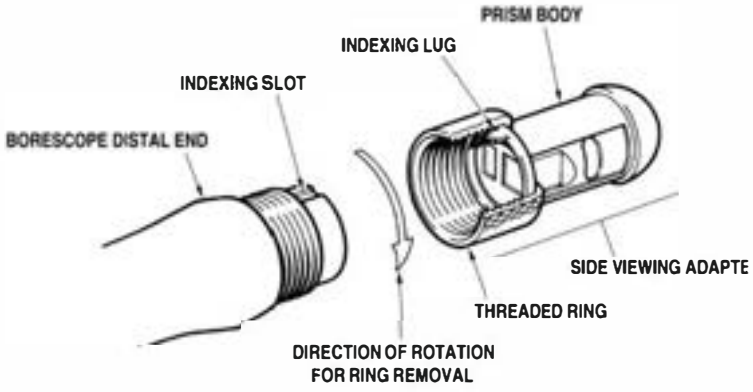


Figure 604 Side-viewing Adapter

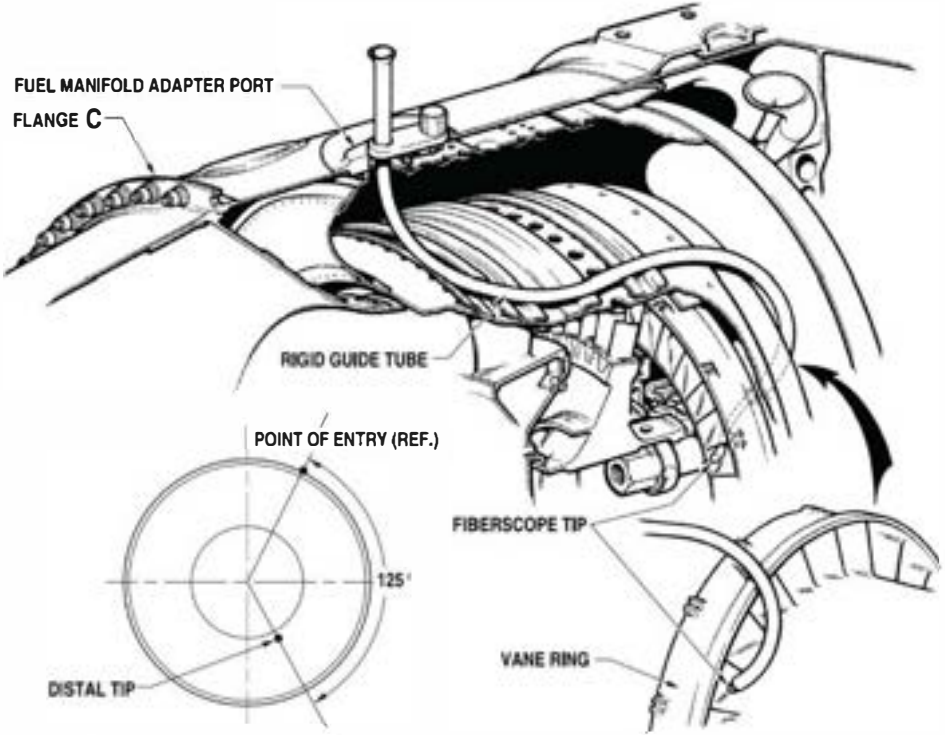


RING REMOVAL



ADAPTER INSTALLATION

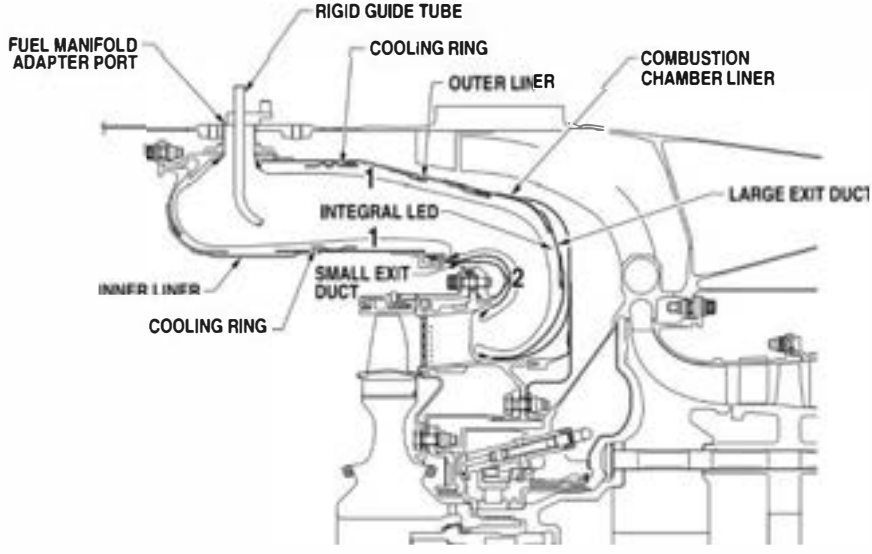
Figure 605 Guide Tube Orientation



RELATION BETWEEN POINT OF ENTRY AND DISTAL TIP

VIEW TOWARD AIR INLET CASE

Figure 606 Inspection of Combustion Chamber Liner and Large Exit Duct



NOTES:

AREA 1: COMBUSTION CHAMBER INNER/OUTER LINER AND INTEGRAL LED.

AREA 2: SMALL EXIT DUCT.

Figure 607 Inspection of PT Disk Face

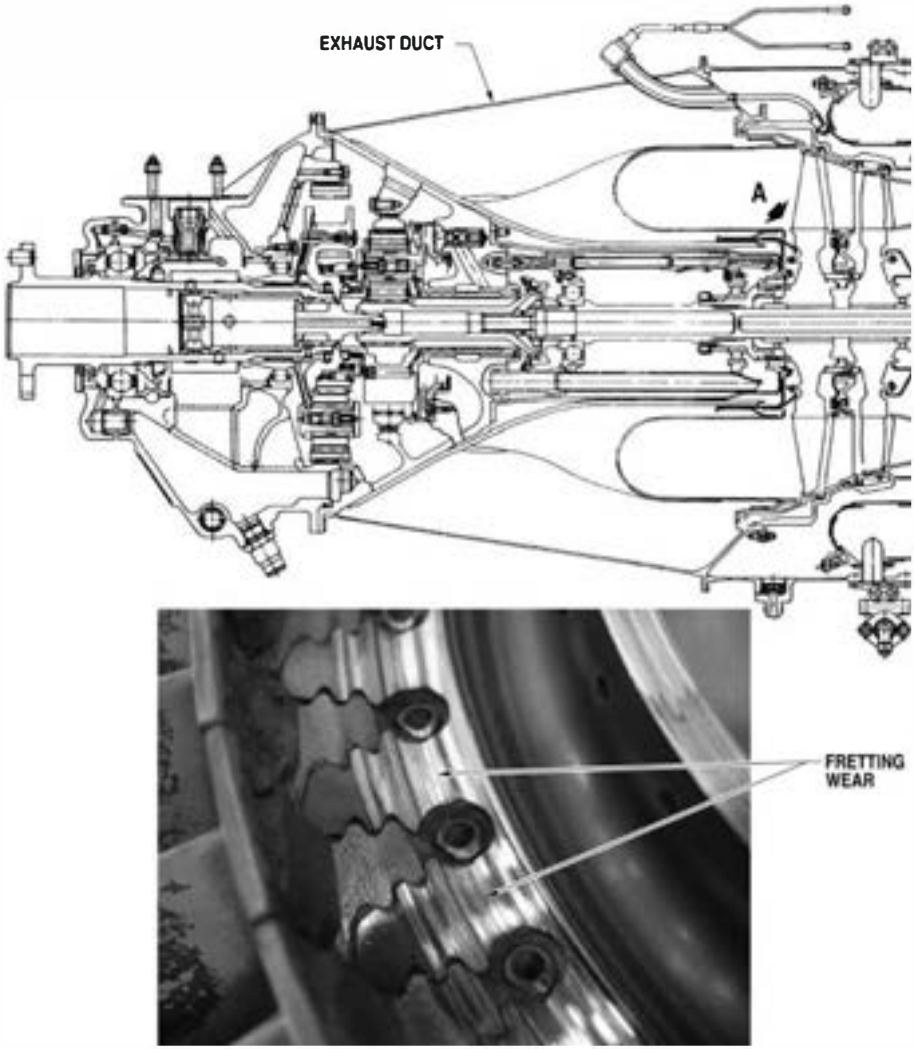
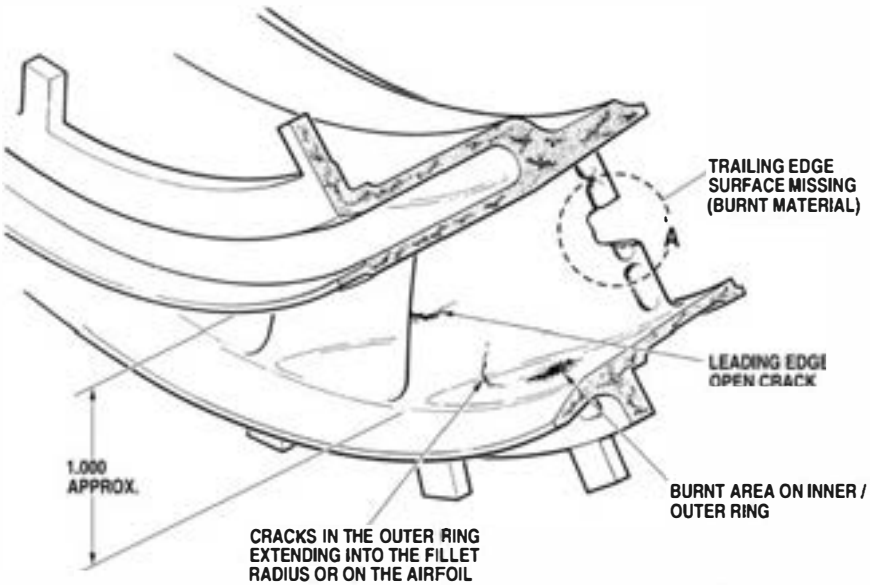
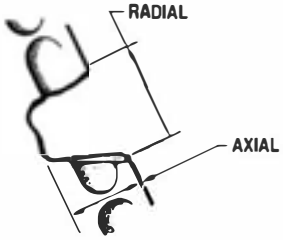


Figure 608 CT Stator Damage - HSI Recommended

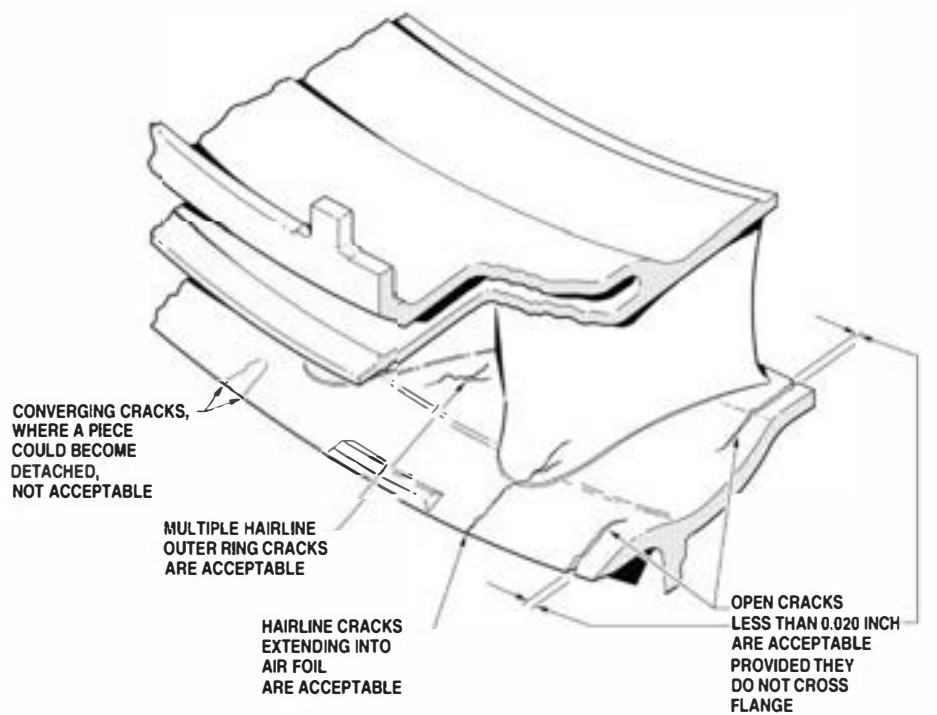




DETAIL A

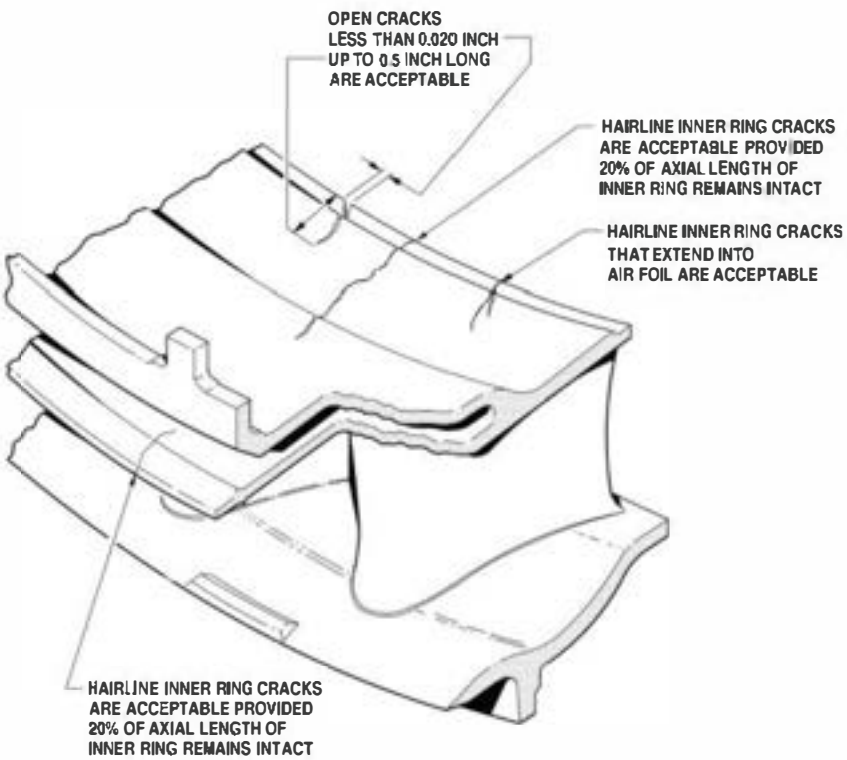
NOTE: TRAILING EDGE DEFECTS EXCEEDING THE ABOVE LIMITS ARE NOT ACCEPTABLE AND AN HSI IS RECOMMENDED DIMENSIONS CANNOT BE ACCURATELY MEASURED WHEN USING A BORESCOPE THEREFORE THE EXTENT OF THE DAMAGE MAY BE ESTIMATED AS A PERCENTAGE OF AIRFOIL LEADING EDGE HEIGHT. (1.000 APPROX.)

Figure 609 CT Stator - Acceptable/Repairable Damage (sheet 2 of 2)



NOTE: THE ABOVE DEFECTS ARE ACCEPTABLE FOR FURTHER SERVICE EXCEPT WHERE NOTED.

Figure 609 CT Stator - Acceptable/Repairable Damage (sheet 1 of 2)



NOTE: THE ABOVE DEFECTS ARE ACCEPTABLE FOR FURTHER SERVICE EXCEPT WHERE NOTED.

Figure 610 CT Stator - Acceptable/Repairable Damage (sheet 2 of 2)

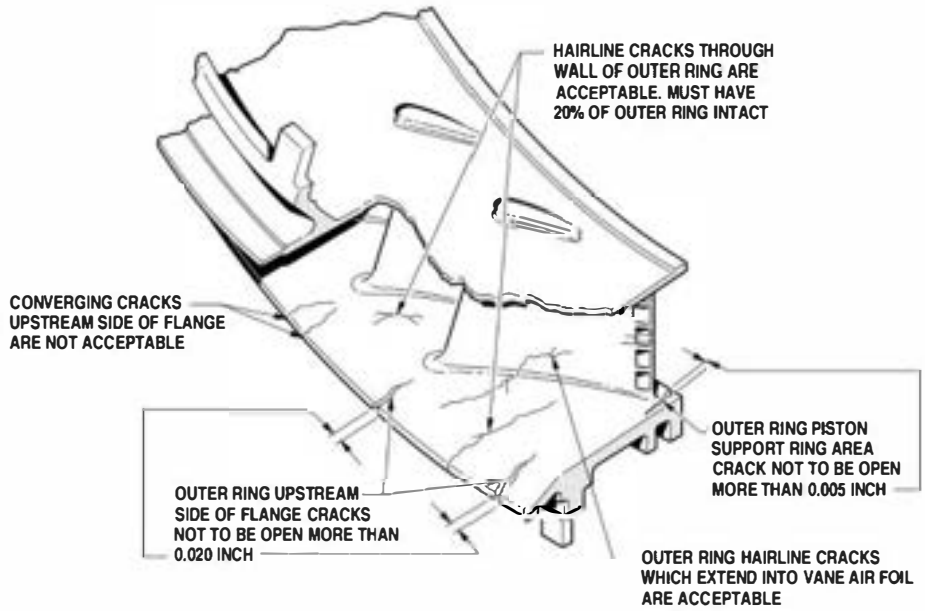
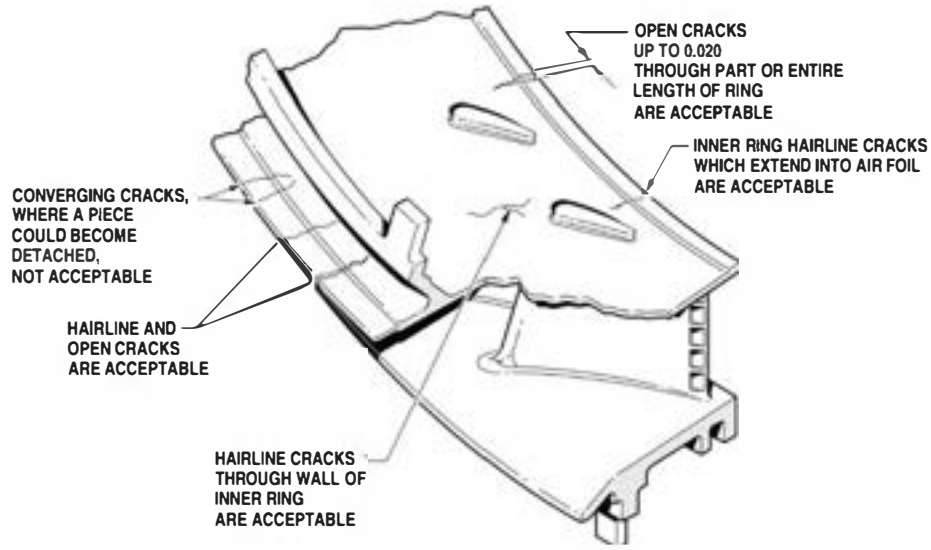
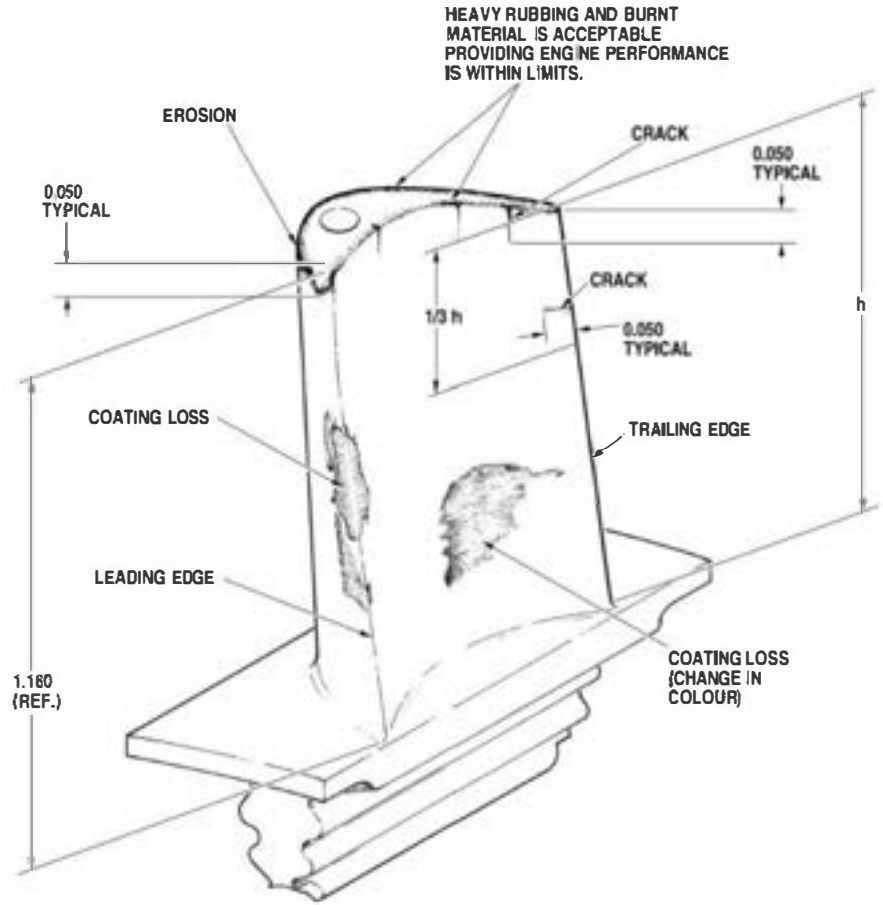


Figure 610 CT Stator - Acceptable/Repairable Damage (sheet 1 of 2)



NOTE: THE ABOVE DEFECTS ARE ACCEPTABLE FOR FURTHER SERVICE EXCEPT WHERE NOTED.

Figure 611 CT Blade Damage - Acceptable



NOTE: 1) LEADING EDGE TIP EROSION IS ACCEPTABLE PROVIDING IT DOES NOT BREAK INTO THE HOLE AT THE BLADE TIP.
2) THE ABOVE DEFECTS ARE ACCEPTABLE FOR FURTHER SERVICE. THE EXTENT OF THE DEFECT(S) MUST BE RECORDED AND MONITORED BY ADDITIONAL INSPECTIONS.

Figure 612 Compressor Turbine Blade Inspection

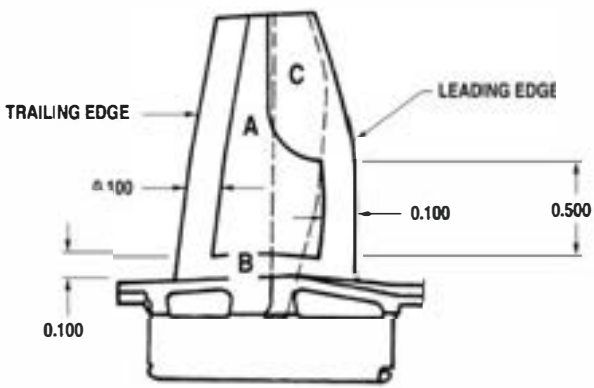


Figure 613 CT Blade - Manufacturing Anomalies

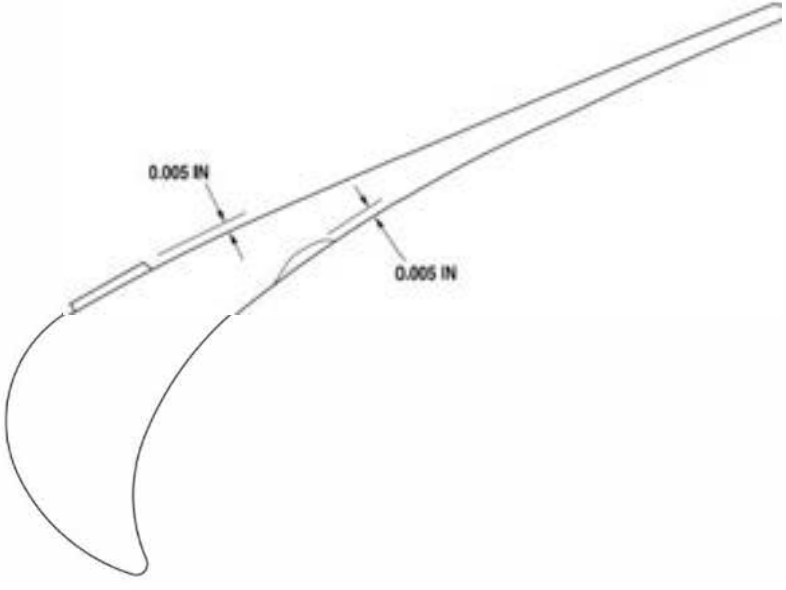


Figure 614 CT Blade Damage - Unacceptable

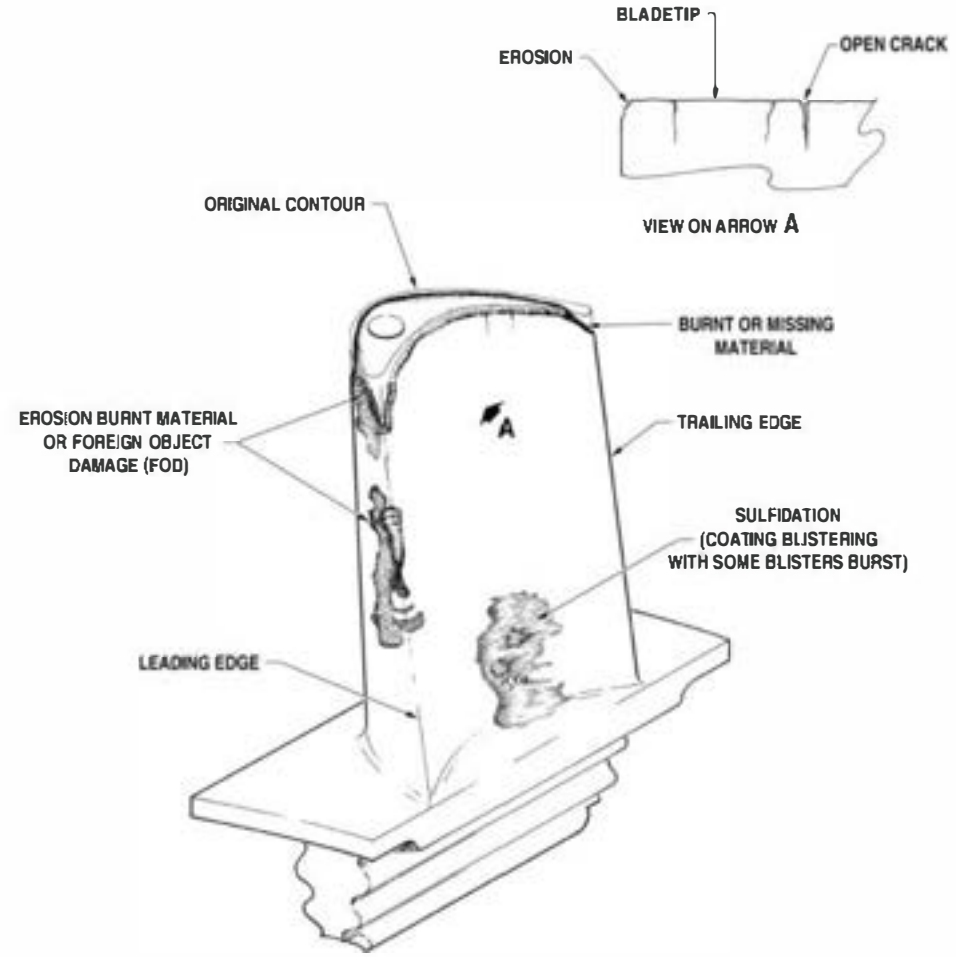


Figure 615 Hot Section Inspection (sheet 2 of 2)

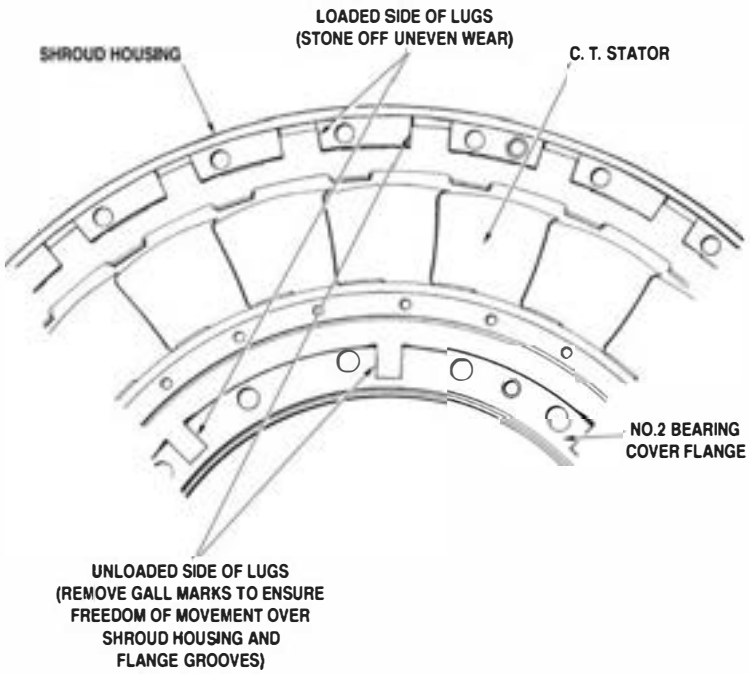
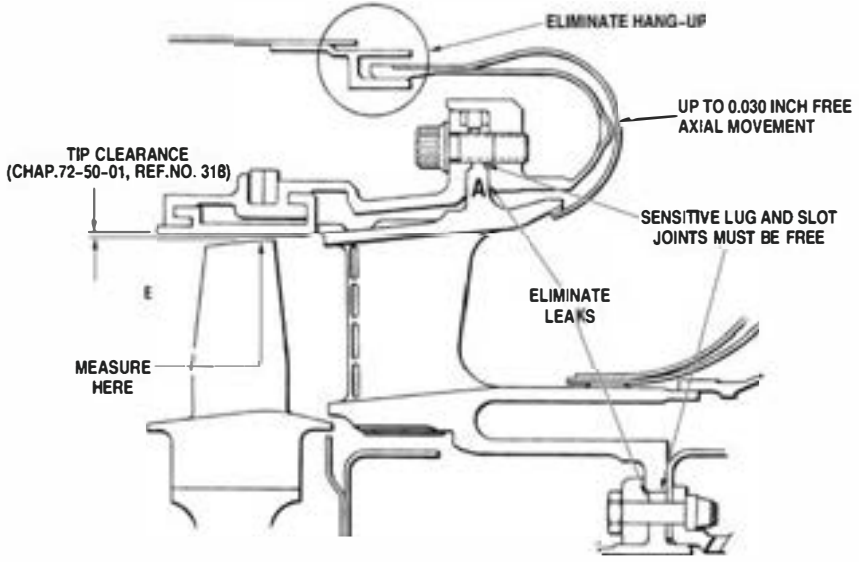


Figure 615 Hot Section Inspection (sheet 1 of 2)



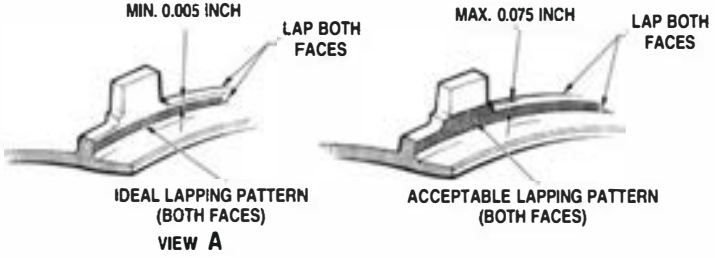


Figure 616 Inspection of Main Oil Filter Secondary Screen

Figure 701 Compressor Wash Rig - Schematic

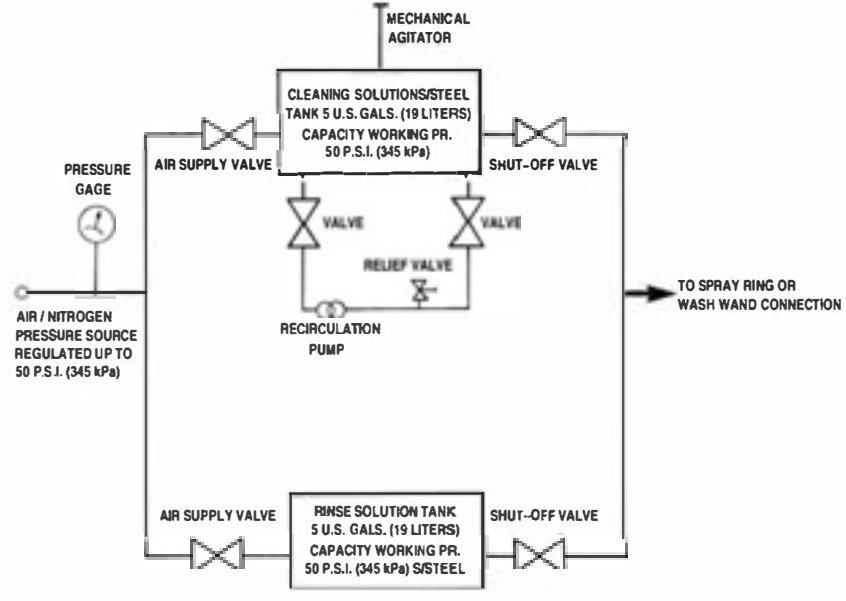
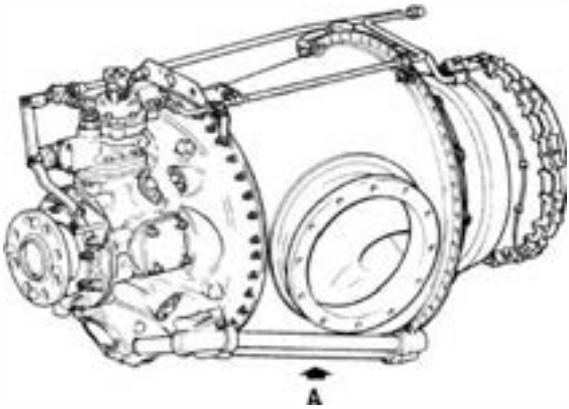
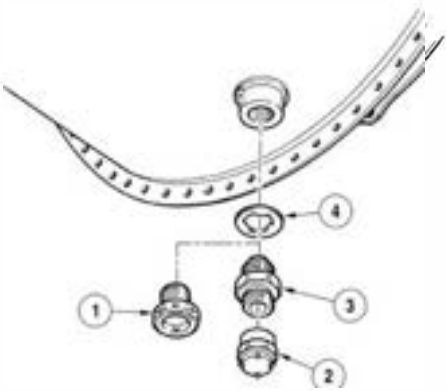


Figure 702 Removal/Installation of Exhaust Duct Drain





VIEW A

Figure 703 Compressor Turbine Wash Tube Installation

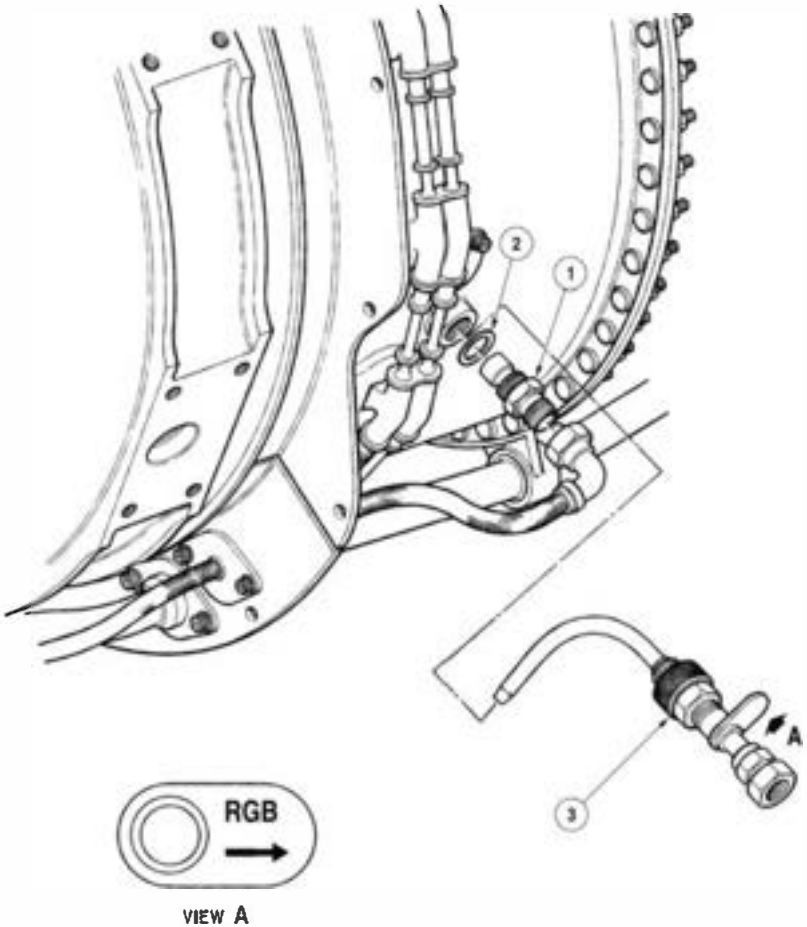


Figure 801 Shanknut Replacement

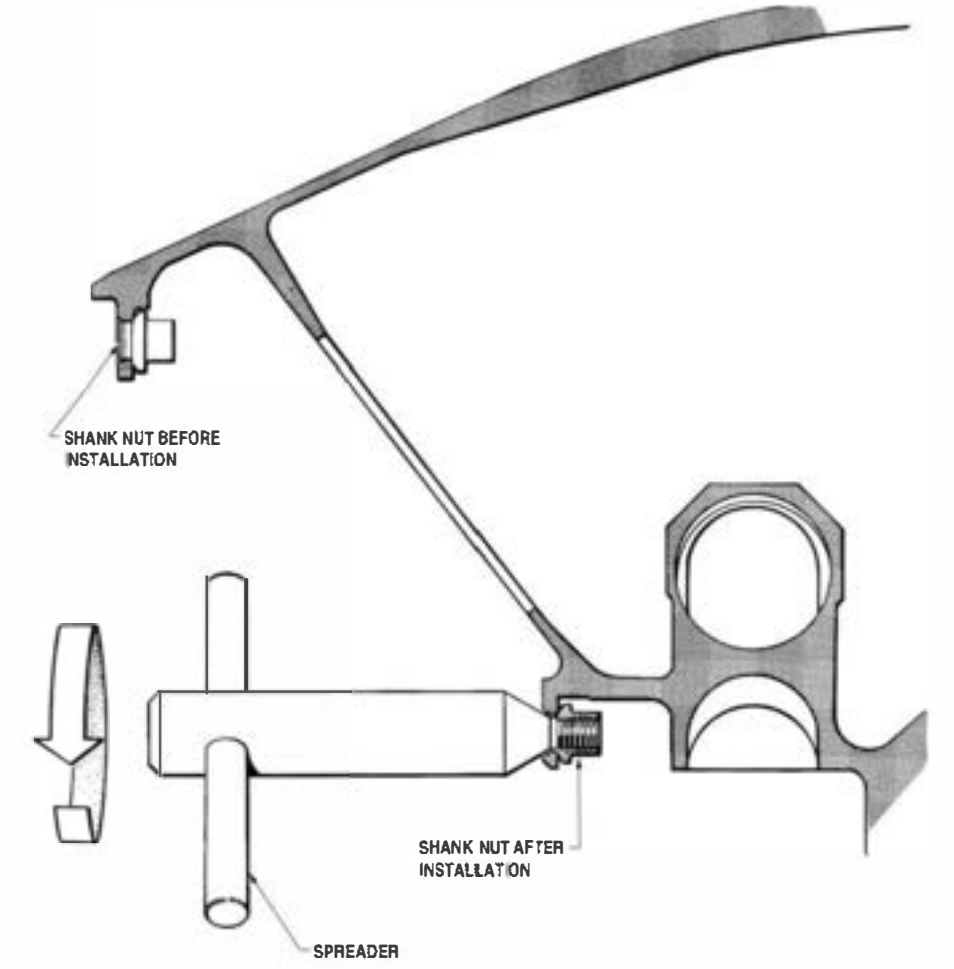


Table 1 Component Maintenance Manuals

COMPONENT	SUPPLIER CODE	SUPPLIER P/N	P&WC P/N	CMM/ACMM ATA NO.	CMM/ACMM P/N
Cable, Ignition	0AFL4	CH53399-06	3119836-01	74-20-02	
Exciter, Ignition	59501	10-381550-4	3035889	74-10-42	
Fuel Control Unit	66503	8063-062	3120023-06	73-20-05	
Thermocouple Wiring Harness	00198	N/A	3043825	77-20-11	3045089
Chip Detector Plug, Magnetic	00198	N/A	3045951-02	79-31-02	3053125
Fuel Pump	59875	825600	3040760	73-10-12	
Igniter, Spark	0AFL4	CH34055	3035102	74-21-28	
Igniter, Spark	59501	10-390667-1	3031213	N/A	
Valve, Flow Divider and Dump	99595	25638-3	3023670	73-10-08	
Compressor Bleed Valve	00198	N/A	3059835-01	75-30-04	3049726
Torque Limiter	07213	3244862-2	3055731-01	73-20-58	
Oil-to-Fuel Heater	78385	10585K	3057249-01	73-10-04	
Propeller Governor	66503	8210-007	3035930	61-20-15	

PWC05-007	Fluid, Leak Check Leak Tec 372E PMC9569	03530
PWC05-009	Ammonium Bifluoride Ref. Crystalline	A0001(s)
PWC05-011	Ammonium Nitrate Powder Form 1.725 Specific Gravity US MIL-A-175 PMC1517	A0001(s)
PWC05-014	Cloth, Abrasive Ref. Scotch Brite	A0001(s), 28112
PWC05-018	Pencil, Metal Marking Hard Ref. 21628 Silver PMC4094	22980(m)
PWC05-018A	Pencil, Metal Marking Hard Ref. Stock No. 02460 for Prismacolor Verithin 753 or Stock No. 03375 for Prismacolor Thick Lead 949 PMC4059-7 (Silver)	22980(m)
PWC05-027	Ink, Marking Ref. Carter 21451 Black	S0089
PWC05-037	Enamel, Epoxy Aluminized Ref. Enamel Base: 529K002 Base + 910K021 Curing Solution PMC1746 PWA569 (CPW269)	A0097(s), ONYS9(m), S0098(s)

PWC05-038	Hydrogen Peroxide Commercial Grade Ref. Open 32.5 to 35% US Fed. A-A-53707 PMC1602	A0001(s), 08338
PWC05-040	Helical Coil Insert Ref. Open 1191-6CNX3.8	A0001(s), 26344(m)
PWC05-041	Dye, Layout and Identification Ref. Dykem Spray Steel Blue PMC 4039 SP-1100	98148(m)
PWC05-046C	Ink, Stamping Black Ref. Dykem Black KX425 PMC 4021-1 to -3	98148(m)
PWC05-048	Pen, Marking Ref. Brushpen No. 57	S0036
PWC05-048A	Pen, Marking Ref. Felt Wick Pen	A0013, 30133
PWC05-048B	Felt Tip Marker (Rapid Drying) (Temporary Marking) Ref. PMC 4050	See NOTE
	NOTE: For trade names and manufacturers, refer to the SPM. Remove the marking ink from the part before heat treatment process and assembly.	
PWC05-053	Sheet, Polyethylene Ref. Open 0.002 in. (0.051mm) thick polyethylene sheet PMC 4205	A0001(s)
PWC05-055	Sodium Dichromate Ref. Open Commercial Grade PMC 1300	A0001(s)

PWC05-055	Sodium Dichromate Ref. Open Commercial Grade PMC 1300	A0001(s)
PWC05-057	Solution, Sodium Hydroxide Ref. Open (a solution of sodium hydroxide (PWC05-056) and 0.12 fluid ounces (3.1 cubic centimeters) of water (PWC05-073)) US. ASTM D456 PMC 1601	A0001(s)
PWC05-058	Solder, Tin-Alloy Ref. 50/50 Mix US.EIA J-STD-004 EIA J-STD-005 EIA J-STD-006	09185(m), 10178(s)
PWC05-061	Cloth, Abrasive Coated Crocus (400 grit) Ref. Open US ANSI B74.18	A0001(s), 44197 (m), 61158(m)
PWC05-064	Solution, Anodize Touch-Up (for Aluminum Alloys) Ref. Alodine No. 1200S US. AMS 2473 PMC 71600	84063
PWC05-066	Tape, High Temp. (Glass Cloth) Ref. Open PMC4273	See NOTE
	NOTE: For trade names and suppliers, refer to SPM.	
PWC05-070	Tape, Pressure Sensitive Adhesive Filament Reinforced Ref. 3M No. 898 Type II, 2 .0 in. Wide US.ASTM D5330	A0001(s), A0083, 76381(m)

PWC05-073	Water, Distilled Deionized and Demineralized Ref. Commercial Grade PMC1737	A0001(s)
PWC05-074	Acid, Sulfuric Ref. Commercial or Technical Grade 66 Degrees Baume PMC1003	A0001(s)
PWC05-076	Oil, Penetrating US Fed. A-A-50493	A0001(s), 59595
PWC05-077	Oil, Preservative Ref. Grade 1010 Brayco 460 US. MIL-PRF-6081 PMC 9852	2R128
PWC05-077C	Oil, Preservative Mobil Avrex M201/1010 US. MIL-PRF-6081 PMC 9852	57635
PWC05-089	Lockwire Nickel Alloy (CRES) Ref. MS9226-03 US. AMS5687 0.025 in. Dia. (See NOTE).	A0001(s), 8W577(m)
PWC05-101	Cloth, Abrasive Aluminum Oxide or Silicone Carbide Ref. Open US ANSI B74.18 No. 320 Grit	A0001(s), 44197(m), 61158(m)
PWC05-103	Crayon, Glazed Ref. Phano No. 71 Red	70362
PWC05-107	Foam, Polyurethane Ref. Open US. MIL-PRF-26514	A0001(s)

PWC05-118	Insert, Keensert Ref. KN 1032	29372, 39211
PWC05-145	See PWC05-019	
PWC05-147	Electrode 2% Thoriated Tungsten Ref. Open PMC5052-3 Length: 7 in. Diameter: 1/16 in.	A0001(s), 05838, 28835
PWC05-151	Wire, Filler, Welding (Inconel 625) Ref. Open US AMS5837	See NOTE
	NOTE: For trade names and suppliers, refer to the SPM.	
PWC05-161	Solution, Chrome Pickle Touch-Up 1.5 pints nitric acid (PWC05-195) to 1.5 pints sodium dichromate (PWC05-055) to a specific gravity of 1.42 Add to 8 pints of water. (PWC05-073)	A0001(s)
PWC05-162	Wetting Agent, Chromate Conversion Salts Ref. ARP No. 2 PMC1632	A0001(s), 76071
PWC05-166	Solution, Chemical Treatment Ref. MIL-C-5541 Class 1A	A0001(s), 71410
PWC05-167	Grit, Abrasive Ref. Open No. 1200 Mesh	A0001(s)

PWC05-190	Patch, Filter Ref. P/N NY6004700 Millipore 60 Micron Nylon	A0084(s), 08071(m)
PWC05-195	Acid, Nitric Technical Grade Ref. Open US Fed. A-A-59105 5 to 10% Solution 42% Reagent Grade 45 Degrees Baume PMC1000	A0001(s)
PWC05-196	Acid, Hydrochloric Technical Grade Ref. Muriatic Acid US ASTM E1146 MIL-H-13528 37 % Reagent Grade 20 Degrees Baume PMC1002	A0001(s)
PWC05-197	Acid, Chromic Flakes or Solution US Fed. A-A-55827 CR03-99.5% Min. S04 -0.20% Max. Commercial Grade PMC1001	A0001(s)
PWC05-198	Salts, Chromate Conversion (Magnesium) Ref. IRIDITE 15 PMC 1690	A0001(s), 76071
PWC05-418	Conversion Coating, Touch-up (Non-Hexavalent Chromium) Ref. Alodine 871 Touch-N-Prep Coating PMC 71871	A0001(s) A0143 71410
PWC05-419	Conversion Coating, Touch-up Applicator (Alodine) (Magnesium Treatment Kit)	A0001(s) 71410

	PMC 71872	
PWC06-002	Petrolatum, White Technical Grade US Fed. AN-P-51 PMC9609	A0001(s), 86459(m)
PWC06-004	Compound, Antiseize (Molybdenum Disulfide) Ref. Dow Corning G-N Metal Assembly Paste PWA587, PMC9549 (CPW262)	71984(m), A0018(s)
PWC06-005B+	Lubricant, Fluorocarbon (Spray Release Agent for Silicone Rubber) Ref. RCTW 9080 (Water-based) PWA 36007-3 PMC 1104	2W738
PWC06-011	Fluid Assembly Ref. Ultrachem Assembly Fluid #1 PWA 36500 PMC 79934 (CPW 471)	56385(m)
PWC06-023	Compound, Antiseize Ref. Silver Goop PWA36001 PMC9940	02570(m), A0019(s), A0037(s), A0013(s), A0038(s)
PWC06-036	Compound, Lubricating (Paste) Ref. Molykote P-37 PWA 36246 PMC 79571 (CPW 571)	71984(m)
PWC06-036+	Compound, Lubricating (Paste) Ref. Molykote P-37 PWA 36246 PMC 79571 (CPW 571)	71984(m)

PWC06-036A	Compound, Lubricating (Paste) Ref. Tiodize T8E Paste PWA 36246	34568
PWC07-012	Coating, Aluminum Heat and Corrosion Resistant Ref. SermeTel W PWA595-1, PMC9748 (CPW88)	58913(m), A0039(s), A0040(s)
PWC07-023	Coating, Aluminum and Zinc Ref. Serme Tel 249 PWA548 (CPW584)	58913(m), A0039(s), A0040(s)
PWC07-024	Catalyst, Coating, Aluminum and Zinc Ref. SermeTel 273 (CPW584)	58913(m), A0039(s), A0040(s)
PWC08-002	Adhesive Fluorosilicone Ref. DC RTV 730 PMC79924 (CPW317)	71984(m)
PWC09-001	Sealant, Silicone Rubber RTV 732 (CPW519-11) PMC 1836	71984(m), K7750, D8367
PWC09-002	Compound, Locking and Retaining Anaerobic (Green) Ref. Loctite Grade 290 US. MIL-S-22473 PWA549-7, PMC79900 (CPW79-290)	05972(m), A0104(s), A0018, D2617, U0406, A0115(s), A0116(s)
PWC09-003	Compound, Sealing Silicone Ref. Dow Corning No. 4 US. MIL-S-8660 PMC9926, (CPW326)	71984(m), D8367

PWC09-005	Compound, Universal Jointing (Solvent Free) Ref. Hylomar Advanced Formulation PL 32-M ADV No. 12369 (ST490) (CPW267)	A0018, S0156(s)
PWC11-001	Cleaner, Alkaline (Internal Engine Washing) Ref. CLIX	20913, 56444
PWC11-001A	Cleaner, Alkaline (Internal Engine Washing) Ref. Almon AL-333	A253
PWC11-001B	Cleaner, Alkaline (Internal Engine Washing) Ref. Magnus 1214	02ER0(m), 85884
PWC11-001C	Cleaner, Alkaline (Internal Engine Washing) Ref. B&B 3100 SPMC 87-4	21361
PWC11-001D	Cleaner, Alkaline (Internal Engine Washing) Ref. ECT R-MCS SPMC 87-9A	A0111(s), N1480
PWC11-001E	Cleaner, Alkaline (Internal Engine Washing) Ref. ECT R-MC SPMC 87-9B	A0111(s), N1480
PWC11-001F	Cleaner, Alkaline (Internal Engine Washing) Ref. Turco 4217 Concentrate	36325(m), 0BYN5(m)
PWC11-001G	Cleaner, Alkaline (Internal Engine Washing) Ref. Turco T-5884 SPMC 87-12	36325(m),0BYN5(m)

PWC11-001H	Cleaner, Alkaline (Internal Engine Washing) Ref. Ardrox 624 Concentrate	A0052(s), 23373(s), 37127(s), A0121(m), 44389
PWC11-001J	Cleaner, Alkaline (Internal Engine Washing) Ref. Triethanolamine	A0001(s)
PWC11-003	Cleaner, Detergent (Engine Washing) Ref. Ardrox 6345 SPMC87-2	K6858(m)
PWC11-003A	Use PWC-0003B	
PWC11-003B	Cleaner, Detergent (Engine Washing) (Biodegradable) Ref. Ardrox 6367 (Turboclean 2)	A0052(s), 23373(s), 37127(s), K6858(m)
PWC11-003C	Cleaner, Detergent (Engine Washing) (Biodegradable) Ref. Ardrox 6368 (Turboclean 2 RTU) (Ready to use)	A0052(s), 23373(s), 37127(s), K6858(m)
PWC11-003D	Cleaner, Detergent (Engine Washing) (Biodegradable) Ref. ZOK 27	1NCU0, U4628
PWC11-003E	Cleaner, Detergent (Engine Washing) (Biodegradable) Ref. B & B TC 100 SPMC 87-5	21361
PWC11-012	Acetone Ref. Open PMC9008	A0001(s)

PWC11-013	No longer available. Use alternatives PWC11-013A, PWC11-049 or PWC11-061.	
PWC11-013A	Compound, Carbon Removing Ref. HDP 2888 SPMC 12	02ER0(m)
PWC11-014	Alcohol, Isopropyl US Fed. TT-I-735 Grade A PMC9094	A0001(s)
PWC11-014B	Alcohol, Isopropyl (Commercial Grade) Ref. Isopropanol # 1449 Commercial Grade PMC 79003	A0001(s), 36842
PWC11-016	Perchlorethylene Replaced by PWC11-014	A0001(s)
PWC11-019	Solution, Chromate Conversion Magnesium Alloy Ref. Open US.AMS-M-3171	A0001(s)
PWC11-021	DELETED	
PWC11-021C	Compound, Cold Carbon Removing Ref. Gerlach Soax No. 66	A0081
PWC11-022	Solvent, Cleaning Methyl Ethyl Ketone (MEK) US ASTM D740 PMC9076, (CPW79908) (See NOTE)	A0001(s), 36842
	NOTE: As an alternative, use the isopropyl alcohol (PWC11-014), acetone (PWC11-012), Ardrox Leeder 1064K (PWC11-023), Desoclean 45 (PWC11-025) or Envirosolv 655 (PWC11-005) to replce the MEK solvent. You can also use SPOP 209, refer to SPM, Chapter 70-21-00.	

PWC11-025	Solvent, Cleaning Ref. Desoclean 45 PMC9060	83574(m)
PWC11-027	Solvent, Petroleum US AMS 3160 US MIL-PRF-680 Type II (NATO code S-753) PMC9001	A0001(s), 36131
PWC11-029	Solvent, Removing RTV Compound Ref. Chlorothene SM	A0001(s)
PWC11-031	Cleaner, Engine Ref. Tergit PMC79783	02ER0(m)
PWC11-038	Solvent, Cleaning Ref. Deoxidine No. 624	71410, A0001(s)
PWC11-049	Remover, Rust, Alkaline Ref. Ardrox 185 SPMC 52	A0052(s), 23373(s), 37127(s), A0121(m), 44389, 02CA7, D1940
PWC11-061	Remover, Rust, Alkaline Ref. MAG-CHEM HDL-202 (Liquid) SPMC 129	02ER0 (m)
PWC11-074	Solvent, Non-Aqueous (Bulk or Aerosol) Ref. New ERA Degreasing Fluid, PMC 79004	A0001(s) A0141 A0142
PWC11-084	Degreaser, Water-Repellent (Inter-Treatment) Ref. HYSO 93	02ER0(m) F6892

PWC13-001	Primer, Epoxy Base: 519 x 303; + Curing Solution: 910-357; + Solvent 020 x 324 PWA568 (CPW268)	A0097(s), S0098(s), 0NYS9(m)
PWC15-004	Compound, Corrosion Preventative (Hard Film, Hot Application) US AMS3075	A0001(s)
PWC15-011	Inhibitor, Rust (External Engine Cold Section) Ref. Corrosion-X US MIL-C-81309	A0133 0VJ14
PWC15-013	Inhibitor, Corrosion (Type III, Class 1) Ref. Rustlick 631 DEF II	A0099
PWC15-013A	Inhibitor, Corrosion (Type III, Class 1) Ref. ZC-015	8E913
PWC15-013B	Inhibitor, Corrosion (Type III, Class 1) Ref. Alox 2028D	60773
PWC15-013C	Inhibitor, Corrosion (Type III, Class 1) Ref. Nox Rust 211	7X108
PWC15-013D	Inhibitor, Corrosion (Type III, Class 1) Ref. 2780	0W138
PWC15-013E	Inhibitor, Corrosion (Type III, Class 1) Ref. LPS-814-BULK	66724

	Ref. LPS-814-BULK	
PWC15-013F	Inhibitor, Corrosion (Type III, Class 1) Ref. Octoil 5069	82925
PWC15-013G	Inhibitor, Corrosion (Type III, Class 1) Ref. 2028CM-3 Bulk	33150
PWC15-013H	Inhibitor, Corrosion (Type III, Class 1) Ref. Technolube FE-008	A0100
PWC15-013J	Inhibitor, Corrosion (Type III, Class 1) Ref. Ardrox 3205	23373(m), A0101(s)
PWC15-013K	Inhibitor, Corrosion (Type III, Class 1) Ref. Batco Rust Preventative	60226
PWC15-013L	Inhibitor, Corrosion (Type III, Class 1) Ref. ACF-50	A0102
PWC15-015	Compound, Corrosion Preventative (Water Displacing) Ardrox 3961	37127
PWC15-016	Compound, Corrosion Inhibitor (Dry Film) LPS Procyon Corrosion Inhibitor Bulk or Aerosol, PMC 79138-1	A0001(s) 66724(m)
PWC15-017	DELETED	

Item	Nomenclature/Specification	Supplier Code
PWC01-001	Fuel, Engine	(Ref. Approved Service Bulletin)
PWC03-001	Oil, Engine Lubricating Ref. Open MIL-PRF-23699 PWA 521 PMC 79873	(Ref. Approved Service Bulletin)
PWC03-002	Fluid, Calibrating Ref. Brayco 922 US MIL-PRF-7024 Type II PMC 9041	A0015
PWC04-004	Grease, High Temperature (Bentonite-type) Ref. Plastilube No. 3 PMC9631	77163, A0022, 1V074
PWC04-005	Grease, Exterior (Extreme) Pressure Ref. Lubriplate 130A PMC79919	73219, A0032, A0033, A0034, A0035
PWC05-002	Dye, Layout and Identification Ref. Micro Supreme Layout Dye PMC4062	01058, 59460
PWC05-003	Cloth, Abrasive Silicone Carbide Ref. Open No. 230 Grit No. 320 Grit No. 400 Grit	A0001(s), 44197(m), 61158(m)
PWC05-007	Fluid, Leak Check Leak Tec 372E PMC9569	03530

Operating Condition	ESHP	SHP	ESFC (lb/eshp/hr)	Jet Thrust (lb.)
Takeoff /Max. Continuous	905	850 (1)	0.633	137
Max. Climb/ Max. Cruise (3)	905	850 (2)	0.633	137

NOTE: 1. Available to 70°C (158°F) @ 2000 rpm Np

NOTE: 2. Available to 64°C (147°F) @ 2000 rpm Np

NOTE: 3. For information only, these ratings are not Transport Canada approved.

PWC30269	Mount Ring	72-00-00		X	
PWC30304-04	Rivet Set	72-50-02		X	
PWC30304-07	Rivet Set	72-50-02		X	
PWC30331	Wrench	72-50-01	X	X	
PWC30335	Spreader	72-50-02	X	X	
PWC30336	Protector	72-50-01	X	X	
PWC30373	Puller/Pusher	72-60-00		X	
PWC30403	Puller	72-50-02		X	
PWC30458	Squeezer	72-50-02		X	
PWC30499-50	Gage	72-60-00	X	X	
PWC30506	Flow Test Rig	73-11-05	X	X	
PWC30530	Blanking Plug (2 required)	73-11-05	X	X	
PWC30556	Puller	79-20-02	X	X	
PWC30854	Adapter	72-60-00		X	
PWC31050	Wrench	72-50-04		X	
PWC31515	Bar	72-50-04		X	
PWC31771	Spreader	70-00-00	X	X	
		72-30-04	X	X	
PWC32000	Bracket (2 off)	72-00-00	X	X	

PWC31771	Spreader	70-00-00	X	X	
		72-30-04	X	X	
PWC32000	Bracket (2 off)	72-00-00	X	X	
PWC32058	Riveter	72-50-02		X	
PWC32062	Adapter Socket	73-10-09	X		
PWC32072	Puller	72-10-00	X	X	
PWC32076	Holder	72-60-00		X	
PWC32111	Puller	72-50-03		X	
PWC32120	Pusher	72-50-04		X	
PWC32136	Fixture	72-50-04		X	
PWC32137	Socket	72-50-04		X	
PWC32174	Base	72-60-00		X	
PWC32175	Ring	72-60-00		X	
PWC32209	Adapter	72-50-01		X	
PWC32271	Tube, Spray	71-00-00	X	X	
PWC32366	Pusher	73-11-05	X	X	
PWC32375	Drift	72-60-00		X	
PWC32380	Gage	72-50-01		X	
PWC32396-400	Jackscrew - Alternate to PWC42034	72-50-01		X	X

		72-60-00		X	X
PWC32421	Sling, Gas Generator Module	72-00-00	X	X	
PWC32486	Socket	72-60-00		X	
PWC32507	Pump	72-50-04		X	
PWC32677-100	Washcart	71-00-00	X		
PWC32677-300	Washcart	71-00-00	X		
PWC32811	Flow Test Fixture	73-11-05	X	X	
PWC32823	Puller	72-50-01		X	
PWC34060	Fixture	72-60-00		X	
PWC34062	Puller	72-60-00		X	
PWC34128	Wheel, Grinding	72-50-01		X	
PWC34405	Leak Test Fixture	73-11-05	X	X	
PWC34414	Puller	72-40-01		X	
PWC34416	Nozzle Sheath Puller	73-11-05	X	X	
PWC34418	Puller	72-60-00	X	X	
PWC34478	Spacer (4 off)	72-50-01		X	
		72-50-02		X	
PWC34522	Puller	72-50-01		X	
PWC34532	Puller	79-20-03	X	X	

PWC34752	Adapter	72-00-00		X	
PWC34910-101	Borescope	72-00-00	X	X	
PWC34910-600	Guide Tube	72-00-00	X	X	
PWC34913	Fixture	72-00-00	X	X	
PWC34941	Wrench	72-00-00	X	X	
PWC37088-1	Drift	72-60-00	X	X	
PWC37088-2	Drift	72-60-00	X	X	
PWC37088-3	Drift	72-60-00	X	X	
PWC37906	Adapter	72-50-04		X	
PWC37917	Dresser	72-50-01		X	
PWC37918	Grinder	72-50-01		X	
PWC42034	Jackcrew - (Obsolete - replaced by PWC32396-400)	72-50-01		X	X
		72-60-00		X	X
PWC50060	Oil Injector	72-50-02		X	
PWC50135	Gage	72-60-00		X	
PWC50237	Drift	72-60-00			
PWC50442	Socket	72-50-04		X	
PWC50502	Compressor	72-60-00		X	
PWC50588	Puller	72-50-04		X	

PWC50591	Adapter - Obsolete - replaced by PWC71489	72-50-04		X	
PWC50713	Puller	72-60-00		X	
PWC50717	Puller, Seal	72-60-00	X	X	
PWC50726-100	Puller	79-20-02	X	X	
PWC50745	Rigging Pin, Propeller Reversing Lever	73-20-00	X	X	
PWC50745	Rigging Pin, Propeller Reversing Lever	76-10-00	X	X	
PWC51140	Engine Stand - Replaced by PWC70907	72-00-00	X	X	
PWC51165	Base, Carrier Seal	72-60-00		X	
PWC51166-3	Sleeve, Carrier Seal	72-60-00		X	
PWC51166-5	Sleeve, Carrier Seal	72-60-00		X	
PWC51167-1	Drift, Assembly - Carrier Seal	72-60-00		X	
PWC51167-3	Drift, Assembly - Carrier Seal	72-60-00		X	
PWC51167-4	Drift, Assembly - Carrier Seal	72-60-00		X	
PWC51167-5	Drift, Assembly - Carrier Seal	72-60-00		X	
PWC51482	Puller, Carbon Seal Carrier	72-60-00		X	
PWC51775	Probe Locator	77-20-01	X	X	
PWC51777	Crimper	72-50-04		X	
PWC51861-600	Sling - Replaces PWC32420	72-00-00	X	X	
PWC54246	Puller/Pusher, Tubes (Alternative to PWC32366)	73-10-05	X	X	

PWC51861-600	Sling - Replaces PWC32420	72-00-00	X	X	
PWC54246	Puller/Pusher, Tubes (Alternative to PWC32366)	73-10-05	X	X	
PWC64241	Guidepin	72-50-01		X	
PWC64247	Puller, Cover	72-50-01		X	
PWC70030	Drift, Carrier	72-60-00		X	
PWC70099	Power Section Sling (without prop)	72-00-00	X	X	
PWC70104	Power Section Sling (with prop)	72-00-00	X	X	
PWC70448	Socket, T5 Thermocouple	77-20-01	X		
PWC70838	Puller, Seal Carrier	72-60-00	X	X	
PWC70869	Drift, Lip Seal	72-60-00	X	X	
PWC70907	Engine Stand	72-00-00	X		
PWC71489	Adapter - Alternate to PWC50591	72-50-04		X	
PWC73013	Borescope Kit, Fiberscope	72-00-00	X	X	
PWC89837	Cylinder, Hydraulic - Replaces PWC32506	72-50-04		X	
PWC89927	Riveter	72-50-02		X	
PWC90086	Spray Chamber	73-11-05	X	X	

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC30046-52	Puller	72-60-00	X	X	
PWC30046-57	Puller	72-60-00	X	X	
PWC30051-01	Base	72-60-00		X	
PWC30051-02	Drift	72-60-00		X	
PWC30052	Puller	72-60-00	X	X	
PWC30075	Drift	72-60-00	X	X	
PWC30114-05	Wrench	77-20-01	X	X	
PWC30114-35	Wrench	61-20-00	X	X	
PWC30128-04	Puller	72-60-00		X	
PWC30128-14	Puller	73-11-05	X		
PWC30269	Mount Ring	72-00-00		X	
PWC30304-04	Rivet Set	72-50-02		X	
PWC30304-07	Rivet Set	72-50-02		X	
PWC30331	Wrench	72-50-01	X	X	
PWC30335	Spreader	72-50-02	X	X	
PWC30336	Protector	72-50-01	X	X	
PWC30373	Puller/Pusher	72-60-00		X	

Leading Particulars	
Type of Combustion Chamber	Annular
Compression Ratio	12:1
Propeller Shaft Rotation	Clockwise pilot view tractor configuration.
Propeller shaft coupling	Flanged
Propeller shaft gear ratio	0.066345:1
Engine dia.	19.0 in. approx. at room temp.
Engine length	70.0 in. approx. at room temp.
Dry weight	456 lb. incl. standard equip.
	472 lb. incl. optional equip.
Oil consumption	0.3 lb/hr (136 cc/hr) or 1.36 liter/10 hr

and cooling water.		or equivalent	
Stainless Steel Tank 5 gallon capacity and capable of withstanding 50 psi 2 off .	(Ref. 71-00-00, CLEANING)		Local Purchase
Tubing, Stainless Steel $^{5}/_{16}$ inch ID, length as required.	(Ref. 71-00-00, CLEANING)		Local Purchase
		In the event of non-availability of ultrasonic cleaning equipment, operators should send fuel nozzles requiring cleaning and testing to an approved overhaul facility, or to a maintenance base having suitable equipment.	
Electrosonic, Cleaner	(Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES) and (Ref. 73-10-07, COMPRESSOR DELIVERY AIR LINES - MAINTENANCE PRACTICES)	Sonac S-2 or Model KS 5518	Kell-Strom Tool Co. 214 Church Street Wethersfield, CT 06109 USA Tel.: (860) 529-6851 or Tel.: (860) 721-0658 (AOG service) Fax: (860) 257-9694
Shut-off Valve Fluid Line	(Ref. 71-00-00, CLEANING)		Local Purchase
			or
			Interfast Inc. 21 Constellation Court Rexdale, Ontario Canada M9W 1K4
Oil Filter Element Rinsing and Debris Apparatus Kit	(Ref. 79-20-02, MAINT. PRAC.)	AVL-OFRA	Aviation Laboratories 5401 Mitchelldale #B6 Houston, TX 77092 USA Tel.: 713-864-6677 Tel.: 800-256-6876 Fax: 713-864-6990

Table 2 Special Equipment

Name	Chapter	Part No.	Supplier
A.C./D.C. Arc Welding Machine; 150 amp minimum capacity with close control in 15 to 75 amp. range. (High frequency control for ease of arc starting is desirable).	(Ref. 70-00-00, REPAIR)	P and H Model DA-300-HF-GW or equivalent	Local Purchase
Shutoff Valve (Air Line)	(Ref. 71-00-00, CLEANING)		Local Purchase
Pressure Gage 0 to 75 psi, accuracy ± 5 percent	(Ref. 71-00-00, CLEANING)		Local Purchase
Argon Regulator	(Ref. 70-00-00, REPAIR)	Airco 8407 or equivalent	Local Purchase
Flowmeter Block Assemblies (2 required)	(Ref. 70-00-00, REPAIR)	Airco 830-1327 or equivalent	Local Purchase
Shielded Arc Torch; with provision for supply of inert gas (argon) and cooling water.	(Ref. 70-00-00, REPAIR)	Linde HW-9 or HW-10 or Airco H20A or H35B or equivalent	Local Purchase
Stainless Steel Tank 5 gallon capacity and capable of withstanding 50 psi 2 off .	(Ref. 71-00-00, CLEANING)		Local Purchase
Tubing, Stainless Steel $^{5}/_{16}$ inch ID, length as required.	(Ref. 71-00-00, CLEANING)		Local Purchase

No.	Drive Pad	Rotation	Ratio	Max. Torque (lb.in.)		Max. Speed (rpm)
				Continuous	Static	
1	Starter-generator (NOTE: 1)	CW	0.2931:1	170	1600	10982
2	Fuel Pump/FCU (NOTE: 1)	CCW	0.1670:1	-	-	6257
3	Ng Tach Generator (NOTE: 1)	CCW	0.1121:1	7	100	4200
4	Optional Accessory Drive (NOTE: 1)	CCW	0.1019:1	60	800	3818
5	Optional Accessory Drive (NOTE: 1)	CW	0.3208:1	135	800	12020
6	Optional Accessory Drive (Hydraulic Pump) (NOTE: 1)	CCW	0.2041:1	150	800	7647
7	Propeller Governor (NOTE: 2)	CW	0.1405:1	50	850	4200
8	Nf Tach Generator (NOTE: 2)	CW	0.1405:1	7	100	4200
9	Propeller Overspeed Governor (NOTE: 2)	CW	0.1405:1	50	850	4200

NOTE: 1. Rear Accessory Drives, 100% is 37,500 rpm Ng.

NOTE: 2. Front Accessory Drives, 100% is 29,900 rpm Nf.

Nomenclature	Specification
Fuel	Refer to Transport Canada Approved Service Bulletins
Oil	Refer to Transport Canada Approved Service Bulletins
Oil Tank - Total Capacity	2.5 US gallons (2.08 Imp. gallons)
Oil Tank - Expansion Space	0.7 US gallons (0.58 Imp. gallons)
Oil Tank - Usable Quantity	1.5 US gallons (1.25 Imp. gallons)

	Normal hot section deterioration.	Do an HSI if T5 limit exceeded.	
Wf, T5 UP, Ng Constant	P3 leaks from engine/airframe system.	Inspect.	Repair as req'd.
	Gas generator case cracked at fuel nozzle or P3 bleed pads. Diffuser exit ducts cracked or loose.	Inspect.	Replace engine if defect confirmed.
	Leaking gas generator drain valves, C flange, fuel nozzle gasket, or T5 harness seal.	Inspect.	Replace engine if defect confirmed.
	Concurrent hot section and compressor deterioration.	Inspect CT stator and CT blades, and compressor.	Do an HSI or send engine for overhaul.

NOTE: 1. An increase in T5 without other parameter shifts may be the result of defective fuel nozzles or a deteriorating combustion chamber liner altering combustion profile and gas path temperature distribution.

NOTE: 2. The relationship between T5 and the temperature in front of the CT stator may change due to hot section component deterioration altering combustion profile and/or gas path temperature distribution. This may affect the T5 trim and the indicated T5, and the relationship between T5 and the temperature in front of the CT stator used for engine certification. A T5 trim verification on-wing or in a test cell will confirm a shift in the indicated temperature.

Engine Parameters	Probable Cause	Action Req'd	Remarks
All parameters UP	Engine/Airframe indicating systems.	Inspect.	Repair as req'd.
	Air inlet door blocked.	Inspect.	Repair as req'd.
	Bypass door or ice vane misrigged.	Inspect.	Repair as req'd.
	Compressor FOD, rub, erosion.	Inspect and/or repair.	Remove engine if damage limits are exceeded.
	Compressor contaminated/dirty.	Wash compressor.	
	Bleed valve open.	Inspect.	Repair as req'd.
	P2.5 air leaks from engine/airframe system.	Inspect.	Repair as req'd.
	PT stator vanes burned/flow area increased. PT blade tip oxidation/rub.	Inspect.	Repair as req'd.
	Hot start.	Inspect hot section and check log book.	Do applicable overtemperature inspection.
All parameters DOWN	Engine/Airframe indicating system.	Inspect.	Repair as req'd.
T5 UP or DOWN, Ng, Wf Constant	Engine/Airframe indicating system. (Note 1)	Inspect . If applicable, do on-wing T5 system trim. (Note 2)	Repair as req'd. T5 usually decreases when probes are unserviceable.
	Fuel nozzle deterioration.	Inspect.	Clean as req'd.
Ng UP or DOWN, T5, WF Constant	Engine/Airframe indicating system.	Inspect.	Repair as req'd.
Wf UP or DOWN, T5, Ng Constant	Engine/Airframe indicating system.	Inspect.	Repair as req'd.
Wf, T5 UP, Ng DOWN	CT stator vanes burned/flow area increased. CT blade tip oxidation/rub.	Inspect CT stator, and CT blades.	If limits exceeded, do an HSI.
	Normal hot section deterioration.	Do an HSI if T5 limit exceeded.	
Wf, T5 UP, Ng Constant	P3 leaks from engine/airframe system.	Inspect.	Repair as req'd.
	Gas generator case cracked at fuel nozzle or P3 bleed pads. Diffuser exit ducts cracked or loose.	Inspect.	Replace engine if defect confirmed.

	ZONE	NOTE: 1	NOTE: 2	NOTE: 3
DEPTH	A	< 0.060 inch	DELETED	≥ 0.060 inch
	B	< 0.035 inch		≥ 0.035 inch
AREA	A	< 30%		> 30%
	B	< 30% Any one strut		≥ 30% Any one strut

NOTE: 1. Repair in-situ within 20 flight hours or one month, or alternatively apply corrosion inhibitor and examine at every MINOR inspection or three months, whichever occurs first.

NOTE: 2. DELETED.

NOTE: 3. Repair overhaul facility before next flight.

CONDITION	INSPECTION	MAX. SERVICEABLE	ACTION
AXIAL MOVEMENT		None permitted.	See Note
BLADE SHIFT (Ref. Fig. 204)		Protrusion of blade root away from disk rim must be equal within 0.016 inch on two sides of the disk.	See Note
CIRCUMFERENTIAL MOVEMENT		Max. 0.030 inch acceptable at blade tip.	See Note
CORROSION (Ref. Inspection/Check, Para 6.B.)		(Ref. Inspection/Check, Para 6.B.)	See Note
CRACKS		Not acceptable.	*
EROSION	Leading edge tip	Radius 0.200 inch max.	*
NICKS AND DENTS (Ref. Fig. 203)	Area A	Max. six up to 0.015 inch deep and 0.100 apart	See Note
	Area B (Fillet)	Max. four up to 0.010 inch deep and 0.100 apart	See Note
	Area C Leading Edge	Max. four up to 0.020 inch deep and 0.100 apart	See Note
	Area C Trailing Edge	Max. four up to 0.010 inch deep and 0.100 apart	See Note
PITS	All Area of Airfoil	Isolated pitting up to 0.008 inch deep not exceeding 30% of the total area	See Note

* Replacement of individual blades is not authorized. Remove trim weights and send bladed disk assembly to an approved overhaul facility.

Outer and Inner rings	Any amount	
SEALING SURFACE		
Inner and Outer Rings	Sealing pattern must be continuous and unbroken.	Lap surfaces
PINCH FIT	Refer to Compressor Turbine Housing Inspection/Check.	
SNUG FIT	Verify fit between compressor vane ring inner lugs and No. 2 bearing cover flange slots. Snug fit required.	

Inspection	Max. Serviceable	Corrective Action
COATING LOSS		
Airfoil	Any amount provided parent metal erosion is within limits.	None
Outer ring	Complete loss of coating	None
Inner ring	Complete loss of coating	None
CRACKS		
Airfoil	Multiple hairline cracks not exceeding 0.500 inch long at the leading edge or 1.000 inch long at the trailing edge are acceptable provided there is no evidence of burning.	None
	If two or more hairline cracks can converge to liberate a parent material, then the component must be rejected.	None
	An open crack greater than 0.001 inch wide is not acceptable.	None
Inner Ring	Hairline cracks that extend into the vane airfoil are acceptable, provided that two or more cracks do not converge to let a piece become detached	None
	Open cracks through part, or the entire inner ring are acceptable provided that two or more cracks do not converge to let a piece become detached.	None
	Open cracks less than 0.020 inch are acceptable.	None
Outer Ring	Hairline cracks through wall are acceptable provided that 20 % of the axial length is intact.	None
	Hairline cracks that extend into the vane airfoil are acceptable, provided that two or more cracks do not converge to let a piece become detached.	None
	Open cracks less than 0.020 inch wide are acceptable.	None
EROSION		
Airfoil	0.010 inch deep on any airfoil surface on any number of vanes. When a CT stator examination reveals trailing edge burning has resulted in a loss of airfoil area of 0.125 sq.in., or more, on any one vane, and burnt area can be seen from the leading edge of the stator vane when viewed parallel to longitudinal axis of the engine (Ref. Fig. 202 and Table 603 of Chapter 72-00-00, INSPECTION), the entire set of CT blades must be scrapped (Ref. 72-50-02, Removal/Installation).	None
Outer and Inner	Any amount	

Type of Damage	Disposition
A nick, 0.020 in. deep by 0.025 in. wide, in blade root.	Engines may not continue in operation with damage in blade root. However, if the damage can be removed by performing a leading edge cutback (Ref. Approved Repairs) the engine can return to service provided performance is satisfactory.

Class	Limits in Ohms 21°C (70 °F)	Nominal Resistance in Ohms 21°C (70 °F)	Expected Nominal T5 Trim (°F)
01	11.95-12.25	12.1	82 °C (147 °F)
02	12.65-12.95	12.8	77 °C (139 °F)
03	13.35-13.65	13.5	73 °C (132 °F)
04	14.40-14.80	14.6	69 °C (124 °F)
05	15.40-15.80	15.6	64 °C (116 °F)
06	16.55-17.05	16.8	61 °C (109 °F)
07	17.90-18.50	18.2	57 °C (102 °F)
08	19.45-20.15	19.8	52 °C (94 °F)
09	21.25-22.15	21.7	48 °C (86 °F)
10	23.50-24.50	24	43 °C (78 °F)
11	26.15-27.45	26.8	39 °C (71 °F)
12	29.50-31.10	30.3	35 °C (63 °F)
13	33.80-35.60	34.7	31 °C (56 °F)
14	39.50-41.70	40.6	27 °C (48 °F)
15	47.50-50.10	48.8	22 °C (40 °F)
16	59.40-62.60	61.0	18 °C (32 °F)
17	78.90-83.10	81.0	14 °C (25 °F)
18	110.30-116.10	113.2	9 °C (17 °F)
19	222.20-233.80	228	6 °C (10 °F)
20	20M min	∞	2 °C (3 °F)

Inspection	Max. Serviceable	Action
BLADE SHIFT (Ref. Fig. 206)	Protrusion of any blade root must be equal within 0.005 in. either side of disk .	Replace
CIRCUMFERENTIAL MOVEMENT	0.030 in. max. at tip	Replace
AXIAL MOVEMENT	None permitted.	Replace
AREA A (Ref. Fig. 207):		
Nicks	Three max., 0.015 in. long by 0.005 in. deep max.	Replace
Dents and pits	Three max., 0.010 in. deep max.	Replace
Cracks	Not acceptable.	Replace
AREA B (Ref. Fig. 207):		
Nicks, dents and pits	One max., 0.020 in. deep max.	Replace
LEADING AND TRAILING EDGES		
Cracks	Not acceptable.	Replace

Item	Max. Serviceable	Action
VANE RING	Cracks up to 0.400 in. long on any number of vanes, leading and/or trailing edges.	Replace
	One crack through entire length, of outer ring, provided crack is not open more than 0.050 in. and sealing faces do not exhibit any distortion.	Replace
	One crack through entire length of inner ring, provided crack is not open more than 0.020 inch.	Replace
	Any number of hairline cracks, inner or outer rings, provided no two converge in such a manner that would allow material to become detached.	Replace
	Erosion or pitting, 0.250 sq.in. by 0.010 in. deep on any airfoil surface, any number of vanes. Stators which have been reworked by vane trailing edge material removal are acceptable (Ref. Fig. 203).	Replace
	Loss of anti-rotation lugs is not acceptable.	Replace
INTERSTAGE BAFFLE	Examine for correct attachment, integrity.	Replace loose rivets.

P&WC P/N	Supplier and P/N	Dim. A (in.)	Dim. B (in.)
*3035102	Champion, CH34055	0.3000	Not applicable to air cooled igniters
*3031213	Bendix, 10-390667-1	0.3000	
* Parts obtained under ordering Part No. 3032096			

THREAD SIZE	TORQUE (lb.in.)
0.250 -28	14 to 16
0.3125-24	22 to 24
0.375 -24	28 to 32
0.4375-20	38 to 42
0.500 -20	58 to 62
0.5625-18	70 to 80
0.625 -18	95 to 105
0.750 -16	145 to 155
0.8125-16	165 to 185

CT Disk OD (in.)	Segment Class	Recommended Shroud Segment Dim. A (±0.002 in.)	Shroud ID Before Grinding (in.)	
			Min.	Max.
9.541 Max.	11	0.199	9.558	9.566
9.533	12	0.203	9.550	9.558
9.525	13	0.207	9.542	9.550
9.517	14	0.211	9.534	9.542
9.509	15	0.213	9.526	9.534
9.501	16	0.217	9.518	9.526
9.493	17	0.221	9.510	9.518
9.485	18	0.225	9.502	9.510
9.477	19	0.233	9.494	9.502
9.469	20	0.237	9.486	9.494
9.461	21	0.241	9.478	9.486
9.453	22	0.245	9.470	9.478
9.445	23	0.249	9.462	9.470
9.437	24	0.253	9.454	9.462

Inspection	Max. Serviceable	Action
CRACKS		
Leading and/or trailing edges	0.400 in. long on any number of vanes.	Replace
Outer ring	One crack through entire length is acceptable provided crack is not open more than 0.050 inch and sealing faces do not exhibit any distortion.	Replace
	Any number of hairline cracks are acceptable provided no two cracks converge in such a manner that would allow a piece to become detached.	Replace
	Loss of lugs is not acceptable.	Replace
Inner ring	One crack through entire length is acceptable provided crack is not open more than 0.020 inch.	Replace
	Any number of hairline cracks are acceptable provided no two cracks converge in such a manner that would allow a piece to become detached.	Replace
	Loss of lugs is not acceptable.	Replace
AIRFOIL SURFACES		
Erosion or pitting	0.250 sq.in. by 0.010 in. deep on any vane for any number of vanes. Stators which have been reworked by vane trailing edge material removal are acceptable.	Replace

Mating Bolt Thread Size	Max Locking Torque	Min Breakaway Torque	Mating Bolt Thread Size	Max Locking Torque	Min Breakaway Torque
0.112-48NF-2A	3	0.5	0.112-40NC-2A	3	0.5
0.138-40NF-2A	6	1.0	0.125-40NC-2A	4	1.0
0.164-36NF-2A	9	1.5	0.138-32NC-2A	6	1.0
0.190-32UNF-3A	13	2.0	0.164-32NC-2A	9	1.5
0.250-28UNF-3A	30	3.5	0.190-24UNC-3A	13	2.0
0.3125-24UNF-3A	60	6.5	0.250-20UNC-3A	30	4.5
0.375-24UNF-3A	80	9.5	0.3125-18UNC-3A	60	7.5
0.4375-20UNF-3A	100	14.0	0.375-16UNC-3A	80	12.0
0.500-20UNF-3A	150	18.0	0.4375-14UNC-3A	100	16.5
0.5625-18UNF-3A	200	24.0	0.500-14UNC-3A	150	24.0
0.625-18UNF-3A	300	32.0	0.5625-12UNC-3A	200	30.0
0.750-16UNF-3A	400	50.0	0.625-11UNC-3A	300	40.0
0.875-14UNF-3A	600	70.0	0.750-10UNC-3A	400	60.0

NOTE: The breakaway torque specified is the minimum torque required to overcome static friction, and applies at installation or removal. The locking torque specified is the maximum torque required to overcome kinetic friction and applies at installation or removal.

NOTE: Use the listed bolt sizes for torque testing cadmium plated nuts, carbon steel nuts, alloy steel nuts, and aluminum nuts.

0.750-10	60.0
0.750-16	50.0
0.875-9	82.0
0.875-14	70.0
1.000-8	110.0
1.000-12	90.0

Power Torque Wrench

Thread Size	Torque lb.in. Min
0.112-40	0.5
0.112-48	0.5
0.138-32	1.0
0.164-32	1.5
0.164-36	1.5
0.190-24	2.0
0.190-32	2.0
0.2500-20	4.5
0.2500-28	3.5
0.3125-18	7.5
0.3125-24	6.5
0.3750-16	12.0
0.3750-24	9.5
0.4375-14	16.5
0.4375-20	14.0
0.5000-13	24.0
0.5000-20	18.0
0.5625-12	30.0
0.5625-18	24.0
0.6250-11	40.0
0.6250-18	32.0
0.750-10	60.0

CT Stator		NO. 2 Bearing Cover Flange	CT Shroud Housing
Inner Lug Min. Width	Outer Lug Min. Width	(Slot Width Maximum)	
0.2505	0.3955	0.2550	0.4020

509	Compressor Turbine, Rotor diameter			9.531 9.541	9.490
515	Gap between CT stator and shroud segments			0.0210 0.0360 AXIAL GAP	

REF. No.	Name	Dim. for Ref. inches		Limits inches		
		Min.	Max.	Min.	Max.	Replace
229	Pre-SB14438 Flange, No. 2 Bearing Housing Cover	5.259	5.261	0.004T	0.002L	
	Cover, No. 2 Bearing Housing Assembly	5.257	5.261			
229	Post-SB14438 Flange, No. 2 Bearing Housing	5.280	5.282	0.004T	0.002L	
	Cover, No. 2 Bearing Housing	5.278	5.282			
260	Lockplate, CT Stator	5.309	5.313	0.005	0.015	
	Cover, No. 2 Brg. Housing Assembly	5.298	5.304			
263	Cover, No. 2 Brg. Housing Assembly	5.3020	5.3030	0.0020T	0.0010	
	Case, Gas Generator Assembly	5.3010	5.3030			
318	CT Blade, Radial Tip Clearance			0.0180 0.0200 (New Segments) 0.0160 0.0220 (Run Segments) (Note)		
NOTE: Refer to Table 207 for Special Assembly Requirements.						
488	Shroud Segment, Compressor	0.1000	0.1020	0.0020 0.0060 END FLOAT		
	Housing, CT Shroud	0.1040	0.1060			
489	CT Stator Assembly	0.1250	0.1260	0.0005T	0.0015	
	Flange, No. 2 Bearing Cover	0.1255	0.1265			
509	Compressor Turbine, Rotor diameter			9.531	9.541	9.490

Nominal Safety Cable Diameter	Lockwire Substitution
0.032 inch (0.815 mm)	AS3214-02 or MS9226-04
NOTE: Lockwire AS3214 may be used in engine external applications only.	

Nominal Cable Diameter	Minimum Pull-off Load
0.032 Inch (0.81mm)	70 Inch-Pounds (7.909 Nm)

REF. No.	Name	Limits	
		Min.	Max.
541	Bolt, CT (1) Tighten bolt initially 600 to 650 lb.in. (2) Loosen to zero. (3) Tighten to final value of 500 to 550 lb.in.		

		Cover Housing, Scavenge Oil Pump	AGB
AMS 4260	Alum. (Alloy 356)	Cover, Main Oil Pressure Pump	AGB
AMS 4275	Alum. (Alloy 750)	Brgs, Main Oil Pump Gear	AGB
		Sleeve, Accessory Drive Gears	RGB
		Cage, Start- Gen Drive Brg	AGB
		Cage, Vacuum Pump Drive Brg	AGB
		Cage, External Scavenge Oil Pump Drive Brg	AGB
		Coupling Shaft Brg	RGB
AMS 5315	Steel	Sleeve, Propeller, Oil Transfer	RGB
AMS 5613	SST (X51410)	No. 1 Brg Front Air Seal,	GG
		No. 2 Brg Front Stator, Air Seal	GG
		No. 2 Brg Front Rotor Air Seal,	GG
		No. 2 Brg Rear Stator Air Seal	GG
		No. 2 Brg Rear Rotor Air Seal	GG
		No. 3 Brg Stator Air Seal ,	PT
AMS 5645, 5646	SST (30321)	Sleeve, AGB Coupling Shaft Brg	AGB
AMS 5671	SST (Inconel X750)	Seal, No. 3 Brg, Front Labyrinth, Air	PT
AMS 5732	SST (A286)	Housing, No. 1 Brg, Outer	GG
AMS 6260	Steel (9310)	Gear, Main Oil Scavenge Pump	AGB
AMS 6265	Steel (9310)	Gear, Accessory Drive,	RGB

		Gear, Second-stage Planet	RGB
		Carrier, Second-stage Planet Gear	RGB
		Shaft, Second-stage Planet Gear	RGB
		Gear, Second-stage, Ring	RGB
		Gear, First-stage, Ring	RGB
		Gear, Second-stage, Sun	RGB
		Coupling, Second-stage Sun Gear	RGB
		Adapter, Second-stage Sun Gear	RGB
		Carrier, First-stage Planet Gear	RGB
		Gear, First-stage, Planet	RGB
		Gear, First-stage, Sun	RGB
		Coupling, AGB Drive	GG
		Coupling, First-stage Sun Gear	PT
		Shaft, AGB Coupling	AGB
		Gear, Start- Gen Drive	AGB
		Gear, Hydraulic Pump Drive	AGB
		Gear, Main Oil Pump Drive	AGB
		Gear, External Scavenge Pump Drive	AGB
		Gear, External Scavenge Pump Drive	AGB
		Gear, External Scavenge Pump Drive	AGB
		Gear, Oil Pressure Pump	AGB
		Gear, Oil Pressure Pump	AGB
		Gear, Oil Pressure Pump	AGB

		Gear, External Oil Scavenge Pump	AGB
		Gear, Scavenge Oil Pump	AGB
		Shaft, External Scavenge Pump Drive,	AGB
		Coupling, Oil Pump Drive	AGB
AMS 6322	Steel (8740)	Sleeve, Second-stage Sun Gear	RGB
		Shaft, First-stage Planet Gear	RGB
AMS 6415	Steel (4340)	Shaft, Propeller	RGB
		Cage, No. 6 Brg	RGB
		Cage, No. 5 Brg	RGB
		Locating Pin, Second-stage Planet Gear Carrier,	RGB
		Torque Cylinder,	RGB
		Shaft, Impeller	GG
AMS 6440/ 6444	Steel (52100)	Roller, AGB Coupling Shaft Brg	AGB
		Roller, Start-Gen Drive Brg	AGB
		Roller, Hydraulic Pump Drive Brg	AGB
		Roller, External Scavenge Pump Drive Brg	AGB
		No. 6 Brg, Ball and Rings	RGB
		No. 5 Brg, Roller and Rings	RGB
		First-stage Planet Gearshaft,	RGB
		Rings, AGB Coupling Shaft Brg	AGB
		Rings, Start-Gen Drive Brg	AGB
		Rings, Hydraulic Pump Drive Brg	AGB

		Rings, Start-Gen Drive Brg	AGB
		Rings, Hydraulic Pump Drive Brg	AGB
		Rings, External Scavenge Pump Drive Brg	AGB
AMS 6490	Steel (M50)	No. 2 Brg, Rings and Rollers	GG
		No. 3 Brg Rings and Rollers	PT
AMS 6491	Steel (M50)	No. 1 Brg Rings and Balls,	GG
		PT Shaft	PT
		PT Shaft Coupling	PT
		No. 4 Brg Rings and Balls,	PT
AMS6265 AMS6444	Steel	Shaft, Second-stage Planet Gear	RGB
		Shaft, First-stage Planet Gear	RGB
AMS 4928	Titanium Alloy	Compressor, First-stage	GG
		Stubshaft, First-stage Compressor	GG
	Molybdenum	Coating, No. 2 Brg, Labyrinth, Seals, Air	GG
AMS 7330		Retaining Ring, Second-stage Sun Gear	RGB

Table 206 Material Specification (Engine Components)

Specification	Material	Nomenclature	Engine Location
AISI 305	Nickel Chromium Steel	CSU Bearing Retainer	RGB
AISI 440C	Chromium Steel	CSU Bearing Race and Balls	RGB
AMS 2412	Silver Plating	Cage, No. 1 Brg	GG
		Cage, No. 2 Brg	GG
		Cage, No. 3 Brg	PT
		Cage, No. 4 Brg	PT
		Cage, No. 5 Brg	RGB
		Cage, No. 6 Brg	RGB
		Cage, Start-Gen Drive Brg	AGB
AMS 4082, 4150	Alum (AA6061)	Sleeve, First-stage, Carrier	RGB
AMS 4117, 4127, 4150	Alum (AA6061)	Stator, No. 1 Brg Air Seal	GG
AMS 4214	Alum (Alloy 355)	Breather, Impeller	AGB
		Body, Main Scavenge Oil Pump	AGB
		Housing, Main Scavenge Oil Pump	AGB
		Cover, Main Scavenge Oil Pump	AGB
		Housing , External Scavenge Oil Pump	AGB
		Spacer, External Scavenge Oil Pump	AGB
		Cover Housing, Scavenge Oil Pump	AGB
AMS 4260	Alum.	Cover, Main Oil Pressure Pump	AGB

REF. No.	Name	Limits	
		Min.	Max.
NOT APPLICABLE			

Contaminant Detected	Main Elements	Cause of Contaminants
Alumina	Al_2O_3	Manufacturing
Black Magnetic	Fe_3O_4	Anaerobic decomposition of shaft material, can look like carbon is a corrosive product.
Calcium Oxide	CaO	Environment
Rust, Non-magnetic	Fe_2O_3	Rust
Sand	SiO_2	Manufacturing/Environment
Silicon Carbide (Black, Shiny, Angular)	SiC	Manufacturing/Blasting
Zirconia	$ZrSiO_4$	Manufacturing
	$Mo5_2$	Common as a trace, could combine with Fe (Iron) to indicate bearing alloy. Usually found in new or overhauled engines.
Calcium Chloride (Salt)	$CaCl_2$	Environment
Sodium Chloride (Salt)	NaCl	Environment
Calcium Sulphate (Salt)	$CaSO_4$	Environment

REF. No.	Name	Limits	
		Min.	Max.
318	Compressor Turbine Radial Tip Clearance (1) With the CT disk and CT vane removed, measure the CT disk OD and the CT vane assembly shroud ID. Calculated clearances must be within limits. If not, then grind or replace the shrouds. NOTE: Measure the CT disk OD at the highest point of the blades (leading or trailing edge). (2) With the CT vane assembly mounted in the gas generator, measure the shroud ID at four places, approximately mid segment position. The ID of the shroud segments should be within 0.003 (new segments) or 0.005 (run segments) F.I.R. If necessary, machine the shrouds to get the correct clearance. (3) With the CT disk installed, measure the CT blade tip clearance with wire or tapered feeler gages, at several locations, at the highest point of the blade (leading or trailing edge). Load the disk 180 degrees in the opposite direction of the clearance being checked and correct the results for bearing play. Machine the shroud segments or replace them if necessary to produce clearances within the final build limits.		
675	Gap between shroud housing and shroud segments.	0.0000	0.0100
684	Circular runout must be within 0.003 FIR.		

REF. No.	Name	Limits	
		Min.	Max.
NOT APPLICABLE			

Contaminant Detected	Source
Black Fluorocarbon Rubber, Red Silicon Rubber, Blue Fluorosilicon Rubber	Preformed Packings, Seal Gaskets
Chloroprene Nitrile Rubber	Gaskets
Carbon	Decomposed Oil, Carbon Seals
Fibers	
Plastics	
Paint Flakes	

MATERIAL	PROPORTION	PROPORTIONAL LIMITS
Sodium Dichromate (PWC05-055)	1.5 lbs.	1.0 to 1.5 lbs.
Nitric Acid (PWC05-195)	1.5 pints	1.0 to 1.5 pints
NOTE: The figures that are given are per gallon of solution required.		

MATERIAL	MAKE-UP	OPERATING LIMITS
Chromate Conversion Salts - magnesium (PWC05-198)	5 oz. wt/gal	4.5 to 5.5 oz. wt/gal
Hydrochloric Acid (PWC05-196)	2 fl. oz/gal	1 to 3 fl. oz/gal
Wetting agent (PWC05-162)	1 ml/gal	
Sodium Hydroxide Solution (PWC05-057) and 16 oz. water (PWC05-073)	Add, as necessary to increase pH to operating range.	pH = 0.6 to 1.1
NOTE: To keep (PWC05-162), add 0.5 ml for every 5 oz. (PWC05-198) added.		

Description	Data
Length	81.0 inches (2057 mm)
Width	28.0 inches (711 mm)
Height	33.0 inches (838 mm)
Weight	300 lb. (136.5 kg)

Description	Data
Length	48.0 inches
Width	32.0 inches
Height	33 inches
Weight	250 lb.

Container	Limits	Precautions
With engine	Two high Max. (Static Storage) One high Max. (Shipping/Transporting)	Only static (no impact) and superimposed stacking recommended. Avoid dropping containers over each other.
Without engine	Four high Max.	

FIBERBOARD CONTAINER	LIMITS	PRECAUTIONS
With PS/PSM	Two high Max. (Static Storage) One high Max. (Shipping/Transporting)	Only static (no impact) and super-imposed stacking is recommended. Avoid dropping containers over each other.
Without PS/PSM	Four high Max.	

Item Installed/Replaced	Checks Req'd (Para No.)
Fuel Drain Valves (Front and Rear)	2.3.4.5.8.
Fuel Lines	2.3.4.8.
Shaft Oil Seals	2.3.4.8.

Check and Sequence	Para. No.
Engine Pre-operational Check	2.
Engine Pre-start Check	3.
Dry Motoring Run	4.
Wet Motoring Run	5.
Engine Start	6.
Engine Shutdown	7.
Post-shutdown	8.

NOTE: 5. Limited to twenty (20) seconds.

NOTE: 6. Limited by oil properties.

NOTE: 7. Normal oil pressure with Ng above 72% at normal oil temperature 60° to 70°C (140° to 160°F). Oil pressures below 100 psig is not permitted. Under emergency conditions, to complete a flight, a lower oil pressure limit of 60 psig is permitted at reduced power level not more than 1100 lb.ft. torque. Oil pressures below 60 psig are unsafe and require an engine shutdown, or landing be made as soon as possible with minimum power required to sustain flight.

NOTE: 8. Applies over Ng range 19000 to 23000 rpm.

NOTE: 9. May be employed in an emergency condition, at all ratings, to complete a flight.

NOTE: 10. Substantiated to FAR 33.73 with minimum in-flight gas generator rpm of 64% (24000 rpm).

NOTE: 11. Limited to ten (10) minutes.

NOTE: 12. During steady state operation, a variation of up to +40 rpm is permitted to account for power setting accuracy.

NOTE: 13. Limited to 20 seconds, refer to 505.

Operating Conditions (1)	SHP	Torque (2)		Maximum Observed ITT °C	Gas Generator Max. Speed Ng (3)		Propeller Shaft Max. Speed Np		Oil Press. (7)	Oil Temp. °C
		lb.ft.	psig		RPM	%	RPM	%	psig	
Takeoff	850	2230	72.95	850	39000	104	2000 (12)	90.7	100 to 135	0 to 104
Max. Continuous	850	2230	72.95	840	39000	104	2000 (12)	90.7	100 to 135	0 to 104
Max. Climb/ Max. Cruise	850	2230	72.95	840	39000	104	2000 (12)	90.7	100 to 135	10 to 104
Min. Idle	-	-	-	750 (8)	19000 Min. (10)	51	-	-	60 Min.	-40 to 110
Starting	-	-	-	1000 (4)	-	-	-	-	200 Max.	-40 Min. (6)
Transient	-	2750 (5)	90.0	870 (5)	39530 (13)	104	2205 (9)	100	40 to 200 (5)	0 to 110 (11)
Max. Reverse	800	-	-	780	-	-	1900	86.2	100 to 135	0 to 104

NOTE: 1. Engine inlet condition limits for engine operation are sea level to 35,000 ft., air inlet temperature to 57.2 °C

NOTE: 2. Torque limit applies within range of 1600 to 2000 rpm propeller shaft. For all operating conditions (except Transient), a variation of +112 lbf.ft. is permitted to account for power setting accuracy and steady state fluctuations. Below 1600 rpm torque is limited to 1100 lbf.in. If torque is more than 1100 lbf.ft., refer to Figure 503 for overtorque condition in Area B.

NOTE: 3. 100% gas generator speed is 37468 rpm, 100% power turbine speed is 33235 rpm.

NOTE: 4. Limited to five (5) seconds.

NOTE: 5. Limited to twenty (20) seconds.

NOTE: 1. Engine inlet condition limits for engine operation are sea level to 35,000 ft., air inlet temperature to 57.2 °C

NOTE: 2. Torque limit applies in range of 1600 to 2000 rpm propeller shaft. For all operating conditions (except transient), a variation of +112 lbf.ft. is permitted to account for power setting accuracy and steady state fluctuations. Below 1600 rpm torque is limited to 1100 lbf.ft. If torque is more than 1100 lbf.ft., refer to Figure 504 for overtorque condition in Area B.

NOTE: 3. 100% gas generator speed is 37468 rpm, 100% power turbine speed is 33235 rpm.

NOTE: 4. Limited to five (5) seconds.

NOTE: 5. Limited to twenty (20) seconds.

NOTE: 6. Limited by oil properties.

NOTE: 7. Normal oil pressure with Ng above 72% at normal oil temperature 60° to 70°C (140° to 160°F). Oil pressures below 100 psig is not permitted. Under emergency conditions, to complete a flight, a lower oil pressure limit of 60 psig is permitted at reduced power level not more than 1100 lb.ft. torque. Oil pressures below 60 psig are unsafe and require an engine shutdown, or landing be made as soon as possible with minimum power required to sustain flight.

NOTE: 8. Applies over Ng range 19000 to 23000 rpm.

NOTE: 9. May be employed in an emergency condition, at all ratings, to complete a flight.

NOTE: 10. Substantiated to FAR 33.73 with minimum in-flight gas generator rpm of 64% (24000 rpm).

NOTE: 11. Limited to ten (10) minutes.

NOTE: 12. At steady state operation, a variation of +40 rpm is permitted to account for power setting accuracy.

NOTE: 13. Limited to 20 seconds, refer to 505.

Operating Conditions (1)	SHP	Torque (2)		Maximum Observed ITT °C	Gas Generator Max. Speed Ng (3)		Propeller Shaft Max. Speed Np		Oil Press. (7)	Oil Temp. °C
		lb.ft.	psig		RPM	%	RPM	%	psig	
Takeoff	850	2230	60.21	850	39000	104	2000 (12)	90.7	105 to 135	0 to 104
Max. Continuous	850	2230	60.21	840	39000	104	2000 (12)	90.7	105 to 135	0 to 104
Max. Climb/ Max. Cruise	850	2230	60.21	840	39000	104	2000 (12)	90.7	105 to 135	10 to 104
Min. Idle	-	-	-	750 (8)	19000 Min. (10)	51	-	-	60 Min.	-40 to 110
Starting	-	-	-	1000 (4)	-	-	-	-	200 Max.	-40 Min. (6)
Transient	-	2750 (5)	74.24	870 (5)	39530 (13)	104	2205 (9)	100	40 to 200 (5)	0 to 110 (11)
Max. Reverse	800	-	-	780	-	-	1900	86.2	105 to 135	0 to 104

NOTE: 1. Engine inlet condition limits for engine operation are sea level to 35,000 ft., air inlet temperature to 57.2 °C

NOTE: 2. Torque limit applies in range of 1600 to 2000 rpm propeller shaft. For all operating conditions (except transient), a variation of +112 lbf.ft. is permitted to account for power setting accuracy and steady state fluctuations. Below 1600 rpm torque is limited to 1100 lbf.ft. If torque is more than 1100 lbf.ft., refer to Figure 504 for overtorque condition in Area B.

NOTE: 3. 100% gas generator speed is 37468 rpm, 100% power turbine speed is 33235 rpm.

NOTE: 4. Limited to five (5) seconds.

NOTE: 5. Limited to twenty (20) seconds.

NOTE: 6. Limited by oil properties.

Peening	Flattening or displacing of material by repeated blows. A surface may be peened by continuous impact of foreign objects, or loose parts.
Pitting	Surface condition characterized by minute holes or cavities which occur on overstressed areas. The pits may occur in such profusion as to resemble spalling.
Scoring	Form of wear characterized by a scratched, scuffed, or dragged appearance, with markings in the direction of sliding.
Scratches	Narrow shallow marks or lines resulting from the movement of a metallic particle or pointed object across a surface.
Scuff	Dull or moderate wear of a surface resulting from slight rubbing.
Seizure	Welding or binding of two adjacent surfaces, preventing further movement.
Spalling	Surface or sub-surface defect characterized by chips of parent metal that spall or flake out of material leaving cavities of varying sizes and depths.
Stress-failure	Metal failure due to compression forces, tension, shear, torsion, or shock.
Tear	Parent metal torn by excessive vibration or other stresses.
Unbalance	Condition created in a rotating body by an unequal distribution of weight about its axis. Will result in vibration.
Wear	Condition resulting from a relatively slow removal of parent material. Frequently not visible to the unaided eye.

Term	Definition
Abrasion	Wearing away of small amounts of metal as a result of friction between parts.
Blister	The raised portion of surfaces caused by separation of layers of material.
Buckling	Large deformation from original shape. Usually caused by pressure or impact of a foreign object, unusual structural stresses, excessive heat, or any combination of these conditions.
Burning	Loss of material from excessive heat.
Burr	A sharp projection or rough edge.
Chafing	Wear caused by friction.
Corrosion	A surface chemical action resulting in surface discoloration, a layer of oxide, or, in advanced stages, the removal of surface material.
Crack	Pressure break in material.
Dent	A smooth, round-bottomed depression.
Distortion	Change from the original shape.
Flaking	Loose particles of surface material.
Frosting	An initial stage of scoring caused by irregularities or high points of metal welding together with minute particles of metal transferring to the mating surface, giving a frosted appearance.
Galling	Fretting, and wearing away by friction.
Gouging	Removal of surface material, typified by rough and deep depressions.
Grooving	Smooth, rounded indentations caused by concentrated wear.
Inclusion	Foreign material enclosed in metal.
Metallization	Coating by molten metal particles sprayed through the engine.
Nick	Sharp bottomed depression with rough outer edges.

	B.	Air Inlet	(1)	Inspect the air inlet screen for cleanliness (Ref. 72-20-00, Inspection/Check).	MINOR
			(2)	With inlet screen removed or alternatively with borescope, inspect compressor inlet case overall surface areas and struts for corrosion (Ref. 72-20-00, Inspection/Check).	MINOR
	C.	Gas Generator Case		External surfaces, and fireseal mount ring brackets for cracks, distortion, and corrosion (Ref. 72-30-04, Inspection/Check).	MINOR
	D.	Fireseal Mount Rings		Cracks and attachment of brackets and seals. (Ref. 72-30-01, Inspection/Check).	MINOR
	E.	Exhaust Duct		Cracks and distortion (Ref. 72-50-05, Inspection/Check).	MINOR
	F.	Propeller Shaft Seal		Check for oil leaks (Ref. 72-10-00, Inspection/Check).	ROUTINE
	G.	Accessories	(1)	Attachment and linkages, air, oil and fuel lines.	MINOR
			NOTE: Visually inspect insulated air tubes for sign of swelling, cracking, bulging of rubber sheath material. Refer to repair section and SB14441. Replace as necessary.		
			(2)	Oil and fuel leaks as applicable.	MINOR
2.	Engine Internals				
	A.	First-stage Compressor Rotor		Do a visual inspection with a mirror or a borescope (Ref. Para. 9.J.).	MINOR
			NOTE: If any FOD has caused the engine to become prone to engine surges or causes unusual compressor whining, the large bent airfoil will make the whining sound (Ref. Fig. 602). Remove the engine immediately.		
	B.	Hot Section		Examine with borescope (Ref. Paras. 9.F.G. & H.).	In conjunction with periodic fuel nozzle leak and function tests (Ref. 3.B.(10)).
3.	Systems				
	A.	Oil System			
			(1)	Check oil level (Ref. 72-00-00, ENGINE, TURBOPROP - SERVICING, Oil Level Check).	ROUTINE

			(1)	Check oil level (Ref. 72-00-00, ENGINE, TURBOPROP - SERVICING, Oil Level Check).	ROUTINE
			NOTE: For list of approved synthetic lubricating oils, limits and instructions, refer to SB14001.		
			(2)	Check condition and locking of oil filler cap (Ref. 72-60-00, Inspection/Check).	ROUTINE
			(3)	Do an oil system servicing (oil change) (Ref. 72-00-00, ENGINE, TURBOPROP - SERVICING, Oil Servicing).	12 months
			NOTE: The engine oil can be changed on condition if approved High Thermal Stability (HTS) lubricants is used, refer to SB14001.		
			(4)	Examine the oil filter and the secondary screen (coarse hat-type screen attached to the inner end of the filter). Elements must be inspected and cleaned. Light traces of sediment only may be removed from the main filter screen. All other contamination requires replacement of the filter element. Any foreign material found in the main oil filter or on the chip detector, must be identified before further inspection/operation (Ref. 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES).	MINOR (See NOTE 1)
			NOTE: . 1: Inspect initially at 100 hours TSN or 100 hours after an engine shop visit (HSI, Overhaul and Unscheduled event) with extension to relevant airframe zone inspection based on inspection results but not to exceed 200 hours.		
			NOTE: . 2: If the engine has a recent history (within 200 flight hours) of generating carbon debris, do an unscheduled inspection for contamination of oil (Ref. Para. 12. X.).		
			NOTE: . 3: If carbon like deposits are found, drain accessory gearbox oil into a clean container and examine debris. Varnish flakes are non metallic and are usually dark on one side and shiny, similar to bronze, on the other side. They are hard and will not form into paste when rubbed between fingers (Ref. step (8)).		
			(5)	Replace filter element (Ref. 79-20-02, Removal/Installation).	1000 hours
			(6)	With magnetic chip detector(s) installed, examine for continuity by the output terminals, open circuit must show the indication of no contamination at pole tips. If continuity is there, remove and examine for contamination. Any foreign material found on the chip detector or in the main oil filter must be identified before further inspection/operation (Ref. 79-20-02, OIL FILTER, HOUSING AND CHECK VALVE - MAINTENANCE PRACTICES) (See NOTE 3).	MINOR (See NOTES 1 and 2)
				NOTE: 1. FOR SINGLE ENGINE AIRCRAFT, If the chip detector is connected to a cockpit indicating system, examine the chip detector initially at 100 hours with extension to relevant airframe zone inspection based on the inspection results, but not more then 200 hours.	

				NOTE: 2. FOR TWIN ENGINE AIRCRAFT, If the chip detector is connected to a cockpit indicating system, examine the chip detector initially at 100 hours with extension to relevant airframe zone inspection based on the inspection results, but not more than 400 hours.	
				NOTE: 3. While the chip detector is removed, examine with both poles bridged (Ref. Check (7)). With poles unbridged, inspect for continuity, and if continuity exists, replace the chip detector.	
			(7)	Bridge chip detector(s) magnetic pins with correct jumper, then check the continuity by the output terminal. If there is no continuity, remove and install the new chip detector. Any foreign material found on chip detector or in main oil filter should be identified before further inspection/operation (Ref. 79-20-02, Inspection/Check).	600 hours or 12 months, whichever comes first.
			NOTE: For aircraft equipped with an airframe supplied indicating device, the integrity of the complete indicating system can be checked by re-attaching the electrical connector to the removed chip detector and checking for chip indication when magnetic poles are bridged. Closed circuit condition must exist.		
			(8)	Check scavenge oil pump housing for leaks.	MINOR
			(9)	Check the AGB internal scavenge pump inlet screen (Ref. Chap. 72-60-00, Cleaning/Inspection). Collect the drained oil. Using a mirror and a flashlight/borescope inspect the scavenge oil pump inlet screen. Any foreign material found blocking the screen or contained in the oil should be identified before further operation (Ref. Unscheduled Inspection).	200 hours or 6 months (at operator's option) for operation in high relative humidity/tropical environment (in the range of 70% to 100% for most of the year).
					1000 hours for engines NOT operating in high relative humidity/tropical environment.
	B.	Fuel System	(1)	DELETED.	
			(2)	Do a check of the fuel pump (in-situ inspection only) for installation and leakage (Ref. 73-10-02, FUEL PUMP - MAINTENANCE PRACTICES).	MINOR
			NOTE: If airframe fuel boost pump fails or is inadvertently left off for an accumulative time in excess of 10 hours, the engine driven fuel pump must be removed and replaced.		
			(3)	Check inlet screen for foreign matter or distortion, clean and reinstall, or install new screen (Ref. 73-10-02, Inspection/Check).	600 hours

CAUTION: ON NEW AIRCRAFT, CHECK FILTER AFTER EACH FLIGHT UNTIL NO CONTAMINATION IS EVIDENT. CHECK AFTER FIRST FLIGHT OR GROUND RUN WHENEVER ANY COMPONENT UPSTREAM OF FILTER IS REPLACED.

			(4)	Check outlet filter for foreign matter or distortion (Ref. 73-10-02, Inspection/Check). Install new filter as service conditions dictate not to exceed 600 hours and when fuel system contamination is suspected.	MINOR
			(6)	Check drain valve(s) for installation and leaks (Ref. 73-10-06, Inspection/Check).	MINOR
			(7)	Check FCU for installation, linkages and pneumatic lines (Ref. 73-20-00, Inspection/Check).	MINOR
			(8)	Check FCU Manual Override System for static operation (Ref. 71-00-00, Adjustment/Test).	MINOR
			(9)	Check flow divider for installation and leaks (Ref. 73-10-04, Inspection/Check).	MINOR
			(10)	Leak test and function test fuel manifold adapter and nozzle assemblies (Ref. 73-11-05, DUPLEX FUEL MANIFOLD - MAINTENANCE PRACTICES).	400 hours (See NOTES)
				NOTE: 1. Do the periodic borescope inspection of the hot section components in conjunction with these tests (Ref. Para. 2.B.).	
				NOTE: 2. For improved hot section durability, it is recommended that the fuel nozzle assemblies must be inspected on a routine basis. For operators new to PT6A operation, cleaning/inspection is recommended at 200 hours initially, with extension, based on the operators experience and rejection rate, not more than 200 hours.	
				NOTE: 3. For other operators, inspection is recommended at 400 hours initially, with extension based on the operators experience and rejection rate, not more than 200 hours.	
			(11)	Check oil-to-fuel heater installation (Ref. 73-10-01, MAINTENANCE PRACTICES).	MINOR
	C.	Ignition System	(1)	Check ignition exciter for installation and condition (Ref. 74-10-00, Inspection/Check).	400 hours
			(2)	Check ignition cables for chafing, wear and installation (Ref. 74-20-00, Inspection/Check).	400 hours
			(3)	Check spark igniters for cleanliness and erosion. Check function (Ref. 74-20-00, Inspection/Check).	400 hours
	D.	Pneumatic System	(1)	Check P3 filter for installation (Ref. 73-10-07, COMPRESSOR DELIVERY AIR LINES - MAINT. PRACTICES).	MINOR
			(2)	Inspect pneumatic tubes and lines for cracks and damages especially at the end fittings and joints.	MINOR

			(3)	Clean the filter related to condition, service experience or environment (Ref. 73-10-07, COMPRESSOR DELIVERY AIR LINES - MAINT. PRACTICES).	MINOR (See NOTES 3)
			(4)	Clean and inspect P3 filter drain valve housing assembly (Ref. 73-10-07, COMPRESSOR DELIVERY AIR LINES - MAINT. PRACTICES).	MINOR (See NOTES 2 and 3)
			(5)	Examine filter bowl.	MINOR
			(6)	Replace filter.	1000 hours (See NOTE 1)
			NOTE: 1. Send filter to an approved facility for ultrasonic cleaning and testing in accordance with the engine overhaul manual every 1000 hours.		
			NOTE: 2. Filter contamination is greatly influenced by particular operating conditions and environment. Inspection intervals may be modified accordingly.		
			NOTE: 3. Inspect initially at 100 hours with extension to relevant airframe zone inspection based on inspection results but not to exceed 200 hours.		

Component			Inspection	Interval
1.	Engine Externals			
	A. Clamps, Brackets, Tubes/Lines, Linkages	(1)	All accessible connections, clamps and brackets for attachment.	MINOR
			NOTE: Inspect accessible lockwire and safety cable for security and installation.	
		(2)	Chafing, cracks and corrosion.	MINOR
			NOTE: Visually inspect insulated air tubes for sign of swelling, cracking, bulging of rubber sheath material. Refer to repair section and SB14441. Replace as necessary.	
			NOTE: Visually inspect external oil pressure tube elbow and coupling for cracks.	
		(3)	Fuel and oil lines for leaks.	MINOR
		(4)	Depending on operating conditions and environment, examine linkages at regular intervals. Pay particular attention to rear linkage cam box, fuel control unit arm, telescopic rod and rod end fittings. Disconnect rod ends and clean. Lubricate with light grease (PWC04-001)after engine external wash. Examine rod end for corrosion, roughness in rotation, side play and radial play. Check free movement of linkage.	MINOR
			NOTE: Inspect initially at 100 hours TSN or 100 hours after an engine shop visit (HSI, Overhaul and Unscheduled event) with extension to relevant airframe zone inspection based on inspection results but not to exceed 200 hours.	
			NOTE: With the exception of rod end fittings, linkages generally will operate satisfactorily without lubrication. While lubrication will be effective in some instances, it must be realized that grease and oil attracts dirt and foreign matter. Depending on local conditions, operators should take these facts into consideration before deciding to lubricate components or do otherwise.	
	B. Air Inlet	(1)	Inspect the air inlet screen for cleanliness (Ref. 72-20-00, Inspection/Check).	MINOR
		(2)	With inlet screen removed or alternatively with borescope, inspect compressor inlet case overall surface areas and struts for corrosion (Ref. 72-20-00, Inspection/Check).	MINOR

Problem	Source	Remedy
Poor illumination.	Oil or dirt on distal tip, or side-viewing adapter prism.	Clean using lens cleaner and tissue.
	Light source intensity switch set at LOW.	Set switch to HIGH.
	Defective lamp.	Replace lamp.
	Damaged borescope light tube.	Return to manufacturer.
	Defective transformer.	Return to manufacturer.
Poor definition.	Poor illumination.	Return to manufacturer.
	Diopter ring not adjusted correctly.	Adjust to suit eyes.
	Damaged fibers in fiberscope, (seen as black dots through viewer).	Return to manufacturer.
Fiberscope distal does not move when control knob is turned.	Damaged control wires.	Return to manufacturer.

PT Stator Housing (Ref. 72-50-03, Inspection/Check)	Cracks, none permitted except as noted in relevant Inspection/Check. Check for proper sealing with interstage sealing rings.
PT Disk Assemblies * (Ref. 72-50-04, Inspection/Check)	Blades for impact damage, erosion and cracks.
PT Stator Assembly * (Ref. 72-50-03, Inspection/Check)	Cracks, erosion and impact damage.
PT Interstage Stator * (Ref. 72-50-04, Inspection/Check)	Cracks, erosion and impact damage.
T5 Trim Thermocouple (Ref. 77-20-01, Inspection/Check)	Check attachment of lugs and leads. Carry out operational check.
T5 Temperature Sensing System (Ref. 77-20-01, Inspection/Check)	Attachment, wiring harness and lugs. Check operation.
Exhaust Duct (Ref. 72-50-05, Inspection/Check)	Cracks and distortion.
RGB Oil Strainer (Ref. 72-10-00, Inspection/Check)	Remove and examine assembly for foreign matter.
Chip Detector (Ref. 72-10-00 or 72-60-00, Inspection/Check)	Remove and inspect RGB and AGB chip detectors for metal deposit.
* Examine in-situ.	

Component	Nature of Inspection
Gas Generator Case (Ref. 72-30-04, Inspection/Check)	Cracks, distortion, overheating and corrosion.
Combustion Chamber Liners, Small and Large Exit Duct (Ref. 72-40-01, Inspection/Check and 72-50-01, Inspection/Check)	Cracks, distortion, burning, blockage of cooling holes due to repair and coating loss. Any amount of coating loss is acceptable provided burning of parent metal has not occurred.
CT Stator Assembly, Shroud Housing (Ref. 72-50-01, Inspection/Check)	Cracks, coating loss, erosion of parent metal or impact damage. Examine stator cooling air inlet and outlet ports for signs of blockage.
CT Shroud Segments (Ref. 72-50-01, Inspection/Check)	Cracks, distortion, erosion and metal build-up.
CT Disk Assembly (Ref. 72-50-01, Inspection/Check)	Measure radial tip clearance.
	Examine blades for tip rub, erosion, impact damage, coating loss, cracks, shift and circumferential movement (Ref. 72-50-02, Inspection/Check).
	Examine blade retaining rivets for condition.
Sealing Ring(s) (Ref. 72-50-01, Inspection/Check)	Wear, fretting and distortion.
Fuel Nozzles (Ref. 73-11-05, Inspection/Check)	Dissimilarity of carbon build-up. Perform functional test.
Fuel Nozzle Sheaths (Ref. 73-11-05, Inspection/Check)	Fretting wear, erosion and carbon build-up.
Compressor Inlet (Ref. 72-20-00, Inspection/Check)	Remove air inlet screen, examine inlet area and struts, first-stage blades and vanes for dirt deposits, corrosion and cracks.
PT Stator Housing (Ref. 72-50-03, Inspection/Check)	Cracks, none permitted except as noted in relevant Inspection/Check. Check for proper sealing with interstage sealing rings.
PT Disk Assemblies * (Ref. 72-50-04, Inspection/Check)	Blades for impact damage, erosion and cracks.
PT Stator Assembly * (Ref. 72-50-03, Inspection/Check)	Cracks, erosion and impact damage.

Environment	Wash	Frequency	Remarks
Continuously salt laden	Desalination (Compressor and CT) and External Engine Wash	Daily	Strongly recommended after last flight of day.
Occasionally operated in salt-laden or harsh environment	Desalination (Compressor and CT) and External Engine Wash	Weekly	Strongly recommended. Adjust interval to suit engine condition
All	Performance Recovery (Compressor only)	As required	Strongly recommended. Performance recovery washes are required less frequently. Adjust frequency to suit engine operating conditions as indicated by ECTM. Motoring wash for light soiling and multiple motoring for heavy soiling is recommended.

NOTE: Multiple motoring washes should be performed to the extent permitted by starter operating limitations. Observe starter cooling period (Ref. Starter Manufacturer's Manual).

NOTE: 2. Harsh environment includes dusty, sandy or heavy polluted environments such as those in proximity industrial smog or active volcanoes.

NOTE: 3. Continually salt-laden or harsh environment also includes salt flats.

B & B 3100 25% by vol. = 1250 ml in 5 liters (1.33 US Gallons)					
Kerosene 15% by vol. = 750 ml					
Isopropyl Alcohol 20% by vol. = 1000 ml					
Water 40% by vol. = 2000 ml					
Total 100% by vol. = 5000 ml or 5 liters (1.33 US Gallons)					
Typical mixture proportions using Turco 4217 (PWC11-001F) or Ardrox 624 (PWC11-001H).					
+2 Up	+36 Up	4	40	Nil	56
-25 to +2	-12 to +36	4	40	20	36
Below -25	Below -12	4	40	36	20
Example 2. (at +2°C):					
Turco 4217 4% by vol. = 200 ml in 5 liters (1.33 US Gallons)					
Kerosene 40% by vol. = 2000 ml					
Isopropyl Alcohol 0% by vol. = 0 ml					
Water 56% by vol. = 2800 ml					
Total 100% by vol. = 5000 ml or 5 liters (1.33 US Gallons)					
Typical mixture proportions using Ardrox 6345 (PWC11-003) or Ardrox 6367 PWC11-003B), Turboclean 2 (PWC11-003C) and ZOK 27 (PWC11-003D)					
+5 Up	+41 Up	20	Nil	Nil	80
-5 to +5	+23 to +41	20	Nil	20	60
-21 to -5	-6 to +23	20	Nil	30	50
Below -21	Below -6	20	Nil	40	40
Example 3. (at +5°C):					
Zok 27 20% by vol. = 1000 ml in 5 liters (1.33 US Gallons)					
Isopropyl Alcohol 0% by vol. = 0 ml					
Water 80% by vol. = 4000 ml					

Water 80% by vol. = 4000 ml
Total 100% by vol. = 5000 ml or 5 liters(1.33 US Gallons)
NOTE: 1. Use any cleaning agent listed (Ref.CONSUMABLE MATERIALS section). Solution strength must be in accordance with manufacturer/supplier's recommendations. Where no specific instructions are provided, proportion of cleaning agent should be as indicated.
NOTE: 2. Use of emulsifying agent (PWC05-005A), 3% by vol. or 150 ml in 5 liters is highly recommended to prevent possibility of kerosene separation.
NOTE: 3. Use Isopropyl Alcohol (PWC11-014). Solution strength must be in accordance with manufacturer/supplier's recommendation. Where no specific instructions are provided, proportions of agent shall be as indicated in Table 704.
NOTE: 4. Drinking quality water is permissible.

Table 703 Rinse Solution Formulation

Ambient Temperature		Cleaning Agent (NOTE 1)	Aviation Kerosene (NOTE 2)	Isopropyl Alcohol (NOTE 3)	Water (NOTE 4)
°C	°F	% by vol.	% by vol.	% by vol.	% by vol.
Typical mixture proportions using B & B 3100 (PWC11-001C) or TC-100 (PWC11-003E), at amb. temp. of -25°C to +2°C: (Similar proportions for Magnus 1214 (PWC11-001B), R-MCS (PWC11-001D), R-MC G21 (PWC11-001E), ALMON AL-333 (PWC11-001A), TURCO 5884 (PWC11-001G) and CLIX (PWC11-001).					
+2 Up	+36 Up	25	Nil	Nil	75
-25 to +2	-12 to +36	25	15	20	40
Below -25	Below -12	25	15	40	20
Example 1. (at +2°C):					
B & B 3100 25% by vol. = 1250 ml in 5 liters (1.33 US Gallons)					
Kerosene 15% by vol. = 750 ml					
Isopropyl Alcohol 20% by vol. = 1000 ml					
Water 40% by vol. = 2000 ml					
Total 100% by vol. = 5000 ml or 5 liters (1.33 US Gallons)					
Typical mixture proportions using Turco 4217 (PWC11-001F) or Ardrox 624 (PWC11-001H).					
+2 Up	+36 Up	4	40	Nil	56
-25 to +2	-12 to +36	4	40	20	36
Below -25	Below -12	4	40	36	20
Example 2. (at +2°C):					
Turco 4217 4% by vol. = 200 ml in 5 liters (1.33 US Gallons)					
Kerosene 40% by vol. = 2000 ml					
Isopropyl Alcohol 0% by vol. = 0 ml					
Water 56% by vol. = 2800 ml					

Ambient Temperature		Water (NOTE 1)	Isopropyl Alcohol (PWC11-014) (NOTE 2)
°C	°F	% by vol.	% by vol.
+2 up	+36 up	100	-
-25 to +2	-12 to +36	50	50
Below -25	Below -12	40	60

NOTE: 1. Drinking quality water is permitted. Refer to Equipment Required for acceptance criteria.

NOTE: 2. Use Isopropyl Alcohol (PWC11-014). Solution strength must be in accordance with manufacturer/supplier's recommendation. Where no specific instructions are provided, proportions of agent shall be as indicated in Table 704.

Cleaning Agent	Specific Instructions
(PWC11-001), (PWC11-001A), (PWC11-001B) or (PWC11-001C)	25 % by volume of selected agent should be added to mixture for all ambients. Rest of proportions should be per Table 702.
P&WC Developed	25 % by volume of the following mixture: 2 parts emulsifier (PWC05-005) 4 parts alkaline cleaner (PWC11-001I) 1 part alkaline cleaner (PWC11-001J)
	Rest of proportions should be per Table 702.
(PWC11-003A)	For ambient temperatures of +2 °C (+36 °F) and above, use as received.
	For ambient temperatures below +2 °C (+36 °F), use 25 % by volume (PWC11-003A) in conjunction with Table 702.
(PWC11-001F) or (PWC11-001H)	Mixture formulation (5 liters):
	200 ml Turco for temperatures from below -25 °C to above +2 °C.
	2000 ml of Kerosene for temperatures from below -25 °C to above +2 °C.
	1000 ml of Isopropyl Alcohol for temperatures from -25 °C to +2 °C.
	2800 ml of water for temperatures above +2 °C. 1800 ml of water for temperatures from -25 °C to +2 °C. 1000 ml of water for temperatures below -25 °C.
	Add 150 ml emulsifier (PWC05-005) and shake mixture well.

Material	Make-up	Operating Limits
Chromate Conversion Salts - magnesium (PWC05-198)	5 oz. wt/gal	4.5 - 5.5 oz. wt/gal
Hydrochloric Acid (PWC05-196)	2 fl oz/gal	1 - 3 fl oz/gal
Wetting agent (PWC05-162)	1 ml/gal	
Sodium Hydroxide Solution (PWC05-057 and 16 oz water PWC05-073)	Add, as necessary, to raise pH to operating range.	pH = 0.6 - 1.1
NOTE: To maintain (PWC05-162), add 0.5 ml for every 5 oz (PWC05-198) added.		

Material	Make-up	Operating Limits
Sodium Dichromate (PWC05-055)	1.5 lbs	1.0 - 1.5 lbs
Nitric Acid (PWC05-195)	1.4 pints	1.0 - 1.5 pints
NOTE: Figures given are weights per gallon of solution.		

Stud Thread Size (Drive End)	Minimum	Maximum Necked Down $	Maximum Plain #
0.112-40	4	-	8
0.138-32	8	-	14
0.164-32	10	30	30
0.190-24	15	40	45
0.216-24	20	65	70
0.250-20	40	95	105
0.3125-18	85	210	230
0.375-16	160	375	425
0.4375-14	200	600	675
0.500-13	250	950	1050

NOTE: 1. Symbol $: These limits apply where the unthreaded diameter of the stud is less than the minimum minor diameter of the coarse pitch thread (drive end).

NOTE: 2. Symbol #: These limits apply where the unthreaded diameter of the stud is equal to or greater than the minimum minor diameter of the coarse pitch thread (drive end).

Stud Thread Size (Nut End)	Minimum	Maximum Necked Down $	Maximum Plain #
0.138-40	8	-	18
0.164-36	10	30	30
0.190-32	15	45	50
0.216-28	20	65	75
0.250-28	40	115	125
0.3125-24	85	240	260
0.375-24	160	450	500
0.4375-20	200	700	800
0.500-20	250	1150	1300

NOTE: 1. Symbol $: These limits apply where the unthreaded diameter of the stud is less than the minimum minor diameter of the fine pitch thread (nut end).

NOTE: 2. Symbol #: These limits apply where the unthreaded diameter of the stud is equal to or greater than the minimum minor diameter of the fine pitch thread (nut end).